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OF

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RECENT ADVANCES IN SCIENCE,

ENGINEERING AND MANAGEMENT

24TH APRIL 2026

ICRASEM 2026

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Prof. Dr. M. Mala, M. A., M.Phil.
Chairperson

CHAIRPERSON'S MESSAGE

I am delighted to note that the faculty members and researchers from the Undergraduate and Postgraduate programmes of Aeronautical Engineering, Computer Science and Engineering, Electronics and Communication Engineering, Artificial Intelligence and Data Science, Information Technology, Mechanical Engineering, Science and Humanities, and Cyber Security, as well as M.E. in Computer Science and Engineering and Environmental Engineering, and the Master of Business Administration, have come together in a collaborative spirit to organize the 8th International Conference on Recent Advances in Science, Engineering and Management (ICRASEM–2026).

This conference serves as a significant platform for academicians, researchers, and industry professionals to share innovative ideas, research findings, and technological advancements. I am confident that the deliberations during this conference will contribute meaningfully to the advancement of knowledge in the fields of Science, Engineering, and Management, benefiting both the participants and society at large.

I sincerely appreciate the dedication and hard work of the organizing committee and faculty members in making this international conference a reality.

I extend my best wishes for the grand success of ICRASEM–2026.

DATE : 24.04.2026

PROF. DR. M. MALA
CHAIRPERSON

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Mr. G. Manikandan
Trust Secretary, Tagore Group of Institutions

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This conference serves as an important platform for academicians, researchers, and industry professionals to exchange innovative ideas, share research findings, and explore technological advancements. I am confident that the discussions and deliberations will significantly contribute to the advancement of knowledge in the fields of Science, Engineering, and Management, benefiting both participants and society at large.

I sincerely appreciate the dedication and tireless efforts of the organizing committee and faculty members in making this international conference a reality.

I extend my best wishes for the grand success of ICRASEM–2026.

DATE : 24.04.2026

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PRINCIPAL'S MESSAGE

"ALONE WE CAN DO SO LITTLE; TOGETHER WE CAN DO SO MUCH."

It gives me great pleasure that various departments have jointly organized the International Conference on Recent Advances in Science, Engineering and Management (ICRASEM–2026) on 24th April 2026.

This conference serves as a valuable platform for researchers and academicians to share ideas, present innovations, and discuss recent developments in science, engineering, and management.

I sincerely thank all the authors for their contributions and appreciate the organizing committee for their dedicated efforts. I also express my gratitude to the management, Co-Chair, Heads of Departments, keynote speakers, session chairs, and sponsors for their support.

I congratulate everyone involved in bringing out this conference proceeding and hope it provides meaningful insights to all participants.

I wish ICRASEM–2026 a successful and memorable event.

DATE : 24.04.2026

Dr. S. NAGARAJAN
PRINCIPAL & CONFERENCE CHAIR

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Dr. M.Durai Raj
Conference Co-Chair

Dr. P. Priyadarsini
Conference Co-Chair

As Co-Chairs of the conference, we take immense pleasure in welcoming all the delegates to the 8th International Conference on Recent Advances in Science, Engineering and Management (ICRASEM–2026) scheduled on 24th April 2026.

The conference brings together participants from across India and abroad. Research papers have been received in various domains including Aeronautical Engineering, Civil Engineering, Computer Science Engineering, Electrical and Electronics Engineering, Electronics and Communication Engineering, Mechanical Engineering, Information Technology, Science and Humanities, and Master of Business Administration, for presentation in different technical sessions.

A conference of this nature provides a valuable platform for academicians, industry professionals, researchers, and students to discuss and deliberate on modern trends and advancements in their respective fields. The participants include faculty members, research scholars, and students. We express our sincere gratitude to the Management and the Principal of Tagore Engineering College for their continuous support and for providing us the opportunity to organize this conference.We request all participants to actively engage in the sessions and make the most of this platform through meaningful discussions and knowledge sharing.

The organizing committee expresses heartfelt thanks to the Chairperson and the Principal for their constant encouragement and financial support in conducting this conference successfully.We also extend our appreciation to the Heads of Departments of Aeronautical, Civil, CSE, EEE, ECE, Mechanical, IT, S&H, and MBA, along with all faculty members and supporting staff, for their dedicated efforts in organizing the conference, reviewing papers, and bringing out the proceedings.

We thank everyone who has directly or indirectly contributed to the successful conduct of this conference.

Date: 24.04.2026

Dr. M. Durairaj
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AERONAUTICAL ENGINEERING

A REVIEW ON FLUID–STRUCTURE INTERACTION INHYPERSONIC INTAKES

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Fluid–structure interaction (FSI) in hypersonic intakes is a critical phenomenon governing aerodynamic performance, structural integrity, and operational stability of high-speed air-breathing propulsion systems. This study presents a comprehensive review of aeroelastic and aerothermoelastic interactions in hypersonic intake configurations, highlighting their strong coupling with shock-wave/boundary-layer interactions, thermal loads, and internal flow features such as shock trains and buzz. The literature indicates that structural deformation, particularly near the cowl lip and ramp regions, significantly modifies shock structures, separation zones, and key performance parameters including mass flow rate, pressure rise ratio, and total pressure recovery. Both experimental and numerical investigations reveal that aerothermoelastic effects can induce instabilities such as flutter and buzz, with FSI acting as an active driver influencing shock dynamics rather than merely a secondary effect. Advanced computational approaches, including two-way coupled CFD–CSD and fluid–thermal–structural interaction (FTSI) frameworks, have been widely adopted to capture these complex multiphysics interactions, with studies showing that one-way coupling is insufficient under high Machnumber and thermal loading conditions. Despite notable progress, challenges persist due to limited experimental data for full-scale intake systems, reliance on simplified turbulence and material models, and the absence of integrated design methodologies incorporating FSI from the initial stages. The review emphasizes the need for high-fidelity simulations, and optimization-based design frameworks to ensure reliable and efficient hypersonic intake performance, establishing FSI as a primary factor in the design and analysis of next-generation hypersonic propulsion systems.

Keywords: CFD, Shockwaves, Boundary Layer, Thermalloads, Coupling, Aerothermoelastic deformation

DESIGN, FABRICATION AND TESTING OF FILAMENT WINDING EXPERIMENTAL SETUP

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Filament winding is a highly efficient and widely adopted composite manufacturing process used for producing high-strength, lightweight cylindrical and pressure-bearing structures such as pipes, tanks, and pressure vessels. The process involves the continuous winding of resin-impregnated fibres—typically glass, carbon, or aramid—over a rotating mandrel in a predetermined pattern. Due to its ability to precisely control fibre orientation and distribution, filament winding offers superior mechanical properties compared to conventional manufacturing techniques. In this work, a low-cost filament winding setup has been designed and developed by integrating essential mechanical and electrical components with basic automation features. The system incorporates a motor-driven mandrel for controlled rotation, a fibre payout mechanism for accurate placement, a resin bath for uniform coating, and a tension control device to maintain consistent fibre stress throughout the winding process. This combination ensures proper fibre alignment, reduces material wastage, and enhances the structural integrity of the final composite product.

To further enhance the efficiency and reliability of the system, an AI-based monitoring approach using computer vision has been proposed and integrated into the setup. This system employs a camera to continuously observe the winding process and analyze the fibre deposition and resin distribution in real time. Using image processing techniques, the system can detect defects such as uneven resin coating, fibre misalignment, gaps, and overlaps during operation. Early detection of such defects enables immediate corrective actions, thereby minimizing material loss and reducing the need for post-production inspection. The developed setup demonstrates improved consistency and quality compared to traditional manual winding methods, while significantly reducing human effort and operational errors. Owing to its low cost, simplicity, and incorporation of intelligent monitoring, the system is highly suitable for educational institutions, research laboratories, and small-scale industrial applications, providing an effective platform for both learning and practical implementation of advanced composite manufacturing techniques.

ANALYTICAL FRAMEWORK FOR COUPLED AERODYNAMIC PERFORMANCE AND STRUCTURAL RESPONSE OF HIGH-SPEED INTAKE SYSTEMS

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Abstract

The present study aims to develop a low-fidelity analysis framework to explore the FSI characteristics of a mixed compression hypersonic intake operating within a Mach number range of 5 to 10. In this study, the aerodynamic compression process is modeled using an oblique shock theory, where multiple shock interactions using one-, two-, and three-ramp configurations have been considered for evaluating various performance parameters such as total pressure recovery, kinetic energy efficiency, and normalized pressure ratio. The flow properties across multiple shock waves have been calculated using classical compressible flow equations. It can be seen from the analysis that an increase in Mach number and number of ramps causes increased compression, but at the same time, there is a corresponding decrease in total pressure recovery due to shock losses, as reported in various analytical solutions for hypersonic intake systems. To account for structural interactions, aerodynamic pressure loading calculated based on post-shock static pressures is coupled with a simple structural model based on a linear elasticity approach. In this study, the intake surface is considered to be a cantilever beam, and deformation is calculated based on material properties, geometry, and pressure loading. Various materials such as titanium alloys, nickel-based superalloys, and composite materials highlight the influence of stiffness on deformation behaviour under hypersonic conditions. The results indicate that higher stiffness materials significantly reduce structural deformation, while increased compression levels amplify structural loading. The developed analytical MATLAB Code for FSI model provides a rapid and computationally efficient tool for preliminary design and performance evaluation, offering a useful bridge between purely aerodynamic analyses and high-fidelity numerical simulations involving coupled fluid and structural physics.

Keywords: Shock–boundary layer interaction, Pressure loads, Thermoelastic response, High-temperature material behaviour, deformation, Structural compliance effects

RATE LIMITING AS A CRITICAL VULNERABILITY IN CONTINUOUS DETERMINISTIC AI: A NONLINEAR ACTUATOR STUDY FOR UNMANNED UNDERWATER VEHICLES

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Abstract

This article presents a detailed simulation study of applied deterministic artificial intelligence (AI) via open-loop DC motor control of unmanned underwater vehicle (UUV) fin actuator motion; building upon previous work by Wang and Sands (2023) we examine three control strategies: Discrete DAI, Continuous (C)DAI and a Model Following Self Tuning Regulator (MF). This work expands upon previously published literature along four distinct dimensions: measurement noise (σ = 0-0.20), sinusoidal ocean wave disturbance (0.08Hz, Amplitude = 0-0.30), Discretization Technique (Matched/ZOH/Tustin), and a comprehensive Non-Linear STEM Actuator Model inclusive of Voltage Saturation, Slew Rate Limits, Input Dead Zone, Hydrodynamic Drag and finite Physical Fin Angle limits. Experimental results from experiments 1 through 4 confirm that CDAI is the superior control method when operated under linear conditions. However, the Non-Linear Analysis conducted as part of experiment 5 reveals the following critical new information; a Sudden Severe slew rate limit creates instability for the CDAI Controller whereas the MF Controller remains stable with a mean error of 0.190 for rates of 4u/s versus 6.287 for the CDAI Controller. Under the full Non-Linear actuator model, with all five constraint conditions active together, the CDAI Controller recovers its previous superiority with a mean error of 0.116 compared to a mean error of 0.171 for the MF Controller. These findings can be utilized to develop a more complete understanding of controller robustness when exploring embedded UUV deployment applications.

Keywords: Aircraft cable harnesses, EMI/EMC, electromagnetic compatibility, full-wave simulation, cable shielding, cable bundle, far-end crosstalk (FEXT), total radiated power (TRP), radar cross-section (RCS), near-field radiation, EWIS.

EXPERIMENTAL INVESTIGATION OF JET CONTROL BY USING SWIRL PATTERNED CONVERGENT NOZZLE

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Abstract

Achieving rapid and effective jet mixing at the nozzle exit is a key requirement in many engineering applications, particularly in propulsion and combustion systems where mixing quality directly affects performance and efficiency. Although conventional convergent nozzles are widely used due to their simple geometry and low-pressure losses, they generally produce a stable and well-organized jet core that delays interaction with the surrounding fluid. This often limits the rate of mixing and reduces overall system effectiveness. In this work, a new convergent nozzle configuration is presented to overcome this limitation by introducing a controlled swirl motion within the flow. Instead of adding external mixing devices, the internal contour of the nozzle is carefully redesigned to impart angular momentum to the fluid as it accelerates toward the exit. This built-in swirl generation enhances radial motion, strengthens shear layer development, and promotes the early formation of vortical structures. Consequently, the jet entrains ambient fluid more effectively and achieves faster mixing downstream of the nozzle. The proposed design is evaluated against a standard convergent nozzle using experimental investigation and/or computational analysis. Flow characteristics such as pressure profiles, turbulence levels, swirl intensity, jet spreading, and entrainment behavior are examined to assess performance. The findings indicate that integrating swirl generation directly into the convergent section significantly improves mixing while maintaining satisfactory pressure characteristics. Overall, the study demonstrates that modifying the internal geometry of a convergent nozzle to create swirl offers a simple, compact, and efficient solution for enhancing jet mixing, with potential benefits for a wide range of fluid flow and energy-related applications.

Keywords: convergent nozzle; pressure profiles; swirl intensity; jet spreading; entrainment behavior; enhancing jet mixing; shear layer;

SENSITIVITY STUDY OF GEOMETRIC, INERTIAL, AND POWER PLANT PARAMETERS ON BASELINE FLIGHT ENVELOPE OF A VERY LIGHT JET (VLJ) AIRCRAFT

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Abstract

A topical area in flight mechanics and controls of aircraft from operational view-point is investigation of performance envelope or flight envelope of aircraft. Flight envelop is plot of True Air Speed vs. Altitude region, wherein aircraft safely flies. Detailed flight envelope gives operational limits of aircraft like stall limit, altitude ceiling limit, flutter limit, and thrust limit.Baseline flight envelope of aircraft gives elementary details about operational limits of aircraft from levelled flight point of view. Baseline flight envelope is useful during conceptual stage of aircraft design when all aircraft details are not available and designer has to make choices amongst many geometric, inertial, and power-plant parameters. Trim analysis is an approach used for plotting baseline flight envelope.In present study, flight dynamic model of a Very Light Jet (VLJ) aircraft was developed using J2 Universal Tool kit (Fig. 1). 200 trim cases were defined, Trim analysis was carried out, and a baseline flight envelope of the VLJ aircraft was plotted (Fig. 2). Subsequently, flight dynamic model was used to assess sensitivity of aircraft mass, wing area, power plant thrust, tilt angle, and toe angle of power-plant assembly with wing on the baseline flight envelope. This canonical sensitivity study would help aircraft designers to ascertain trim flight conditions, guide detailed architecting of the aerodynamic, inertial, and power plant designs, help in quick detection of any top-level elementary design flaws during conceptual design stage, and optimize mission profile.

Key words: Flight dynamic model, flight envelop, sensitivity study, trim analysis, very light jet (VLJ).

SKY SEEK: REAL-TIME AUGMENTED REALITY BASED CELESTIAL OBJECT IDENTIFICATION AND GUIDANCE SYSTEM FOR MOBILE PLATFORMS

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Abstract

Astronomical observation in practical field conditions remains constrained by the inherent difficulty of translating abstract celestial coordinate systems into real-time spatial orientation within the observer's immediate sky view. Conventional tools such as star charts and digital planetarium applications provide theoretical visibility but require significant cognitive interpretation, particularly when aligning right ascension–declination data with dynamic altitude–azimuth positioning. This disconnect introduces substantial barriers in real-time object acquisition, especially for amateur observers and educational users.

This paper presents SkySeek, a smartphone-based augmented reality system designed to directly bridge the gap between astronomical computation and real-world observation. The system integrates geolocation data, device orientation derived from sensor fusion, and astronomical time calculations to determine precise celestial object positions. These positions are transformed from equatorial coordinates into horizontal coordinates and subsequently projected onto the camera frame, enabling real-time overlay of stars, constellations, planets, and satellites directly onto the live sky view. The architecture is implemented on the Android platform using Kotlin, incorporating CameraX for real-time imaging, Jetpack Compose for interface rendering, and a modular computation pipeline for continuous positional updates. The system integrates star catalogs, constellation mapping, and satellite tracking using Two-Line Element (TLE) data with orbital propagation models. Additional subsystems such as calibration control, horizon masking, and sensor error mitigation ensure operational stability under real-world observational constraints including magnetic disturbances and sensor drift.

A defining feature of SkySeek lies in its interactive observational workflow, which extends beyond visualization to include search-based targeting, guided alignment assistance, observation logging, and persistent user sessions. This transforms the smartphone into an active astronomical instrument rather than a passive reference tool. The system significantly reduces the cognitive load associated with celestial navigation by providing intuitive, realtime guidance. The results demonstrate that a standard mobile device, when integrated with accurate astronomical modeling and sensor-driven alignment mechanisms, can function as a reliable and portable astronomy assistant. SkySeek contributes a practical and scalable framework for enhancing accessibility, usability, and precision in observational astronomy.

Keywords: Augmented reality; mobile astronomy; celestial object identification; satellite tracking; real-time sky observation; Android; CameraX; Jetpack Compose; SGP4

DESIGN AND DEVELOPMENT OF A REUSABLE ROCKET SYSTEM FOR FULLY FUNCTIONAL COMMUNICATION SATELLITE LAUNCH

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Abstract:

This project came out of a simple question; can you build a working aerospace telemetry system using nothing but Arduino boards and cheap sensor breakouts? The answer, after several months of testing and a fair amount of debugging, is mostly yes.What we ended up with covers three things. First, a flight computer small enough to fit inside a model rocket. Second, a CubeSat-format sensor platform that logs pretty much every environmental parameter we could think of. Third, a laptop-side application that pulls it all together and shows what is happening in real time. The flight computer uses a On board computer. Paired with an Adafruit MPU6050 and a Adafruit BMP 390, it tracks orientation, acceleration, and altitude throughout the flight. Writing the stage detection was trickier than expected; getting the system to reliably tell the difference between a fast ascent and sensor noise took several rounds of tuning. The LoRa link worked better than we expected honestly. We ran it across a decent distance during field tests and barely lost any packets. The one consistent issue was altitude drift right after power-on, before the BMP390 had time to stabilize. We worked around it with a short calibration delay at startup. The CubeSat was built on a Arduino Mega because the Nano simply ran out of pins. By the time we finished adding sensors, GPS, temperature, humidity, pressure, UV, magnetometer, vibration, sound, gas, and a light sensor, we had used almost every available GPIO. I2C addressing caused problems early on since a couple of modules shared the same default address. That took a while to sort out properly. Once it was running though, the data quality was good. Also added SD logging after losing some readings during a wireless test, and kept it in for all subsequent runs. Ground software was written in Html. It reads incoming LoRa packets, parses the fields, displays them in a basic dashboard, and writes everything to a CSV file simultaneously. We kept the interface simple on purpose, during a test you mostly just want to see numbers updating, not navigate menus. Post-test review was done directly from the CSV files in Excel, which worked fine for our purposes. Integration testing showed the full pipeline, sensor to radio to ground display, running with an average end-to-end delay below three seconds. Not fast enough for active control, but more than sufficient for monitoring and post-flight analysis, which is what the system is actually designed for. A few things still need work: the CubeSat enclosure has no thermal insulation, the flight computer has no sensor redundancy, and the ground software crashes occasionally on long sessions. None of that affected the core results, but they are real limitations worth acknowledging. Overall the system works. It is not polished, but it does what it was designed to do reliably enough to be useful as a foundation for further development.

Keywords: Rocket flight computer; CubeSat payload; avionics system; Arduino Nano; Arduino Mega; LoRa telemetry; real-time data transmission; flight phase detection; barometric altimetry; inertial measurement unit; BMP280; MPU6050; onboard data logging; ground control interface; sensor integration; I2C communication; telemetry monitoring; environmental sensing; GPS tracking; experimental aerospace systems; low-cost avionics; SD card logging

EXPERIMENTAL CHARACTERISATION OF EDGEWISE COMPRESSIVE STRENGTH OF STITCHED FOAM SANDWICH PANEL

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Abstract:

Sandwich composite structures are widely used in aerospace and structural applications due to their high strength-to-weight ratio, panel stiffness, and superior energy absorption characteristics. However, conventional foam-core sandwich panels are prone to failure modes such as face-core debonding, delamination, and reduced out-of-plane strength. To address these limitations, the present study focuses on the experimental characterization of edgewise compressive strength of stitched foam sandwich panels.

In this work, sandwich panels were fabricated using Di-vinycell H80 PVC foam as the core material and bidirectional glass Fiber reinforced polymer (GFRP) as face sheets. Through-thickness stitching was introduced using three different yarn materials that are glass, basalt, and carbon employing a continuous running stitch pattern to enhance interlaminar bonding. The panels were manufactured using the Vacuum Assisted Resin Transfer Molding (VARTM) process to ensure uniform resin distribution and improved structural integrity. Test specimens were prepared using water jet machining in accordance with ASTM standards.

Edgewise compression tests were conducted to evaluate the mechanical performance of stitched and unstitched panels. The results demonstrate that stitching significantly improves the load-carrying capacity, compressive strength, and resistance to failure by effectively suppressing delamination and enhancing core-skin interaction. Among the tested configurations, variations in yarn type influenced the degree of mechanical enhancement, highlighting the importance of stitch material selection.

Overall, From the edgewise compression test, it is evident that the stitching influences the stiffness of the sandwich panel, as the stitched sandwich panels exhibit an increased compression modulus depending on the fiber pile, where the carbon fiber stitching increases the stiffness by 40% compared to the unstitched ones, with 23% more stiffness than the glass fiber stitching, and 28% more than the basalt fiber stitching.

Key words: Di-vinycell H80 PVC foam, VARTM, Edgewise compressive strength, Stitched Panels, bidirectional glass Fiber reinforced polymer.

EVALUATION OF IMPACT STRENGTH OF FOAM-CORE SANDWICH PANELS UNDER LOW VELOCITY IMPACT

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Abstract

Composite sandwich panels are widely used in lightweight structural applications because they offer good stiffness and strength without adding much weight. Even though these panels are structurally efficient, their behaviour under impact loading is still an important concern, especially in applications where accidental impact or foreign object may occur. In this study, three different types of face sheet materials were used, namely glass fibre, carbon fibre and Kevlar fibre, while Divinycell H-grade foam was used as the core material. Epoxy resin was used as the binding material for the fabrication of all the panels. The sandwich panels were fabricated by using the vacuum infusion method. This method was selected because it helps in getting better resin flow and proper bonding between the fibre layers and the foam core. During the fabrication stage, care was taken in arranging the fibre layers, placing the foam core properly and maintaining vacuum sealing throughout the process. After curing, the fabricated panels were cut into test specimens of size 130 mm × 130 mm for carrying out the impact test. The impact testing was carried out using a Compressed air-based projectile setup. An 11 g projectile was used for testing, and the panels were tested at two different velocities, 75 m/s and 105 m/s. After testing, the behaviour of the panels was studied by comparing values such as penetration depth, residual velocity and estimated impact force. Visual damage on the panels was also observed after the test. From the results obtained, it was found that all the panels showed more damage at the higher velocity condition. Among the three materials, the Kevlar fibre sandwich panel performed better during impact and showed comparatively less penetration. The glass fibre panel showed average performance, whereas the carbon fibre panel showed more damage under similar testing conditions. This difference in behaviour is mainly because each fibre material has a different response to sudden impact loading. Finally, this work helped in understanding of how different composite sandwich panels react under low velocity impact. The study also showed that the vacuum infusion process can be used successfully to fabricate good quality sandwich panels for such experimental work. The results from this project can be useful for further studies related to lightweight structures where impact resistance is an important requirement.

Keywords—sandwich panels; low velocity impact; foam core; vacuum infusion; Kevlar composite; carbon fibre; glass fibre;

SYNTHESIS AND MECHANICAL BEHAVIOR OF NITI SHAPE MEMORY ALLOY

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Abstract

NiTi shape memory alloy was synthesized through 16 h of mechanical alloying, resulting in a fine-grained microstructure with a homogeneous distribution of constituent elements. Crystallite size, lattice strain, and phase composition of the prepared alloy powders were analyzed using X-ray diffraction (XRD). The morphology of the initial Ni and Ti powders and the alloyed powders was examined using scanning electron microscopy (SEM), while elemental composition was confirmed by energy-dispersive spectroscopy (EDS). The mechanically alloyed powders were consolidated using spark plasma sintering (SPS) at 850 °C and 950 °C. Post-sintering, density and Vickers micro hardness were measured, and the compressive strength of the NiTi alloy was evaluated. The results indicate that the developed NiTi alloy exhibits enhanced mechanical properties, making it a potential candidate for applications requiring shape memory and super elastic behavior.

Keywords: Mechanical alloying; Spark plasma sintering; NiTi alloy; Shape memory alloy; Microstructure; Mechanical properties.

FABRICATION AND MECHANICAL BEHAVIOUR OF AL30NI30CR30W5RE5 REFRACTORY HIGH-ENTROPY ALLOY THROUGH MECHANICAL ALLOYING

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Abstract

$Al_{30}Ni_{30}Cr_{30}W_5Re_5$ refractory high-entropy alloy (RHEA) was fabricated through mechanical alloying using a ball milling process with a ball-to-powder ratio of 10:1 for 16 h to achieve a homogeneous mixture of elemental powders. The prepared powders were compacted and consolidated by spark plasma sintering (SPS) at temperatures of 900 °C and 950 °C. Structural and microstructural characterization was carried out using X-ray diffraction (XRD), scanning electron microscopy (SEM), and electron backscatter diffraction (EBSD). XRD analysis confirmed phase formation and crystallite size refinement, while SEM revealed a uniform and refined microstructure. EBSD analysis provided insights into grain structure and crystallographic orientation, indicating significant grain refinement. Energy-dispersive X-ray spectroscopy (EDS) confirmed the presence and homogeneous distribution of all constituent elements. Mechanical properties were evaluated through density measurement, Vickers micro hardness testing, and compressive strength analysis. The results show increased hardness and reduced porosity with increasing sintering temperature, indicating improved mechanical performance. The developed RHEA demonstrates strong potential for high-temperature structural applications.

Keywords: Refractory high-entropy alloy; Mechanical alloying; Spark plasma sintering; Microstructure; Mechanical properties.

EVALUATION OF IMPACT STRENGTH OF COMPOSITE HELMET – AN EXPERIMENTAL APPROACH

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Abstract

In modern engineering applications, the demand for lightweight structures with improved impact resistance has significantly increased, especially in aerospace, automotive, and protective equipment sectors. Composite materials have emerged as a suitable alternative due to their high strength-to-weight ratio and energy absorption capability. In this study, composite helmets were fabricated using glass fibre reinforced polymer (GFRP) by varying the number of laminate layers. Three different configurations, namely 2-layer, 4-layer, and 6-layer helmets, were developed using the vacuum infusion process to ensure uniform resin distribution and proper bonding.

The impact performance of the fabricated helmets was evaluated using a compressed air-based projectile testing setup under controlled conditions. A metallic projectile of known mass was used to strike the helmet specimens at a velocity of approximately 125 m/s. The performance was assessed based on penetration behaviour, residual velocity, energy absorption capability, and visible structural damage.

The results showed that laminate thickness has a significant influence on the impact response of composite helmets. The 2-layer helmet exhibited penetration and higher residual velocity, indicating lower energy absorption capability. In contrast, both 4-layer and 6-layer helmets successfully resisted penetration and absorbed higher impact energy. However, no significant improvement was observed between the 4-layer and 6-layer configurations, suggesting the existence of an optimal laminate thickness. Overall, the 4-layer configuration provided the best balance between strength, weight, and impact resistance.

Keywords—Composite helmet; Impact testing; GFRP; Energy absorption; Vacuum infusion; Laminate thickness

DESIGN, DEVELOPMENT AND PERFORMANCE ANALYSIS OF IGNITER-LESS PULSED PLASMA THRUSTER

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Abstract: This report is an overview of igniter-less pulsed plasma thruster technology along with its operational mechanisms on the basis of their working and electrode geometries. It also focuses on the influence of electrode geometries, critical electronic subsystems, its functions and working that would play a vital role in PPTs performances. By analyzing the current research approaches, challenges and the implications, this project aims to deliver a clear and consolidated understanding of PPT, enabling a next generation agile and capable small spacecraft and CubeSats. Pulsed Plasma Thruster is a category of electric propulsion which is a subdivision of electromagnetic electric propulsion, where the electric energy stored in the capacitors are rapidly discharged into frequent pulses so as to generate thrust. The fundamental operating characteristics involve ablation and then simultaneous ionization of a solid propellant like that of teflon. High voltage electric current is used to ablate the teflon which would result in the formation of plasma which is then accelerated by a combination of electromagnetic and electrothermal forces. Lorentz force is the electromagnetic force that is used in this aspect. PPT's are unique compared to other thrusters making it exceptionally precise with repeatable impulse bit enabling it ideal for attitude control and maneuvering. It works without the involvement of any moving parts, making it simple and reliable. A DC high voltage pressure generator, a capacitor bank, resistors and so on constituted the electrical circuit which also underwent numerical analysis to establish its inductance and resistance. Modelling of the test stand was done on SolidWorks which was then 3D printed upon which subsequent experimental validations were done using copper electrodes and PTFE propellant. A modular 3D printed test stand enabled the testing of electrode geometries attaining stability and a controlled plasma generation. With the help of ANSYS Maxwell, the validation of discharge characteristics and electromagnetic simulations were performed, predicting peak current and instantaneous Lorentz force for the impulse bit. The engineering cycle of the PPT emphasizing ANSYS based simulations and electrical circuit design was done. The various effects of discharge behaviour and the influence of geometry on its characteristics are investigated both in ambient and vacuum conditions. For achieving perfect vacuum conditions, a vacuum chamber was designed in SolidWorks and a structural analysis was done using ANSYS. The study of geometric parameters such as electrode length, gap, width and flare angles were done and they were varied to analyze their influence on plasma discharge and arc formation. Further focus was given on arc localization at sharp edges and regions of minimal electrode gap that would significantly affect the performance and electrode erosion. This finally offers the contribution towards the understanding of the geometrical optimization of PPT for improved propulsion behavior and discharge control. Finally, this report concludes with the prototype of an igniter-less PPT for which the experiments were done in both ambient and vacuum conditions, where different geometries were tested in ambient condition whereas a rectangular parallel electrode was tested in vacuum condition where the discharge characteristics were observed and the impulse bit was found through numerical calculations.

Keywords: Pulsed Plasma Thrusters; Electrode Geometry; Test Stand; Vacuum Chamber; ANSYS Maxwell; ANSYS Static Structural; Electric Circuit; Solid Works; Impulse bit.

CONCEPTUAL DESIGN OF HYBRID SHROUDED WIND TURBINE FOR UAV CHARGING

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Abstract

Renewable energy, particularly wind energy, offers a reliable solution for independent power generation in remote and high–altitude environments. This study presents a hybrid renewable energy system that combines a shrouded wind turbine (SWT) with solar panels to use both wind and solar resources to charge Unmanned Aerial Vehicles (UAVs). In this system, solar panels are mounted above the turbine structure to explore the feasibility of integrating energy generation and storage on a single platform. Different solar panel configurations are analysed considering parameters such as turbine area, power output, panel surface area, and cost to estimate total electrical energy produced. The study also evaluates the energy requirements of the UAV battery, including capacity, charging power, and estimated charging time. Based on this analysis, an appropriate configuration is identified to improve energy utilisation and ensure efficient UAV charging. In cases where a UAV is not present, the energy can be redirected to a ground station, reducing energy loss and improving system efficiency. Overall, this work highlights the effective generation, storage, and utilisation of energy in a hybrid system for UAV applications. Future improvements will focus on aerodynamic optimisation, energy management, and practical implementation

Keywords: Shrouded wind turbine; Hybrid-renewable energy system; Solar-wind energy integration; UAV charging; Energy harvesting.

EXPERIMENTAL CHARACTERISATION OF FLEXURAL STRENGTH OF STITCHED FOAM SANDWICH PANEL

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Abstract

In recent years, sandwich structures have become effective engineering solutions for aerospace and civil applications. Their excellent strength-to-weight ratio, better flexural performance, resistance to corrosion, and high transverse shear stiffness contribute to this. The growing need for lightweight but strong materials has led to significant research on different combinations of core and face sheet designs.

This study aims to improve the interfacial integrity of sandwich structures by adding through-thickness stitching. This approach aims to minimize delamination and enhance out-of-plane properties. Stitched foam core sandwich panels were made using bidirectional woven glass fiber-reinforced composite face sheets, which were connected with vertical stitching threads. We used three types of stitching yarns—glass, basalt, and carbon—to explore their effects on structural performance.

The running stitch technique was used for effective through-thickness reinforcement. We conducted experimental characterization in accordance with ASTM standards, with a special focus on the flatwise compressive strength to assess the interaction between the core and the face sheet. Flexural tests were also done to measure the flexural strength and modulus of elasticity of the panels we created.

Flexural test results show that the flexural strength of the stitched sandwich panel with carbon pile 29 % greater than that of the unstitched one, 18 % greater than that of the glass, 14 % greater than that of the Basalt.

Keywords: Through-thickness stitching; Carbon fiber; Flexural strength; Delamination resistance; Foam core sandwich panel;

NUMERICAL INVESTIGATION OF THROTTLING-INDUCED UNSTART DYNAMICS AND COWL DEFLECTION EFFECTS IN A HYPERSONIC MIXED-COMPRESSION INLET AT MACH 5

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Abstract

The present work reports a detailed numerical investigation of the flow behavior inside a two-dimensional three-ramp mixed-compression hypersonic inlet at a freestream Mach number of $M\infty$ = 5.0, operating at an altitude of 35 km. Simulations are performed using ANSYS Fluent 2026 R1 with a density-based coupled solver, the SST k–ω turbulence closure, and Sutherland's viscosity law for air modeled as an ideal gas. Two independent parametric studies are conducted: (i) the throttling ratio ζ is varied from 0 to 0.7 by inserting a wedge plug at the isolator exit, and (ii) the cowl deflection angle δ is varied from 2° to 5° under the unthrottled baseline condition. A grid independence study conducted on three mesh levels confirms that a fine mesh of ≈194,003 nodes with $y^+ < 1$ yields mesh-independent results.

For the throttling study, steady fully started flow is confirmed for $\zeta \leq 0.2$ (peak $P/P\infty < 31$); periodic unsteadiness emerges at $\zeta = 0.3$ and intensifies through $\zeta = 0.7$, with peak $P/P\infty$ rising from ≈30 to ≈73 (+143%) and the pressure peak migrating upstream from $x/L \approx 0.55$ to $x/L \approx 0.87$. In contrast, varying the cowl deflection angle between 2° and 5° produces negligible variation in Mach number, static pressure, and wall pressure distribution, with peak $P/P\infty$ changing by less than 2.3% and all curves overlapping up to $x/L = 0.8$. Throttling is identified as the dominant parameter governing hypersonic inlet unsteadiness, while moderate cowl deflection acts as a passive geometric parameter within the range studied.

Keywords: Hypersonic inlet; Mixed-compression; Throttling dynamics; Cowl deflection; URANS; SST k–ω; Shock-wave boundary-layer interaction; Inlet unstart; Pseudo-shock train; ANSYS Fluent

NUMERICAL INVESTIGATION OF AERODYNAMIC PERFORMANCE OF A FISH BONE ACTIVE CAMBER (FISHBAC) MORPHING LAMBDA WING

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Abstract

Morphing wing technology provides real-time geometric adaptation, providing aerodynamic performance benefits over traditional discrete control surfaces, especially in unmanned aerial vehicle (UAV) applications where mission efficiency dictates endurance and range. This paper is a systematic three-dimensional computational fluid dynamics (CFD) study of a Fish Bone Active Camber (FishBAC) morphing lambda wing using the NACA 2412 airfoil profile. The wing design combines a structurally rigid leading section (65% of the chord) and a continuously deformable trailing edge (35% of the chord) to allow smooth redistribution of camber without discrete control surface discontinuities. Five trailing-edge deflection angles (−20°, −10°, 0°, +10°, +20°) were tested at four freestream velocities (20, 40, 60 and 80 m/s) under standard atmospheric conditions, resulting in 20 converged CFD cases. All simulations were performed in ANSYS Fluent 2026 R1 using the Shear Stress Transport (SST) k-ω turbulence model with Low Reynolds Number correction. Mesh independence was determined on a structured-dominant grid with more than 2.5 million elements, with wall y^+ ≈ 1, and a lift coefficient difference of 0.84% between refinement levels. The +10° trailing-edge deflection has the global aerodynamic optimum with the highest lift-to-drag ratio of L/D = 12.982 at 80 m/s, a 53.6% increase over the undeflected baseline. The peak lift is obtained at +20° deflection, with CL = 1.5635 at 80 m/s. The full ±20° deflection envelope provides a total camber authority of ΔCL = 2.427, and fully attached flow is verified in all 20 cases by surface pressure contour analysis. A systematic aerodynamic asymmetry between positive and negative deflection regimes is determined and measured: positive deflections produce about 2.8 times more incremental lift per degree than similar negative deflections, due to the positive camber of the NACA 2412 baseline profile. Novel three-dimensional lambda planform flow characteristics, such as kink-induced leading-edge suction concentration and redistribution of spanwise pressure, are reported in the first instance in combination with FishBAC morphing. This is, to the best of the knowledge of the authors, the first systematic parametric 3D CFD study to couple FishBAC continuous camber morphing with a lambda wing planform on the NACA 2412 section over a series of subsonic freestream conditions.

Keywords: Fish Bone Active Camber (FishBAC), Morphing wing, UAV Aerodynamics, Lambda wing, Aerodynamic Polar, Leading-edge Vortex.

MULTI METRIC EMI/EMC ANALYSIS OF SHIELDING CONFIGURATIONS FOR AIRCRAFT CABLE HARNESSES

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Abstract

Electromagnetic interference (EMI) caused by aircraft cable harnesses is a key issue when it comes to the safety and certification of the systems. Although the literature generally considers each of the individual EMC aspects separately, a comprehensive comparison of the shielding configurations and performance of multiple shielding configurations and metrics remains scarce. This paper is a full wave simulation study of four typical cable designs i.e. unshielded single conductor, shielded coaxial cable, unshielded bundle of cables, and shielded bundle of controlled inter conductor spacing with Altair FEKO in frequency range of 500 MHz to 1 GHz. Six electromagnetic compatibility measures are measured, such as near-field electric field distribution, far-field radiation behaviour, total radiated power (TRP), radar cross-section (RCS), source impedance behaviour and far-end crosstalk (FEXT).The findings reveal that the unshielded configuration is an efficient unintended radiator capable of delivering the highest levels of near-field V/m of 60 dB and TRP of +11 dB W in resonance conditions. Conversely, radiation and coupling effects are greatly suppressed by the introduction of shielding. The shielded bundle setup has a near-field strength reduction of about 57 dB and a performance of FEXT of up to 55.6 dB better than the unshielded bundle. The overall simulation findings and first-order theoretical results suggest that there is a minimum inter-conductor separation of about 3 mm that is proposed as a design rule of thumb in minimizing coupling in shielded bundles, pending more experimental confirmation. The given multi-metric framework offers physically consistent and design-oriented information that gives practical advice to optimisation of electromagnetic compatibility of Electrical Wiring Interconnection Systems (EWIS) in aircraft.

Keywords: Aircraft cable harnesses, EMI/EMC, electromagnetic compatibility, full-wave simulation, cable shielding, cable bundle, far-end crosstalk (FEXT), total radiated power (TRP), radar cross-section (RCS), near-field radiation, EWIS.

EXPERIMENTAL CHARACTERISATION OF FLATWISE COMPRESSIVE STRENGTH OF STITCHED FOAMSANDWICH PANEL

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Abstract

Over the past few years, sandwich structure systems are being used more and more frequently as viable structures for engineering applications. This increased use of composite structural materials in the aerospace and civil structural areas has occurred largely because of their extremely low weights (which reduces the overall weight of the entire structure), high resistance to bending and corrosion, and good resistance to transverse shear. Various researchers and companies around the world have conducted analyses relating to the design and production designs of many different combinations of core and face sheet thicknesses. The purpose of this study is to investigate and review the implications of, and the degree of success of, stitching together the face sheets and core. This research will include experimental characterization of stitched sandwich panels, designed with regard to ASTM test standards, with respect to the flatwise compression strength of the sandwich panels fabricated with stitched foam cores. This research project will consist of a comprehensive investigation into the construction methods used to produce stitched foam core sandwich structures and analyze their flatwise compressive strength. The foam core sandwich specimens will be constructed using two woven fabrics, one constructed of glass fibers and one made of hybrid carbon/basalt fibers. Each of these sandwich specimens will be constructed using a running stitch method as an additional means of mechanical connection. Finally, the in-plane properties of these stitched sandwich structures will be enhanced by orthogonal stitching. Flat wise compressive test is used to evaluate the compressive strength and modulus of elasticity of the panels in the direction perpendicular to the plane of the panel.

OPTIMIZATION OF ODOMETRY ALGORITHM FOR RESOURCE-CONSTRAINED EMBEDDED SYSTEMS IN AUTONOMOUS ROVERS

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Abstract

The autonomous navigation of a rover in an environment where a GPS module cannot be usedrequires high-end sensors and precise positioning systems. Traditional embedded systems have high computational overheads. This leads to hardware failures, which should be minimal in the field of aerospace-grade microcontrollers. This study presents a simpler programming and hardware architecture for a four-wheeled autonomous rover, with a key focus on minimizing code complexity without compromising the integrity of navigation. The system works on a *Differential Drive Kinematics* model based on Runge-Kutta 2^{nd} order integration to obtain (x,y) co-ordinates with the help of photoelectric encoders. To improve performance and reduce the use of excessive sensors, the hardware was restructured into parallel motor banks (M1, M3). This led to a significant decrease in the I/O instruction cycle compared to a conventional configuration utilizing all the motor banks (M1-M4). In addition, it reduces the generation of heat during prolong use. An uncomplicated navigation algorithm was integrated using servos as actuators and an ultrasonic sensor as scanner for efficient path planning. Real-Time telemetry was established via Bluetooth communication to connect to Python which works as a *Digital Twin* for visualization. Testing shows that the optimized programming significantly reduced compilation time and memory footprint. The code maintained reliable localization accuracy while achieving good obstacle avoidance. Through the results obtained it can be seen that reducing the size of the algorithm can provide better *Resource-Constrained Exploration* without compromising accuracy.

Keywords: Differential Drive Kinematics, Digital Twin, Resource-Constrained Exploration.

RATE LIMITING AS A CRITICAL VULNERABILITY IN CONTINUOUS DETERMINISTIC AI: A NONLINEAR ROBUSTNESS EVALUATION FOR UUV FIN ACTUATOR CONTROL

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Abstract

Abstract—This paper presents a comprehensive simulation based robustness evaluation of deterministic artificial intelligence (DAI) applied to DC motor control for unmanned underwater vehicle (UUV) fin actuators. Based on the pioneering efforts of Wang and Sands [15], three control strategies are compared sys tematically: discrete DAI, continuous DAI (CDAI), and a model following self-tuning regulator (MF). The experiment builds upon the literature in four orthogonal planes of complexity: measurement noise (0–0.20), sinusoidal ocean-wave perturbation (0.08 Hz, amplitude 0–0.30), discretization scheme (Matched pole/ZOH/Tustin), and a physically realistic nonlinear actuator model with five sequential constraint components: voltage saturation, slew-rate limiting. Experiments 1–4 all support the superiority of CDAI in linear plant conditions, and CDAI achieves the lowest tracking error in 14/18 experimental conditions. The nonlinear analysis (Experiment 5) demonstrates a critical and hitherto unreported result: severe slew-rate limiting alone destabilizes CDAI (error mean = 6.287, RMSE = 7.118) and MF is well-regulated (error mean = 0.190, RMSE = 0.482), a 33× performance difference. However, when using the full combined f ive-constraint nonlinear model, CDAI regains its performance edge with an error mean of 0.116 compared to 0.171 for MF, indicating that constraint co-occurrence does not adversely affect performance. These results are the first quantitative description of DAI-based controller robustness in physically realistic actuator conditions, and define actionable hardware-dependent selection criteria for embedded UUV deployment.

Keywords: Aircraft cable harnesses, EMI/EMC, electromagnetic compatibility, full-wave simulation, cable shielding, cable bundle, far-end crosstalk (FEXT), total radiated power (TRP), radar cross-section (RCS), near-field radiation, EWIS.

DATA-DRIVEN CONCEPTUAL AND COMPUTATIONAL ANALYSIS OF HYBRID ROCKET FOR CUBESAT LAUNCH

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Abstract

This paper presents a data-driven conceptual and computational design of a single-stage hybrid rocket utilizing paraffin wax as the solid fuel and liquid oxygen (LOX) as the oxidizer for launching a 1U CubeSat (10 × 10 × 10 cm) with a mass of approximately 1.33 kg to a suborbital altitude of 100 km. The proposed system is designed to achieve a delta-v requirement of approximately 2800 m/s using environmentally friendly and non-toxic propellants. The rocket is designed to produce a thrust of approximately 350 N with a burn time of around 25 seconds, achieving a propellant mass fraction of nearly 63% and an initial vehicle mass ranging between 6–8 kg for oxidizer-to-fuel ratios between 1.5 and 2.5. Thermochemical performance parameters were estimated using NASA CEA simulations, yielding specific impulse values between 281 s and 287 s, combustion temperatures ranging from 2638 K to 3590 K, and exhaust velocities between 2763 m/s and 2967 m/s. Regression rates were modeled using empirical power-law relations, with estimated regression rates of approximately 0.0113 mm/s at an oxidizer mass flux of 489 kg/m²s. Computational tools such as Python and MATLAB were used for iterative mass budgeting, propulsion sizing, and system optimization. Computational Fluid Dynamics (CFD) simulations were conducted to validate internal flow behavior and performance characteristics, confirming acceptable mesh quality, convergence, and stable flow patterns through velocity, pressure, temperature, and turbulence analysis. The results demonstrate the feasibility of the proposed hybrid rocket configuration for small satellite launch applications, achieving total impulse values between 8800 Ns and 9000 Ns while maintaining operational safety and throttle capability.

Keywords: Hybrid Rocket; Paraffin-LOX; CubeSat Launch; Computational Design; Rocket Propulsion

CFD-BASED ANALYSIS OF WATER VAPOUR PROPELLANT AND EXPANSION SLOT GEOMETRY EFFECTS IN FREE MOLECULAR MICRO-RESIST JETS

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Abstract

Free Molecular Micro-Resistojets (FMMR) has emerged as a promising green micro-propulsion solution for CubeSat platforms, offering low operational pressure, non-toxic propellant storage, and MEMS-compatible fabrication. Prior numerical studies by Cervone et al. (2017) established baseline FMMR performance using gaseous nitrogen as a surrogate propellant in Direct Simulation Monte Carlo (DSMC) simulations, and characterised flow behaviour exclusively within circular cross-section expansion slots. This study addresses two research gaps through CFD analysis in ANSYS Fluent 2025 R2 using slip-flow boundary conditions. First, water vapour (H_2O) is investigated as the actual operational propellant in place of nitrogen across plenum pressures of 50 Pa and 150 Pa and wall temperatures of 573 K, 700 K, and 900 K. Second, rectangular slot geometry of equal cross-sectional area (10^4 μm^2) is compared against the circular baseline at 573 K wall temperature. Results show that water vapour consistently achieves 32–58% higher specific impulse than nitrogen at identical conditions, with the advantage most pronounced at lower pressures. The rectangular slot geometry outperforms the circular slot by 28–77% in specific impulse due to enhanced dual-wall heat transfer. The optimal configuration of rectangular slot with water vapour propellant at 150 Pa plenum pressure yields an Isp of 52.87 s, representing a 254% improvement over the nitrogen circular slot baseline at 50 Pa.

Keywords — FMMR; CubeSat propulsion; water vapour; micro-resistojet; DSM; , CFD; ANSYS Fluent; expansion slot; specific impulse; green propellant.

DESIGN AND SIMULATION OF REGENERATIVE COOLING AND FILM COOLING ASPECTS IN CRYOGENIC ENGINE

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Abstract

In modern rocket engines, the combustion chamber is subjected to very high temperatures up to 3600K, requiring the use of appropriate measures for cooling in order to preserve the functionality of the system. This research will examine the combined use of regenerative and film cooling technologies as appropriate ways of achieving adequate temperature control in the combustion chamber. Regenerative cooling technology will be applied to achieve adequate cooling by using coolant flow inside the combustion chamber, whereas film cooling will act as an additional measure in order to ensure that hot gases do not have any contact with the chamber walls. Computerized simulations will be used to assess the effects of different film cooling mass flow rates on the behavior of the temperature of the wall and that of the combustion chamber. From the results obtained from this simulation, the combination of both types of cooling will lead to adequate temperature reduction in the combustion chamber, since increasing the film coolant mass flow rate will contribute to cooling due to the increased thickness of the film.

Keywords: Regenerative cooling; film cooling; cryogenic rocket engine; thrust chamber; heat transfer; coolant channel; combustion gases; wall temperature; heat flux.

EXPERIMENTAL EVALUATION OF TRIPLE IMPINGING INJECTOR IN LIQUID ROCKET ENGINE

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Abstract

Mixing and atomization in LPRE are accomplished with the help of an appropriately designed injector. Injectors are responsible for regulating the delivery of propellant, controlling the intensity of mixing, and defining the initial conditions of combustion that essentially govern stability, efficiency, and emission characteristics. Their geometric configuration strongly influences spray breakup, droplet size, and flame structure.Various injector concepts used in LPREs include shear-coaxial, swirl, pintle, and impinging-jet injectors. Each of these has certain advantages regarding mixing quality, throttling behaviour, combustion stability, and manufacturability. In this regard, impinging-jet injectors are widely preferred owing to their simplicity, robust mixing, and fine atomization without resorting to complicated internal flow hardware.

The current effort targets a triple-impinging injector configuration, which is intended to improve atomization efficiency in terms of multi-jet interaction with controlled momentum exchange. Such configurations have received increasing interest recently due to their potential to enhance mixing homogeneity while reducing stability issues of classic double-impinging geometries. Understanding their behaviour is essential for advancing injector design for next-generation LPREs.The combined computational and experimental approach has been adopted in the present study. CFD simulations are performed to predict jet interaction, mass-flow characteristics, spray breakup modes, and cone formation. High-speed visualization and flow-measurement experiments were conducted to validate numerical trends. Numerical modelling in combination with controlled laboratory testing enables the comprehensive characterization of the injector's performance envelope.

The focus of this work is to carry out a critical comparison of the CFD and experimental results in terms of major performance parameters-mass-flow rate, impingement location, spray cone angle, and atomization quality-with the objective of forming quantitative simulation-to-test correlations that support reliable prediction methods and deliver design-level understanding of triple-impinging injector behaviour for advanced LPRE applications.

Keywords: Liquid Propellant Rocket Engine (LPRE); Injector Design; Triple-Impinging Injector; Impinging-Jet Atomization; Spray Breakup; Droplet Formation; Mixing Efficiency; Computational Fluid Dynamics (CFD); Experimental Validation; Spray Cone Angle; Mass Flow Rate; Combustion Stability; Multi-Jet Interaction; Momentum Exchange; High-Speed Visualization

DUAL-MODEL DATA-DRIVEN FRAMEWORK FOR POTENTIAL CORE LENGTH PREDICTION IN COAXIAL JET NOZZLES USING SPLINE INTERPOLATION AND POLYNOMIAL REGRESSION

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Abstract

The mixing of the exhaust stream is a close relationship to jet noise attenuation in the propulsion system of an aircraft and the most direct quantitative measure of the mixing of the exhaust stream is the potential core length (PCL) of a coaxial jet. Traditional methods of calculating the physical measurements or high-resolution computational fluid dynamics of PCL required significant time and computing resources, thus rendering them infeasible in quick, early stage, parametric design. The paper presents a low-weight, two-model predictive control model which takes co-flow percentage and nozzle lip thickness as the two independent variables and gives PCL as the only output. A bivariate spline interpolation model with a zero smoothing parameter can essentially recover the training model with practically zero reconstruction error, thus it is the tool of choice in retrieval when the design query lies within the limits of the measured configurations. A third-degree-polynomial regression fitted on the same data compromises the exact-point fidelity to learn the overall functional trend a property that is decisive when the framework is required to extrapolate to operating conditions not available in training data. The polynomial model is the lowest root-mean-square error model in four rival surrogate models under the most severe of three cross-validation regimes, the Leave-One-Co-flow-Out test, which is better than the spline and Gaussian Process alternatives. Quantitative results are provided by physical observations that PCL increases with co-flow percentage and decreases with lip thickness in qualitative agreement with published experimental results on shear-layer and wake dominated coaxial jet regimes. The dual-model architecture provides practising engineers with an almost-instant design assessment device to supplement the high-fidelity simulation minus its computational overhead.

Keywords: Potential core length; coaxial jet; co-flow percentage; lip thickness; bivariate spline interpolation; polynomial regression; aerodynamic modelling; jet noise; data-driven prediction.

A PHYSICS-AWARE MACHINE LEARNING FRAMEWORK FOR MULTI-PROCESS MANUFACTURABILITY ASSESSMENT OF TOPOLOGICALLY OPTIMIZED AEROSPACE STRUCTURES

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Abstract

Traditional Topology Optimization (TO) often produce biologically inspired, ultra-lightweight aerospace components that satisfy structural requirements but fail during the transition to physical production due to manufacturing complexity. While existing research focuses on optimizing shapes for specific processes, there remains a significant gap in providing a real-time, comparative assessment of a design's viability across different manufacturing methods. This study introduces a novel, multi-head Convolutional Neural Network (CNN) architecture designed to quantify the 'Fabricability Index' of optimized aerospace components. A comprehensive dataset of selected geometries was synthesized using Density-Based Topology Optimization under varying load-case stochasticity. These designs were systematically labelled using a multi-criteria decision-making (MCDM) rubric encompassing subtractive (CNC-milling), additive (Laser Powder Bed Fusion), and hybrid manufacturing constraints. Unlike previous studies that treat manufacturability as a binary constraint, this project introduces a 'Complexity Heatmap' using Explainable AI (XAI) techniques to identify specific geometric features—such as inaccessible cavities or extreme overhangs—that drive production costs. Results demonstrate that the proposed model can predict manufacturability scores with over 90% accuracy compared to traditional Design for Manufacturing (DfM) manual audits. This framework provides a scalable tool for aerospace engineers to select the most cost-effective manufacturing route during the conceptual design phase, effectively reducing the lead time between generative design and flight-ready hardware.

Keywords: Topology optimization, Manufacturability Assessment, Convolutional Neural Network, Fabricability Index, Explainable AI, Design for Manufacturing, Aerospace Structures, Laser Power Bed Fusion, MCDM.

FEA-BASED PERFORMANCE STUDY ON HYBRID SORBOTHANE-RUBBER RECOIL PADS AND THICKNESS OPTIMIZATION USING MACHINE LEARNING VALIDATION

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Abstract

Recoil generated by shoulder-fired weapons poses a real and cumulative risk to the shooter. Each discharge sends an impulse through the receiver, along the buttstock, and into the shoulder and when that energy is not properly managed over repeated firing, the result is musculoskeletal strain, reduced accuracy, and in sustained operational use, lasting physical injury. The recoil pad sits at the final point of that energy path, and its material composition determines how much of the impulse reaches the body. This study examines whether Sorbothane, a viscoelastic polymer with well-documented damping properties, outperforms conventional rubber in this role, and whether combining the two in a layered hybrid design can offer a useful middle ground between damping performance and structural practicality. Finite element analysis was carried out in ANSYS Explicit Dynamics, using a transient 1,500 N equivalent recoil load based on 7.62×39 mm ballistic data. Three configuration types were evaluated: pure rubber, pure Sorbothane, and six hybrid variants that placed the two materials in different layer orders and thickness proportions. The results confirm that Sorbothane substantially outperforms rubber, absorbing roughly 65% more internal energy, while the hybrid configurations fell between the two extremes depending on which material faced the impact surface. A thickness sensitivity study was then run on Sorbothane-only pads, and the resulting simulation data was used to train both linear and polynomial regression models. The linear model proved more reliable for predicting energy absorption beyond the training range and is proposed as a lightweight design tool for thickness selection.

Keywords: Recoil Pad, Sorbothane, Impact Energy Absorption, Explicit Dynamics, Machine Learning

EXPERIMENTAL EVALUATION OF MECHANICAL PROPERTIES OF FRP LAMINATES REINFORCED WITH HYBRID SUGARCANE FIBRE–SILICON CARBIDE COMPOSITES

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Abstract

The growing demand for lightweight, high-performance, and sustainable materials has intensified research into hybrid fiber-reinforced polymer composites. In this study, glass fiber reinforced polymer (GFRP) laminates reinforced with sugarcane fiber and silicon carbide (SiC) particulates are developed and systematically evaluated. Three composite configurations are fabricated using a three-layer lamination technique: GFRP reinforced with 20 wt% sugarcane fiber, GFRP reinforced with 15 wt% SiC, and a hybrid composite containing 15 wt% sugarcane fiber and 5 wt% SiC. Epoxy resin is used as the matrix material to ensure effective load transfer and structural integrity. The proposed work aims to comprehensively assess the mechanical behaviour of the fabricated laminates. Mechanical characterization includes tensile, flexural, impact, and hardness tests to evaluate strength, stiffness, energy absorption, and surface resistance. The outcomes of this study are expected to highlight the advantages of hybrid sugarcane fiber–SiC reinforcement in enhancing mechanical performance of GFRP laminates. The proposed research contributes to the development of eco-friendly hybrid composites with improved functional characteristics for structural, automotive, and industrial applications.

Keywords: Hybrid GFRP composites, Sugarcane fiber reinforcement, Silicon carbide particulates, Mechanical properties, Epoxy matrix composites, Sustainable materials

SYSTEM

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Abstract

This project focuses on the development of a fixed-wing Unmanned Aerial Vehicle (UAV) for real-time air quality monitoring. The system is designed to measure important environmental parameters such as particulate matter (PM2.5), temperature, humidity, and gas concentration using onboard sensors.

Conventional air quality monitoring systems are mostly stationary and cannot cover large areas effectively. To overcome this limitation, a fixed-wing UAV is used, which can travel longer distances and collect data from multiple locations. The UAV is integrated with a PM2.5 sensor and a BME680 sensor, along with a microcontroller for data collection and processing.

The collected data is transmitted wirelessly to a ground station using a long-range communication system, where it can be monitored in real time. This approach allows efficient and flexible monitoring of air quality over a wide area.

The proposed system is simple, cost-effective, and suitable for environmental monsitoring applications. It provides a practical solution for collecting real-time air quality data and helps in better understanding pollution levels across different regions.

Keywords: UAV, Fixed Wing UAV, Air Quality Monitoring, PM2.5, BME680 Sensor, Environmental Monitoring, Real-Time Data, Wireless Communication

DESIGN AND FABRICATION OF LOW-COST 32-PORT PRESSURE SCANNER FOR PROPULSION APPLICATIONS USING CD NOZZLE JETS

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Abstract:

In propulsion systems, the performance of a convergent–divergent (CD) nozzle is highly dependent on the pressure distribution along its surface. Accurate measurement of pressure at multiple locations is essential to analyze flow behavior, jet expansion, and thrust characteristics. However, commercially available multi-port pressure scanners are expensive and not easily accessible for academic laboratories.

This project focuses on the design and fabrication of a low-cost 32-port pressure scanner for propulsion applications using CD nozzle jets. The system consists of pressure tapping points along the nozzle wall, silicone tubing for pressure transmission, a pressure sensor for converting pressure into electrical signals, and a microcontroller-based data acquisition system. A multiplexer is used to sequentially read pressure data from multiple ports, thereby reducing system cost and complexity.

The experimental setup is implemented in a wind tunnel to study pressure distribution along the nozzle. The collected data is analyzed to understand flow characteristics such as choking, expansion, and shock formation. The developed system provides an economical and efficient solution for experimental studies in aerodynamics and propulsion, making it suitable for academic and research applications.

FLOW STEADY ANALYSIS OF SUPERSONIC COMBUSTOR EMPLOYED WITH UNSWEPT RAMP EMBEDDED SURFACE LOBE CAVITY.

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Abstract

The study of flow characteristics in scramjet combustors is crucial for understanding the complex aerodynamic and combustion processes involved in high-speed flight. The research presented in this article explores the shock structure, wall pressure distribution, and flow separation within a laboratory model of a scramjet combustor, focusing on various compressions ramp modifications. Two distinct configurations of compression ramps – plain ramp, ramp with a surface lobe cavity were tested to investigate their impact on the flow behavior. The CFD simulation was done in an integrated scramjet combustor model, which featured a C-D nozzle, consists of 151mm length, a constant area section of 50 mm in length, followed by a diverging section of 150 mm. The model combustor had a rectangular cross-section with a constant width of 25 mm throughout its length. The top wall of the diverging combustor was made inclined at a constant angle of 2° relative to the bottom wall. The inlet Mach number to the combustor was set at 2.55. CFD works were carried out using air at a total pressure of 1000 kPa. Wall pressure distribution measurements were used to capture detailed information about the shock structure and wall pressure distribution within the combustor. The compression ramp configurations varied in geometry, surface embedded modifications and positions within the combustor. The first configuration consisted of a simple plain ramp. In the second configuration, a surface with lobe cavity was incorporated into the compression ramp. These two configurations were compared to study their effects on shock structure, and wall pressure distribution. The position of the compression ramp within the diverging section was varied to examine the impact of ramp placement on flow separation and shock behavior. Specifically, the ramp was placed at two distinct positions: combustor inlet and 25% of the total length of the diverging section from the inlet of the diverging section. This approach allowed for a comprehensive understanding of the position of ramp's influence on the internal flow dynamics and its interaction with the shock system within the combustor. The results indicated that the shockstructure varied considerably depending on the ramp configuration and position within the combustor.

Keywords*:* Supersonic combustor; unswept ramp; embedded surface cavity; flow steady analysis.

CFD ANALYSIS OF CHARACTERISTICS IN A SCRAMJET COMBUSTOR WITH ARC-GROOVED COMPRESSION RAMPS

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Abstract

The study of flow characteristics in scramjet combustors is crucial for understanding the complex aerodynamic and combustion processes involved in high-speed flight. The research presented in this article explores the shock structure, wall pressure distribution, and flow separation within a laboratory model of a scramjet combustor, focusing on various compressions ramp modifications. Two distinct configurations of compression ramps – plain ramp, ramp with a surface Arc-groove were tested to investigate their impact on the flow behavior. The simulation was done in an integrated scramjet combustor model, which featured a C-D nozzle consists of 151mm length, a constant area section of 50 mm in length, followed by a diverging section of 150 mm. The model combustor had a rectangular cross-section with a constant width of 25 mm throughout its length. The top wall of the diverging combustor was made inclined at a constant angle of 2° relative to the bottom wall. The inlet Mach number to the combustor was set at 2.55. CFD work were carried out using air at a total pressure of 1000 kPa. Wall pressure distribution measurements were used to capture detailed information about the shock structure and wall pressure distribution within the combustor. The compression ramp configurations varied in geometry, surface embedded modifications and positions within the combustor. The first configuration consisted of a simple plain ramp. In the second configuration, a surface Arc-groove was incorporated into the compression ramp, with depth (/D) of the Arc-Groove varying from 2mm to 4mm. These two configurations were compared to study their effects on shock structure, and wall pressure distribution. The position of the compression ramp within the diverging section was varied to examine the impact of ramp placement on flow separation and shock behavior. Specifically, the ramp was placed at two distinct positions: 20%, and 33.3% of the total length of the diverging section from the inlet of the diverging section. This approach allowed for a comprehensive understanding of the position of ramp's influence on the internal flow dynamics and its interaction with the shock system within the combustor. The results indicated that the shock structure varied considerably depending on the ramp configuration and position within the combustor. The shock waves formed at the ramp surface and propagated downstream, with multiple reflections from the combustor walls. However, when a surface Arc-Groove was added to the compression ramp, the shock structure became more complex, with additional shock waves forming at the Arc-Groove edges and creating significant disturbances in the flow downstream.

INTEGRATION OF SHAPE MEMORY ALLOYS IN COMPOSITE STRUCTURES FOR AEROSPACE AND CIVIL APPLICATIONS

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Abstract

The integration of Shape Memory Alloys (SMAs) in composite structures represents a groundbreaking advancement in engineering, offering adaptive, self-healing, and damage-resistant materials for aerospace and civil applications. SMAs, known for their ability to recover their original shape after deformation when exposed to heat or external stimuli, provide enhanced structural resilience and durability. This research investigates the mechanical behavior, fatigue resistance, and thermal adaptability of SMA-reinforced composite materials under dynamic loading conditions. The study explores NiTi-based SMA fibers embedded in polymer and ceramic matrix composites for applications in aircraft wings, morphing structures, and earthquake-resistant buildings. Experimental analysis, coupled with finite element modeling (FEM), will evaluate the performance of these hybrid structures in extreme environments such as high-altitude aerodynamics and seismic events. The findings will provide insights into the potential of smart composite materials to revolutionize next-generation aerospace and civil infrastructure, reducing maintenance costs and enhancing structural efficiency, sustainability, and longevity. This study paves the way for future self-repairing, energy-efficient engineering systems across multiple disciplines.

Keywords: Shape Memory Alloys, Smart Composites, Aerospace Structures, Civil Engineering, Adaptive Materials, Structural Resilience

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

AN AI-POWERED RECRUITMENT SYSTEM USING NLP, DEEP LEARNING AND GENERATIVE AI

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Abstract

The rapid digitalization of recruitment has increased the demand for intelligent, secure, and unbiased hiring systems capable of evaluating candidates beyond traditional resume-based screening. This project proposes an Advanced AI-Powered Recruitment, Interview, and Proctoring System that integrates Natural Language Processing (NLP), Deep Learning, Generative AI, Agentic AI, and Multimodal Behavioural Analysis to deliver a comprehensive and tamper-resistant talent acquisition solution. The system functions as an enhanced Applicant Tracking System (ATS) and candidate ranking engine, where NLP techniques extract and semantically analyze skills, experience, and domain relevance from resumes and job descriptions. Deep learning models generate candidate suitability scores by capturing complex relationships between job requirements and candidate profiles. Generative AI enhances the process by dynamically generating personalized, domain-specific interview questions. A key contribution is the integration of an AI-driven interview and proctoring framework that ensures identity verification, authenticity, and fairness. Face detection, identity matching, gaze tracking, and head pose estimation confirm candidate presence and attention. Object detection and system monitoring identify mobile phone usage, external devices, and window switching, while audio analysis detects multiple speakers and external assistance. The system further incorporates behavioural and cognitive analysis using facial expressions, speech prosody, and linguistic coherence to assess confidence, stress, and response authenticity. Advanced safeguards such as deepfake detection, lip-sync verification, and camera tampering detection prevent fraudulent practices. A multimodal analysis framework correlates video, audio, and text to detect anomalies. Agentic AI generates personalized feedback and learning recommendations, while a composite risk-scoring engine provides real-time alerts and explainable decision support, enabling a secure, scalable, and fair recruitment ecosystem.

Keywords: AI-Powered Recruitment; Natural Language Processing; Deep Learning; Generative AI; Multimodal Behavioural Analysis; Automated Interview Systems; AI Proctoring; Deepfake Detection; Candidate Ranking; Skill Matching; Explainable AI (XAI)

STRESS DETECTION AND MANAGEMENT FOR WORKING PROFESSIONALS USING AI

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Abstract

Stress has become a major concern among working professionals in recent years due to increasing workload, extended working hours, competitive environments, and imbalance between personal and professional life. Prolonged exposure to stress can lead to serious mental health issues such as anxiety, depression, reduced productivity, and overall decline in quality of life. Despite the availability of various stress detection systems, many existing solutions depend on intrusive physiological sensors like heart rate monitors and wearable devices, which are often inconvenient and not suitable for continuous or daily use. This project proposes an Artificial Intelligence (AI)-based stress detection and management system that is designed to be user-friendly, accessible, and non-intrusive. The system identifies stress levels by combining multiple approaches such as gamified questionnaires, personality assessments, and facial emotion recognition. User inputs and facial expressions are analyzed using machine learning algorithms to provide accurate and reliable stress level predictions. To enhance user engagement and interaction, the system integrates a gamification strategy where users earn scores based on their responses and activities. Based on the detected stress level, the system provides personalized recommendations and tasks tailored to the user's needs. These tasks include guided breathing exercises, relaxation techniques, social engagement activities, and leisure-based actions that help in reducing stress effectively. Furthermore, the system includes an interactive dashboard that allows users to monitor their stress levels, track progress over time, and analyze behavioral patterns. This helps users gain better insights into their mental health and encourages consistent usage of the system. The application also supports multiple languages, ensuring better accessibility and inclusivity for a diverse group of users. Unlike traditional medical systems, this solution focuses on early detection, prevention, and day-to-day stress management rather than clinical diagnosis. The proposed system aims to provide a practical, scalable, and efficient approach to improving mental well-being among working professionals through the integration of AI technologies.

Keywords: Stress Detection; Artificial Intelligence; Machine Learning; Facial Emotion Recognition; Mental Health; Gamification

HYBRIDGUARD: SECURE RETRIEVAL-AUGMENTED GENERATION FOR INTELLIGENT IT HELPDESK AUTOMATION IN ENTERPRISE ENVIRONMENT

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Abstract

Enterprise IT helpdesk systems are critical components of organizational infrastructure, responsible for managing technical support requests, incident resolution, and user assistance across diverse operational environments. However, these systems increasingly face significant challenges, including a rapid surge in ticket volumes, prolonged response and resolution times, repetitive handling of frequently occurring issues, and communication barriers arising from multilingual user bases. Traditional automation approaches such as rule-based chatbots and keyword-driven systems often lack contextual understanding, adaptability, and semantic reasoning capabilities. As a result, they frequently produce inaccurate or generic responses, fail to generalize across varied problem descriptions, and are unable to ensure data security and response reliability in enterprise settings. To address these limitations, this paper proposes a secure, Retrieval-Augmented Generation (RAG)-based Large Language Model (LLM) chatbot specifically designed for enterprise IT helpdesk automation. The proposed system leverages a hybrid information retrieval architecture that combines dense and sparse retrieval techniques to achieve both semantic depth and lexical precision. Dense retrieval is implemented using FAISS-based vector similarity search over embeddings generated from historical ticket data, enabling the system to capture contextual and semantic relationships between queries and resolutions. In parallel, BM25-based sparse retrieval is employed to ensure robust keyword matching and relevance ranking, particularly for domain-specific terminologies and exact phrase matching. The fusion of these retrieval strategies enhances the system's ability to retrieve highly relevant and contextually grounded information from the enterprise knowledge base. A key contribution of this work is the integration of a dual-layer safety architecture to ensure secure and trustworthy interactions. The first layer consists of a rule-based pattern filtering mechanism that detects and blocks known malicious patterns, prompt injection attempts, and policy violations. The second layer employs a fine-tuned semantic classifier that evaluates both user inputs and generated outputs for contextual safety, preventing hallucinations, misinformation, and unintended leakage of sensitive organizational data. Experimental results indicate a response accuracy of 91.4%, a mean resolution time reduction of 62%, an F1-score of 0.89, and a safety interception rate of 96.8%, substantially outperforming traditional systems.

Keywords: Large Language Models; Enterprise Chatbot; Retrieval-Augmented Generation; FAISS; BM25; IT Helpdesk Automation; Conversational AI; Hybrid Retrieval; Prompt Injection; Sentence Embeddings; Vector DB

AI DRIVEN SMART TOURISM CHATBOT FOR ASIA

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Abstract

The tourism industry across Asia presents a vibrant yet highly complex ecosystem, where travelers frequently encounter persistent challenges such as multilingual communication barriers, fragmented access to real-time information, and difficulty in discovering authentic, trustworthy local services. Existing tourism platforms are predominantly built on static web architectures and rule-based chatbot systems, which lack adaptability, contextual understanding, and the ability to provide personalized recommendations. These limitations significantly reduce user engagement and hinder seamless travel experiences in culturally diverse regions. To address these challenges, this project introduces an AI-Driven Smart Tourism Chatbot specifically designed for Asia's heterogeneous cultural, linguistic, and geographical landscape. The proposed system integrates advanced deep learning methodologies, combining Convolutional Neural Networks (CNN) for feature extraction and Natural Language Processing (NLP) techniques for semantic understanding and intent classification. By leveraging transformer-based embeddings and contextual language models, the chatbot achieves enhanced comprehension of user queries, including colloquial expressions, regional dialects, and mixed-language inputs. The system is developed using a scalable and modular architecture built on Python, TensorFlow, and advanced NLP libraries such as NLTK and spaCy. It incorporates real-time data integration through APIs connected to multiple stakeholders, including hotels, transport services, local guides, and emergency response systems. Additionally, the chatbot employs sentiment analysis and user profiling mechanisms to adapt responses dynamically, ensuring personalized recommendations aligned with user preferences, travel history, and contextual factors such as location and time. In conclusion, the proposed AI-driven chatbot represents a transformative solution for the tourism sector, bridging communication gaps, enhancing accessibility, and delivering intelligent, real-time assistance.

Keywords: Smart Tourism Chatbot; Deep Learning; Natural Language Processing; Multilingual Support; Real-Time Information Retrieval

AGENT-AWARE MIDDLEWARE FOR AUTONOMOUS LEGACY SYSTEM ENHANCEMENT

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Abstract

Despite the rapid advancement of enterprise technology over the past few decades, the majority of organizations in the education and finance sectors still rely on traditional infrastructures, such as Excel sheets, databases (SQL), and legacy software. Despite their dependability, these systems lack the autonomy and intelligence needed for contemporary operational efficiency. As a result, there is a significant risk of human error in crucial business processes and heavy manual workloads. Additionally, replacing this legacy infrastructure is frequently extremely costly and disruptive to day-to-day operations. This project proposes an Agent-Aware Middleware for Autonomous Legacy System Enhancement as a solution to the problem of modernizing these systems without replacing them. Through a decentralized multi-agent architecture, this novel, non-invasive solution uses specialized AI agents to sense data, understand complex policies stored in unstructured PDF documents, and make predictive decisions. The middleware in the education sector automates leave and attendance management by syncing Excel data with institutional policies. In order to enhance risk assessment and loan management, intelligent agents in the finance industry compare structured records to legal requirements. The framework includes a Human-in-the-Loop (HITL) mechanism and a strong audit trail to guarantee accountability. This study shows that intelligent middleware is a scalable and effective way to close the gap between contemporary autonomous intelligence and legacy reliability.

Keywords: Multi-Agent Systems (MAS); Autonomous Agents; Legacy System Modernization; Robotic Process Automation (RPA); Human-in-the-Loop AI; Digital Transformation; Intelligent Decision Support Systems (IDSS); Education Technology (EdTech); FinTech Compliance

AGENTIC AI-DRIVEN OPTIMIZING DEMAND FORECASTING IN RETAIL SYSTEMS WITH AI-BASED PREDICTIVE ANALYTICS

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Abstract

In today's data-driven retail environment, accurate sales forecasting and intelligent decision-making are essential for optimizing operations and minimizing losses. This project presents an Agentic AI-Based Retail Sales Forecasting and Automation System that leverages artificial intelligence to analyze retail data, predict future sales, and automate inventory management processes. The system accepts retail data in the form of CSV files and employs a Long Short-Term Memory (LSTM) model to perform time-series forecasting. It predicts both short-term (weekly) and long-term (monthly) sales trends. These predictions are displayed through an interactive graphical interface, allowing users to switch between weekly and monthly views for better insights and decision-making. To enhance usability, the system integrates a Retrieval-Augmented Generation (RAG)-based chat module that enables users to interact with the dataset using natural language queries. Users can easily retrieve information such as highest sales, sales on specific dates, and overall trends without requiring technical knowledge of data analysis. Additionally, the system includes an automated stock management module that uses forecasted sales data to estimate future inventory requirements. Based on these predictions, the system generates stock recommendations and sends a confirmation email to the user. Upon approval, it proceeds with automated order placement and invoice generation, thereby reducing manual effort and improving efficiency in supply chain management. The entire solution is built using an agent-based architecture, where each functionality such as forecasting, data querying, stock planning, and communication is handled by independent intelligent agents coordinated through a central controller. The backend is developed using Python, and the frontend is implemented using HTML with Jinja templates, featuring a user-friendly dark-themed interface. This project demonstrates the integration of machine learning, natural language processing, and automation into a unified platform for retail analytics.

Keywords: Agentic AI; Artificial Intelligence; Retail Analytics; Sales Forecasting; Time Series Prediction; LSTM; Deep Learning; RAG; Natural Language Processing; Data Analytics; Inventory Management; Stock Optimization; Automation; Intelligent Agents; Business Intelligence; Demand Prediction

ACCISENSE: A DEEP VISUAL LEARNING FRAMEWORK FOR INSTANT ROAD ACCIDENT DETECTION AND ALERT GENERATION

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Abstract

Road accidents require immediate emergency response to reduce fatalities and provide timely medical assistance. This project proposes an intelligent accident detection and alert generation system that uses CCTV camera feeds to automatically identify road accidents and trigger emergency notifications. The system analyses real-time video data to detect accidents and extracts vehicle number plate details to inform the vehicle owner about the incident. Once an accident is identified, an automated alert message is sent to the nearest hospital, accompanied by a voice notification to ensure rapid attention. Simultaneously, the system sends an alert to the nearest police station to initiate quick response and traffic management. To improve emergency coordination, the system includes a smart hospital response mechanism. If the nearest hospital declines the ambulance request due to unavailability, the alert is automatically forwarded to the next nearest hospital until assistance is confirmed. This reduces response delays and ensures faster medical support. By integrating computer vision, OCR-based number plate recognition, and automated notification services, the proposed framework enables a reliable, real-time accident response ecosystem. The solution aims to enhance public safety, minimize human intervention, and strengthen coordination between hospitals, police departments, and vehicle owners for effective emergency management.

Keywords: Accident Detection; CCTV Surveillance; Emergency Alert System; Number Plate Recognition; OCR; Hospital Notification; Police Alert; Computer Vision; Smart Emergency Response; Real-Time Monitoring

A SMART, PRIORITY-AWARE EMERGENCY RESPONSE SYSTEM WITH ETA-OPTIMIZED RESOURCE DISPATCH

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Abstract

The increasing frequency and complexity of emergency incidents in urban and semi-urban areas have placed significant pressure on existing emergency response systems, where delays in service dispatch often result in loss of life and property. Conventional emergency dispatch mechanisms rely primarily on proximity-based or rule-driven decisions, lacking real-time prioritization, multi-service coordination, and accurate response time estimation. This paper proposes a Smart, Priority-Aware Emergency Response System with ETA-Optimized Resource Dispatch, which enables intelligent coordination of ambulance and fire and rescue services by processing critical incident parameters such as emergency type, severity level, victim count, geographical location, and time sensitivity. A dynamic priority assessment mechanism computes an urgency score that determines the appropriate response strategy and required services. The proposed system incorporates Estimated Time of Arrival (ETA) optimization by considering real-time traffic conditions, resource availability, crew readiness, and service-specific operational constraints. Emergency data is processed through a centralized decision engine and visualized through a web-based monitoring interface, allowing authorities to track incidents, dispatched resources, and response performance in real time. Testing and evaluation confirm that the system accurately prioritizes emergencies, dispatches optimal resources, and significantly enhances coordination between ambulance and fire-rescue services compared to conventional approaches.

Keywords: Emergency Response System; Priority-Aware Dispatch; ETA Optimization; Ambulance Services; Fire and Rescue Services; Intelligent Emergency Management; Web-Based Monitoring; Resource Dispatch

A NAIVE BAYES FRAMEWORK FOR EMAIL SPAM AND PHISHING URL DETECTION USING TF-IDF FEATURES

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Abstract

Email communication has become an essential part of modern digital interaction, but it is increasingly exploited for malicious activities such as spam and phishing attacks. Traditional filtering systems, which rely on static rules and blacklists, often fail to detect evolving and obfuscated threats. This project proposes a unified machine learning-based framework for detecting both email spam and phishing URLs using Term Frequency-Inverse Document Frequency (TF-IDF) feature extraction and the Multinomial Naive Bayes classification algorithm. The system integrates multiple datasets, including spam email content and phishing URL data, and performs preprocessing techniques such as text normalization, stop-word removal, and URL tokenization. The extracted features are transformed into numerical vectors using TF-IDF with n-gram representation to capture contextual information. A Multinomial Naive Bayes model is then trained on the processed dataset to classify inputs as either spam/phishing or legitimate (ham). Experimental results demonstrate that the proposed system achieves an accuracy of approximately 88%, with balanced precision and recall, indicating reliable performance. The model is further optimized using data balancing techniques and hyperparameter tuning to reduce false negatives. Additionally, a user-friendly web interface is developed using Streamlit for real-time threat detection. The proposed framework is efficient, scalable, and suitable for practical deployment in email security systems. Future enhancements may include deep learning integration and real-time email server connectivity for improved detection accuracy.

Keywords: Spam Detection; Phishing URL Detection; TF-IDF; Multinomial Naive Bayes; Machine Learning; Cybersecurity

COUNTERFACTUAL FAILURE INTELLIGENCE SYSTEM FOR SAFETY-CRITICAL APPLICATIONS

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Abstract

Artificial intelligence is increasingly employed in safety-critical systems to support failure prediction and decision-making; however, most high-performing AI models function as black boxes, offering limited interpretability and minimal guidance on how predicted failures can be prevented. This limitation is particularly critical in aviation systems, where understanding the causes of failures and taking proactive corrective actions are essential for ensuring safety and reliability. To address this challenge, this project proposes a Counterfactual Failure Intelligence System for Safety-Critical Aviation Applications, which focuses on generating interpretable and actionable insights alongside traditional failure prediction. The proposed system leverages counterfactual explanations to identify minimal and realistic changes in aircraft system parameters that can transform a predicted failure state into a safe operational condition. By analyzing these what-if scenarios, the system helps uncover causal relationships between input features and failure outcomes, enabling better understanding of risk factors. The approach integrates a machine learning-based failure prediction model with a counterfactual explanation module inspired by recent advances in explainable artificial intelligence, including optimization-based techniques and feature-level importance. The generated counterfactuals are further analyzed to support failure intelligence, allowing engineers and operators to assess potential mitigation strategies before failures occur. The expected outcome of this project is an interpretable decision-support framework that not only predicts potential failures but also explains how they can be avoided, thereby enhancing transparency, trust, and proactive safety management in aviation systems.

Keywords: Counterfactual Explanations; Explainable Artificial Intelligence; Failure Prediction; Safety-Critical Systems; Aviation Safety; Decision Support

MULTI-MODAL DEEP LEARNING BASED DIGITAL RESTORATION OF ANCIENT PAINTINGS

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Abstract

Ancient paintings represent valuable cultural heritage but are highly vulnerable to deterioration due to environmental exposure, aging, cracks, fading, and physical damage. Traditional restoration methods are manual, time-consuming, and may risk altering the originality of the artwork. To overcome these limitations, this project proposes an automated digital restoration framework using a multi-modal deep learning approach. The system integrates both texture and structural information to achieve accurate reconstruction of damaged regions. The core of the proposed method is an edge-guided Context Encoder-based Generative Adversarial Network (GAN). Initially, the damaged image undergoes preprocessing, including resizing and normalization. Edge detection algorithms such as Canny are applied to extract structural features, which are then combined with RGB image data to form a multi-modal input. The generator network reconstructs missing or degraded regions using contextual learning, while the discriminator ensures the realism of the restored output through adversarial training. A combination of adversarial loss and L1 reconstruction loss is used to optimize performance and maintain both visual quality and structural consistency. The proposed system is implemented as a Flask-based web application that allows users to upload damaged paintings and obtain restored outputs in real time. Experimental results demonstrate improved boundary preservation, reduced artifacts, and enhanced color consistency compared to traditional and single-modal methods. Future work includes integrating transformer-based architecture, enabling high-resolution restoration, and extending the framework for large-scale digital archives and real-time applications.

Keywords: Generative Adversarial Network (GAN); Edge Detection; Multi-Modal Learning; Context Encoder; Image Inpainting

INSTRUCTION-GUIDED ADAPTIVE INVOICE EXTRACTION WITH DYNAMIC SCHEMA GENERATION

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Abstract

Invoices are critical financial documents widely used in enterprise workflows such as billing, expense management, auditing, and regulatory compliance; however, most existing automated invoice processing systems rely on predefined templates, rule-based pipelines, or fixed schemas, limiting their ability to generalize across diverse layouts and evolving analytical requirements. This limitation is particularly evident in cab billing invoices, which exhibit significant structural variability across vendors and platforms. This paper presents an instruction-guided adaptive invoice extraction framework that integrates document understanding with user-driven analytics through dynamic schema generation. The proposed system processes invoice images and PDFs using image preprocessing and Optical Character Recognition (OCR) to extract textual and spatial information, followed by layout-aware document understanding using transformer-based models such as LayoutLMv3 to construct structured semantic representations of invoice entities. Unlike traditional systems that produce static outputs, the framework introduces an instruction interpretation layer that enables users to specify requirements in natural language, which are transformed into semantic intent representations to dynamically guide schema generation and downstream data transformation processes. Furthermore, a hybrid extraction strategy combining rule-based validation with model-assisted inference is employed to enhance robustness and accuracy in handling noisy and unstructured documents. The vendor-agnostic design enables seamless adaptation to heterogeneous invoice formats without manual template configuration. Experimental evaluation on multi-vendor cab invoice datasets demonstrates improved flexibility, reduced manual effort, and effective handling of structural variability, providing a scalable and extensible solution for intelligent document processing in enterprise finance and analytics systems.

Keywords: Invoice Data Extraction; Intelligent Document Processing; Adaptive Schema Generation; Instruction-Guided Systems; Layout-Aware Document Understanding; LayoutLMv3; OCR; Multimodal AI; Dynamic Data Structuring; Expense Analytics

AI PRIVACY SHIELD: PROTECTING DIGITAL IDENTITY FROM INTELLIGENT SYSTEMS

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Abstract

The rapid evolution of artificial intelligence has intensified concerns regarding digital privacy, particularly with the widespread use of facial recognition systems, deepfake generation, and large-scale data scraping techniques. This paper presents AI Privacy Shield, a comprehensive and scalable framework designed to protect user images from AI-driven threats through an integrated, multi-layered approach. The proposed system combines adversarial perturbation techniques to disrupt facial recognition models, deepfake immunisation mechanisms to prevent misuse in generative adversarial networks, and invisible watermarking for secure ownership verification and traceability. In addition, an AI profiling module is incorporated to analyse visual attributes and provide insights into how machine learning models interpret user data, thereby enhancing transparency and awareness. The system is implemented as a full-stack web application featuring a responsive interface with adaptive dark and light modes, ensuring an intuitive user experience. A robust backend architecture integrates modular AI components and supports efficient, secure data processing. A dedicated privacy evaluation mechanism quantitatively measures the effectiveness of applied protection techniques using metrics such as recognition confidence reduction and perceptual similarity. Experimental evaluation demonstrates that the proposed framework significantly reduces identification accuracy while preserving visual quality. Furthermore, the integration of anti-scraping detection and data poisoning strategies enhances resilience against unauthorised data collection and misuse. Overall, the proposed system provides a practical, efficient, and user-centric solution for safeguarding digital identity in modern AI ecosystems.

Keywords: Artificial Intelligence; Privacy Preservation; Adversarial Machine Learning; Deepfake Immunisation; Facial Recognition; Data Poisoning; Image Watermarking; AI Security; Digital Identity Protection; Computer Vision

AI-BASED MONITORING, DETECTING AND TRACKING OF DRUG TRAFFICKING IN ENCRYPTED SOCIAL MEDIA

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Abstract

The rapid development of encrypted social media platforms has transformed digital communication while enabling illicit activities such as drug trafficking. The widespread use of end-to-end encryption, anonymity, and ephemeral messaging creates significant challenges for traditional surveillance and law enforcement systems. Traffickers exploit these platforms using coded language, slang, emojis, and indirect communication, making conventional keyword-based detection methods ineffective. This paper proposes an intelligent, scalable, and privacy-preserving framework for detecting and tracking drug trafficking activities without decrypting private messages. The system focuses on analysing publicly available data, metadata, and behavioural patterns. It integrates Natural Language Processing (NLP) with machine learning techniques to identify suspicious textual patterns. Text data is processed using feature extraction methods such as TF-IDF and contextual embeddings for accurate classification. The framework also employs a multimodal approach by incorporating behavioural analytics and graph-based network analysis. Features such as interaction patterns and temporal anomalies are used to detect suspicious behaviour, while network analysis helps identify hidden connections. An ensemble model improves detection accuracy and reduces false positives. Experimental results demonstrate high performance and scalability, making the system suitable for real-world cybercrime investigations while ensuring user privacy.

Keywords: Drug Trafficking Detection; Encrypted Social Media; Natural Language Processing; Machine Learning; Behavioural Analysis; Network Analysis; Anomaly Detection; Privacy-Preserving Systems

SAFE SIGHT: AN AI-BASED CCTV MONITORING SYSTEM FOR REAL-TIME VIOLENCE DETECTION USING DEEP LEARNING AND CLIP

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Abstract

Security concerns in public environments necessitate advanced surveillance solutions. Traditional CCTV systems rely entirely on human operators, leading to fatigue-induced delays and missed incidents. This paper presents Safe Sight, an AI-powered CCTV monitoring system for real-time violence detection using OpenAI's CLIP (Contrastive Language-Image Pre-training) model. The system processes live video streams from multiple IP cameras, classifying each frame into three threat levels—Danger (≥ 0.8), Warning (≥ 0.6), and Safe (< 0.6)—based on computed violence probability scores. Colour-coded visual alerts, audio notifications, and timestamp overlays are generated automatically. A Tkinter-based GUI supports simultaneous multi-camera monitoring with real-time status indicators. The system is implemented using Python, PyTorch, OpenCV, and Hugging Face Transformers with GPU acceleration. Functional, performance, and user acceptance testing confirmed high classification accuracy, sub-second alert response, and stable multi-stream operation.

Keywords: CCTV surveillance; violence detection; deep learning; CLIP model; real-time monitoring; computer vision; artificial intelligence; OpenCV; Tkinter.

INTELLIGENT COLLEGE MANAGEMENT SYSTEM: AN AI-POWERED PLATFORM FOR ACADEMIC ADMINISTRATION AND AUTOMATION

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Abstract

Traditional college administration systems often face challenges such as manual record management, lack of centralized data access, and inefficient communication between students, faculty, and administrators. The proposed College Management System (CMS) aims to create a unified digital platform that automates academic and administrative processes within an educational institution. The system enables efficient management of student records, faculty details, course information, attendance tracking, and study material distribution. Role-based access control is implemented to provide different levels of access for Admin, HOD, Faculty, and Students, ensuring secure and organized data handling. Faculty members can upload subject materials and monitor student engagement, while students can access learning resources and important announcements anytime. The system also provides reporting and monitoring features that help administrators analyze academic activities and institutional performance. By digitizing these processes, the CMS reduces manual workload, improves data accuracy, and enhances communication across departments. Overall, the proposed system aims to improve institutional efficiency and provide a scalable solution for modern educational management.

Keywords*:*College Management System; Backend Architecture; Educational Administration; API Integration; Campus Digitization; Data Centralization; Modular Framework

AI-ASSISTED COMPLAINT MANAGEMENT PORTAL

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Abstract

Managing citizen complaint in city municipalities has always been a challenge. Staff receive complaints on paper or through municipal portal, then manually decide where to send them and taking decision often takes hours or even days. There is no countdown, no deadline, and no one checking whether the issue was actually fixed. Complaints may expire in inboxes. This work presents the AI-Assisted Municipal Complaint Management Portal, a system we built to replace that inefficient process with something that actually works. When someone's complaint is submitted on the web portal, our system reads the text through a Natural Language Processing (NLP) module that checks out the service type whether it involves water, sanitation, electricity, roads, streetlights, garbage, or transport. Then classification happens instantly, and the specific department officer gets the complaint assigned to them. There is no queue, no batch, no delay. After submission of the complaint, a Service Level Agreement (SLA) timer starts based on the type of service ranging from 24 hours for water and sewage to 7 days for road damage. Every citizen gets that same clock no matter their location or identity. When an officer lets a deadline pass, the system automatically escalates the complaint to the CM Cell on its own. If the CM Cell misses their deadline too, it goes straight to the District Collector. At every step, the officer gets a warning and the citizen gets notified. The system monitors for patterns if multiple people from the same area report the same issue, the area gets flagged on the officer dashboard. No complaint falls through the cracks.

Keywords: complaint management, municipal services, NLP classification, SLA enforcement, auto-escalation.

AI-BASED VOICE CONTROLLED SMART WASTE MANAGEMENT SYSTEM FOR ELDERLY AND DISABLED PEOPLE.

Abstract

This paper presents an AI-based voice-controlled smart waste management system designed to support elderly and physically challenged people. In traditional waste disposal systems, users need to bend or touch the dustbin, which creates difficulty for aged people and individuals with physical disabilities. To overcome this issue, a touch-free and voice-controlled movable dustbin is proposed in this work. The system operates using voice commands, ultrasonic sensors, and a microcontroller-based control unit.

When the user gives a voice command, the dustbin automatically moves toward the user and the lid opens without physical contact. This improves hygiene, reduces human effort, and provides a user-friendly waste disposal system. The proposed model is developed using Arduino, ultrasonic sensors, servo motors, and a voice recognition module. The system is low-cost, easy to implement, and suitable for smart homes and healthcare environments. Experimental testing shows that the system works effectively with high accuracy in voice recognition and automatic lid operation. The system can be further improved by integratingIoT technology and mobile applications in future work.

THE SINGLE WINDOW APPROVAL SYSTEM FOR THE ENTREPRENEURS

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Abstract

The Single Window Approval System for Entrepreneurs is a digital platform designed to simplify and accelerate the process of obtaining business-related approvals and licenses. Traditionally, entrepreneurs face significant challenges due to complex procedures, multiple regulatory bodies, and time-consuming documentation. This system integrates various government departments into a unified interface, enabling users to submit applications, track progress, and receive approvals through a single portal. By leveraging modern technologies such as cloud computing and secure data management, the system ensures transparency, efficiency, and reduced administrative burden. It minimizes delays, eliminates redundant paperwork, and enhances ease of doing business, particularly for startups and small enterprises. Additionally, the platform supports real-time status updates, automated notifications, and centralized document storage, improving communication between applicants and authorities. The Single Window Approval System not only fosters a business-friendly environment but also contributes to economic growth by encouraging entrepreneurship and investment. Overall, it serves as a crucial step toward digital governance and streamlined regulatory processes.

Key Words: Single Window System; Entrepreneur Support; Business Approvals; Digital Governance; Ease of Doing Business; Regulatory Integration; Online Licensing; Process Automation; Startup Ecosystem.

MACHINE LEARNING-BASED CYBERBULLYING DETECTION USING TWITTER DATASET

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Abstract

The cyberbullying detection system is a software application created to spot cyberbullying in text-based interactions, including emails, chat chats, and social media posts. The system analyses the input language using natural language processing (NLP) techniques to see if it contains any signs of cyberbullying. The system employs sentiment analysis through various machine learning methods, including Decision Tree Classifier, Stochastic Gradient Descent (SGD) Classifier, Random Forest Classifier, Logistic Regression, Multinomial Naïve Bayes and Linear Support Vector Classifier (SVC). to find patterns and signs of cyberbullying in the input text. These methods are developed using a dataset of text classified as including or excluding cyberbullying. The most accurate algorithm, which can reliably identify cyberbullying in text, is picked for model development. The Flask Framework is used to build the system's backend connectivity. It offers resources and frameworks for creating web applications, including routing, processing requests, and rendering templates. The user enters text into the cyberbullying detection system, which machine learning models and NLP algorithms subsequently examine. The machine learning models are used for cyberbullying detection in text-based exchanges, and the Flask framework is used for backend connectivity. The algorithm detects cyberbullying once it has examined the input text, and the categorization outcome is shown on the screen.

Keywords: Cyberbullying Detection; Natural Language Processing (NLP); Sentiment Analysis; Machine Learning Classifiers; Text Classification; Flask Web Framework; Supervised Learning Dataset.

FAKE PROFILE DETECTION IN SOCIAL NETWORKS

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Abstract

The rapid growth of social media platforms has led to an increase in the creation of fake profiles, which are often used for malicious activities such as identity theft, spreading misinformation, and online fraud. This project focuses on the detection of fake profiles using data analysis and machine learning techniques. The system analyzes various profile attributes such as username patterns, profile activity, number of followers, posting behavior, and account age to identify suspicious characteristics.

By applying classification algorithms, the model distinguishes between genuine and fake accounts with improved accuracy. The project also involves data preprocessing, feature extraction, and model evaluation to enhance detection performance. The proposed system aims to provide an efficient and automated solution to reduce fake accounts on social platforms, thereby improving user trust and online security.

Overall, this mini project demonstrates how intelligent systems can be used to tackle real-world cyber security challenges and contributes toward creating a safer digital environment.

Keywords: Fake profiles; Social networks; Machine learning; Data analysis; Cyber security.

AGENTIC GMAIL MCP

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This project presents a Gmail automation system built using the Model Context Protocol (MCP), enabling seamless interaction between AI agents and Gmail services. The system allows users to perform various email operations such as reading, sending, searching, forwarding, and managing emails through natural language commands.

At its core, the architecture integrates a Large Language Model (LLM) with an MCP server that functions as an intelligent controller. The LLM interprets user intent from conversational input, while the MCP layer maps these intents into structured tool calls. These tool calls interact with the Gmail API using secure OAuth 2.0 authentication, ensuring safe and authorized access to user data.

The system includes a set of modular tools such as email retrieval, metadata extraction, full-body parsing, email forwarding, and status modification (e.g., marking emails as read or moving them to trash). It also implements token management and automatic credential refreshing to maintain persistent sessions without requiring repeated user authentication.

By combining AI-driven intent understanding with robust API integration, the Gmail MCP system simplifies email management workflows, enhances productivity, and demonstrates a scalable approach for building intelligent, tool-augmented AI assistants.

Keywords: Gmail automation; Model Context Protocol (MCP); Large Language Model (LLM); Gmail API; OAuth 2.0; Natural Language Processing; AI assistants

KINEMIDI: A CROSS-MODAL FRAMEWORK FOR GENERATIVE SYMBOLIC MUSIC FROM HUMAN MOTION

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Abstract—

While cross-modal synthesis has seen significant progress in Music-to-Dance generation, the inverse task of mapping continuous human motion to structured, multi-track symbolic music remains underexplored. We present KineMIDI, a framework for generating symbolic music conditioned entirely on visual kinematics. The system extracts real-time 3D skeletal data via convolutional neural networks and applies a novel "Hips-Centering" normalization technique to ensure scale and depth invariance. By calculating the second temporal derivative of joint motion, KineMIDI isolates visual rhythmic peaks to construct a dense, 199-dimensional kinematic condition vector for each frame. This sequence conditions a custom 15.1-million-parameter Transformer-Encoder architecture. To counteract temporal audio drift, we introduce a Biased Attention Masking algorithm that aligns generated MIDI velocity spikes directly with physical acceleration peaks. Implemented within an asynchronous, multithreaded pipeline, the system maintains sub-second synchronization. Evaluations against heuristic approaches, Recurrent Neural Networks (RNNs), and baseline Transformers demonstrate that KineMIDI achieves superior beat alignment, generative robustness, and computational efficiency, offering a practical method for algorithmic composition and interactive performance.

INTELLIGENT SPEECH SMOOTHING AND GENERATION SYSTEM FOR MENTALLY CHALLENGED PEOPLE

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ABSTRACT

Speech disorders in intellectually challenged people lead to ambiguous pronunciation, causing communication difficulties. This paper introduces an *IntelligentSpeech Smoothing* **System** that uses machine learning to predict the speaker's intended sentence from the distorted speech. The system comprises data preprocessing, speech augmentation, feature extraction, and intent classification. The proposed system preprocesses the speech data and augments it with noise addition, speech rate modification, and pitch changes.

The system extracts features from the preprocessed speech using the encoder of a pre-trained Whisper model. The features are then used to train a multi-class Logistic Regression classifier for predicting the intended text. The system also includes a Stream lit-based web application for real-time audio input and visualization of the smoothed output sentence.

The experimental outcome verifies that the system is capable of successfully detecting the intended speech with promising accuracy even with a small training dataset

COMPUTATIONAL INTELLIGENCE APPROACHES FOR PREDICTING DIABETES IN A CITY-LEVEL HEALTHCARE DATASET

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Abstract*:*

This research paper aims to evaluate the precise and timely prediction of diabetes, which is crucial for effective clinical management and intervention strategies. This study examines the efficacy of Logistic Regression, Random Forest, and Support Vector Machine (SVM) models utilising a dataset comprising 769 patients from Chennai to evaluate their predictive capabilities. The findings demonstrate that SVM attains the highest accuracy rate (78%), followed by Logistic Regression (77%) and Random Forest (76%), with no statistically significant difference observed ($p = 0.3484$) among the models. Although SVM presents a marginally superior classification performance, Logistic Regression offers interpretable risk factors, rendering it advantageous for clinical decision-making processes. Random Forest contributes to the identification of pivotal predictors that influence diabetes risk. These outcomes imply that machine learning models can facilitate early screening and personalised treatment strategies in the management of diabetic patients. Further enhancements incorporating additional clinical parameters may augment prediction accuracy, thereby benefiting medical practitioners in risk assessment and patient management.

Keywords: Diabetes prediction, Machine learning, Support Vector Machine, Logistic Regression, Random Forest, Clinical decision-making, Risk assessment.

REAL-TIME AMBULANCE COORDINATION AND TRACKING SYSTEM

ABSTRACT

- The need for faster emergency medical response has increased the importance of technology-based ambulance management systems. Traditional methods often cause delays due to manual communication and lack of coordination among stakeholders.
- The Smart Ambulance System – Enhanced Version is developed as a real-time, web-based platform that connects patients, drivers, hospitals, and traffic authorities through a centralized server.
- It captures the patient's GPS location, assigns the nearest ambulance, and provides continuous ETA updates using Leaflet-based tracking. Severity alerts help hospitals prepare in advance, while automated SMS and email notifications improve communication.
- Secure access is maintained through Email OTP authentication, and MongoDB ensures reliable data storage. The system demonstrates improved response time, coordination, and efficiency compared to conventional ambulance services**.**

AI-DRIVEN ADMISSION MANAGEMENT AND FACULTY TRACKING SYSTEM

Many engineering and polytechnic institutes face a massive number of inquiries during admissions, which are difficult to manage through traditional methods such as phone calls, emails, or in-person meetings. To address this, we developed an AI-powered chatbot that serves as a 24/7 virtual assistant, responding to queries related to admissions, eligibility, fees, scholarships, curriculum, hostel facilities, and placements. Using Natural Language Processing (NLP), the chatbot supports both text and voice communication in multiple languages. Other features include an RFID-based staff availability tracking system, in which faculty members tap their ID cards on a wall-mounted scanner (ESP32 with MFRC522) as they enter their cabins, and a virtual campus tour with navigation similar to Google Maps. This enables students to verify faculty presence prior to a visit by updating their real-time availability to a central database that is accessible through the chatbot. In higher education institutions, the system dramatically lowers administrative workload, increases user satisfaction, and improves information exchange and retrieval efficiency.

DISEASE RISK PREDICTION USING ML

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Abstract:
Heart disease is one of the leading causes of death worldwide, making early detection essential for preventive healthcare. This paper presents a web-based Heart Disease Risk Prediction System using Logistic Regression to estimate risk probability and classify patients into low, moderate, and high-risk categories. The system integrates Explainable AI techniques to highlight key contributing factors influencing predictions. Interactive visualizations are used to improve interpretability, while personalized recommendations and downloadable reports enhance user engagement and decision-making. The proposed system aims to provide accurate, interpretable, and user-friendly risk assessment to support early diagnosis and preventive healthcare strategies.

Keywords: Heart Disease Prediction, Logistic Regression, Risk Stratification, Preventive Healthcare, Clinical Decision Support, Web-Based Application, Personalized Health Recommendation

"AI BASED PDF AND DOCUMENTATION SYSTEM"

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Abstract

This project presents an AI-Powered Documentation system that integrates document editing, PDF manipulation & intelligent automation within a single application. The system includes a word processor, style document edition and a PDF editor capable of modifying, merging & converting a document. It further incorporates utility tools such as hand written to text conversion and text to PDF. Recent advancements in Natural Language Processing (NLP) have enabled the development of AI-powered systems capable of generating, summarizing, and structuring documentation and reports with high accuracy and efficiency. AI components are embedded to enhance the overall document workflow. The overall document correction, sentence generation, page alignment optimized and automated report production. The combination of traditional editing tools with AI-based enhancements significantly improves efficiency, reduces manual workload & supports the creation of accurate and professional documents. This system is intended to serve users in educational, corporate and administrative environment requiring reliable document processing solution

Keywords

Artificial Intelligence; Documentation Systems; Report Generation; Large Language Models; Summarization; Natural Language Generation; PDF operations; API; Formatting.

AN EFFICIENT AND EXPLAINABLE DEEPFAKE DETECTION SYSTEM USING DEEP LEARNING

ABSTRACT

The rapid advancement of artificial intelligence has enabled the creation of highly realistic manipulated facial images, commonly known as deepfakes, posing severe threats to digital trust, media authenticity, and public security. This paper presents an efficient and explainable deepfake detection system that combines Convolutional Neural Networks (CNNs) and Vision Transformer architectures to accurately distinguish real facial images from synthetically manipulated ones. The proposed system employs MTCNN for precise face detection and alignment, followed by feature extraction using a hybrid framework comprising CSWin Transformer, InceptionV3, and Xception models to capture both local facial artifacts and global manipulation patterns. The extracted feature maps are aggregated using Global Average Pooling to produce compact feature vectors, which are subsequently classified using a Softmax-based fully connected layer trained end-to-end with categorical cross-entropy loss. To enhance transparency and user trust, Explainable AI techniques including SHAP and LIME are integrated to generate heatmaps and visualize the regions influencing model decisions. The system addresses key challenges such as dataset bias, overfitting, and poor generalization across diverse deepfake generation methods. Experimental results demonstrate that the proposed system achieves reliable detection performance with an AUC of 0.7329, delivering a robust, interpretable, and scalable solution suitable for real-world media verification and security applications.

Keywords—Deepfake Detection, Deep Learning, Vision Transformer, CNN, Explainable AI, SHAP, LIME, MTCNN, Face Manipulation.

ABSTRACT

The rapid increase in smartphone usage among children has led to significant concerns such as excessive screen dependency, reduced physical activity, limited social interaction, and rising emotional stress. Continuous and unregulated exposure to digital devices negatively affects cognitivedevelopment and overall well-being, creating challenges for parents in monitoring and managing their child's digital behavior. Existing parental control systems primarily focus on screen-time restriction and content filtering; however, they lack intelligent behavioral analysis, emotional awareness, and adaptive engagement mechanisms. To address these limitations, this paper proposes Zen Safe, an AI-driven mobile-based digital well-being system integrated with cloud technologies for real-time monitoring, behavioral analysis, and personalized intervention. The system continuously analyzes user interaction patterns, including screen time, application usage, and activity frequency, to detect excessive usage and emotional imbalance. Based on the detected behavioral state, it provides context-aware interventions such as educational micro-tasks, creative activities, cognitive exercises, and scheduled break reminders. An interactive assistant module offers real-time guidance and communication support, while a reward-based reinforcement system using points and badges encourages children to adopt healthier digital habits. Additionally, a cloud-integrated parental dashboard enables remote monitoring and provides meaningful behavioral insights for informed decision-making. Experimental results demonstrate an emotion detection accuracy of 94.6%, along with a reduction in excessive screen usage and increased engagement in productive offline activities, highlighting the effectiveness of the proposed system in promoting digital well-being.

VECHILE DAMAGE ASSESSMENT FOR INSURANCE CLAIM

Abstract

This mini project proposes a vehicle damage assessment system for insurance claims, utilizing AI tools for image processing and machine learning. The system processes vehicle images, detects damaged parts, and classifies damage types and severity levels. A structured damage report, along with estimated costs, is generated for efficient claim processing. To increase accuracy and trust, a human-in-the-loop approach is incorporated, where insurance experts approve the results of the AI tools. The proposed system minimizes claim processing time, ensuring customer satisfaction in insurance claim management. show the result of humanize content or not and percentage

THE RECYCLEBOTS: AN AI-DRIVEN SMART WASTE SEGREGATION SYSTEM

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Abstract

Effective waste management is a persistent challenge in residential and institutional settings, primarily due to inadequate segregation and dependence on manual processes. This paper presents an intelligent smart bin system that integrates Artificial Intelligence (AI) and Internet of Things (IoT) technologies to enable automated and real-time waste classification and sorting. A deep learning model based on MobileNetV2 is utilized to classify waste into biodegradable, non-recyclable, and recyclable categories, achieving an overall accuracy of 98.52%. The performance of the model is validated using a confusion matrix and classification metrics, demonstrating strong predictive capability, with biodegradable waste achieving a precision of 1.00 and recall of 0.99, non-recyclable waste achieving a precision of 0.90 and recall of 0.99, and recyclable waste achieving a precision of 0.90 and recall of 0.95. The system is further supported by the integration of multiple sensing units, including ultrasonic, proximity, weight, and metal sensors, ensuring robust detection and monitoring. A servo-actuated mechanism facilitates precise and automated segregation into designated compartments. In addition, an IoT-enabled framework provides continuous monitoring of bin status and operational conditions. The proposed approach enhances segregation efficiency, minimizes human involvement, and offers a scalable and economically viable solution for deployment in smart homes, Institutional environments and smart city infrastructures.

Keywords: Smart Waste Management; Artificial Intelligence; IoT; MobileNetV2; Waste Segregation; Smart Bin

SIGNATURE FORGERY DETECTION USING SIAMESE NETWORK AND BLOCKCHAIN

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ABSTRACT

Signature verification plays a critical role in identity authentication across various domains such as banking, legal documentation, government services, and digital transactions. However, traditional verification methods based on manual inspection or handcrafted feature extraction are often time-consuming, inconsistent, and incapable of detecting skilled forgeries. With the increasing sophistication of forgery techniques, there is a pressing need for an automated, accurate, and secure verification system.

This paper proposes an intelligent signature forgery detection system using a deep learning-based Siamese Network integrated with blockchain technology. The Siamese Network is designed to learn similarity patterns between genuine and forged signatures by extracting high-level feature embeddings and computing a similarity score. Unlike conventional classification models, this approach effectively identifies even highly skilled and visually similar forgeries. The system preprocesses input signatures through grayscale conversion, resizing, normalization and dimensional alignment.

To address the issue of data integrity and security, blockchain technology is incorporated for storing verification results. Each verification outcome, along with user identity and timestamp, is securely recorded in a tamper-proof distributed ledger, ensuring transparency, immutability, and traceability. Additionally, a user-friendly interface is developed using Streamlit, enabling seamless enrollment and real-time verification of signatures. Experimental results demonstrate that the proposed Siamese Network significantly outperforms traditional CNN-based models in terms of accuracy and loss metrics, achieving high validation accuracy in detecting forged signatures. The proposed framework offers a reliable, automated, and secure solution for signature verification, addressing the limitations of existing systems. Its applications extend to banking, legal authentication, forensic analysis, healthcare documentation and digital identity verification, thereby contributing to enhanced security and fraud prevention.

Keywords: Signature Forgery Detection, Siamese Network, Deep Learning, Blockchain, Image Processing, Authentication

Reference: Dr.Jaishanthi, Department of CSE, Tagore Engineering College

SIGN2SPEAK: ASL TO VIDEO AND SPEECH GENERATOR USING DEEP LEARNING

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Abstract

Hearing impaired people find it difficult to communicate with the rest of the population because of less knowledge about sign language. It is this communication gap which can cause social isolation and impairment of access to important services. The proposed project is a vision based system that converts sign language gestures into text, speech and an animated avatar output in real time in order to provide a more natural and effective interaction. The system leverages a webcam to provide live video input and therefore, the solution does not demand any special hardware and thus, economical and easily implemented. MediaPipe is used in efficient hand detection and proper extraction of hand landmarks to give a structured representation of the hand gestures. The resultant features are then inputted into a Convolutional Neural Network (CNN) which is trained to classify and identify sign language gestures with a high level of accuracy. The use of deep learning techniques enhances the system's ability to handle variations in hand shapes, orientations, and environmental conditions. After recognizing the gestures, they are translated into textual results that are then converted to speech with the help of Text to Speech (TTS) technology. Besides the text and audio output, the system also produces a video output as an animated avatar which visually depicts the speech that has been recognized and makes the communication process more interactive and human like. The suggested system is real time and allows immediate feedback and facilitates the seamless communication process. It is a combination of ideas in computer vision, deep learning, and human computer interaction to provide an efficient and user friendly solution. As a whole, the given project will contribute to the creation of assistive technologies that facilitate inclusive communication and assist in filling the gap between the hearing impaired population and society.

Keywords: ASL to speech convertor; Deep learning; OpenCv; Convolutional Neural Network; Text to Speech technology; Accessibility; Machine learning.

SAFEJACK: AN ESP32-BASED IOT WEARABLE CYBER-PHYSICAL SYSTEM FOR REAL-TIME CONSTRUCTION WORKER SAFETY MONITORING USING MQTT, AWS CLOUD, AND MACHINE LEARNING

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Abstract

Construction sites are inherently hazardous environments characterized by dynamic operational conditions, exposure to toxic gases, and elevated risks of physical injury. Traditional safety monitoring approaches rely on manual supervision and periodic inspection, which are insufficient for real-time hazard detection and proactive intervention. This paper presents SAFEJACK, an Internet of Things (IoT)–enabled wearable cyber-physical system designed to enhance construction worker safety through continuous environmental and physiological monitoring, cloud-based analytics, and machine learning–driven hazard prediction. The system utilizes an ESP32 microcontroller integrated with gas sensors (MQ-7, MQ-4, MQ-136), BMP280 pressure sensor, DS18B20 temperature sensor, MPU6050 accelerometer for fall detection, and NEO-6M GPS module for location tracking. Sensor data are transmitted using the MQTT protocol to AWS IoT Core, where they are stored in AWS DynamoDB and Amazon S3 for scalable cloud processing. Machine learning algorithms implemented using Python and Scikit-learn perform anomaly detection and predictive safety analysis. Additionally, computer vision techniques using OpenCV enable construction progress monitoring and defect identification. Real-time visualization is provided through Microsoft Power BI dashboards, enabling stakeholders to monitor worker safety and site conditions continuously. Experimental results demonstrate hazard detection accuracy of 95.8% and system latency below 200 ms. The proposed system enhances situational awareness, enables proactive risk mitigation, and contributes to intelligent, data-driven construction safety management.

Keywords : Internet of Things (IoT) ; ESP32 ; Wearable Safety Systems ; MQTT ; AWS IoT Core ; Machine Learning ; Computer Vision ; Cyber-Physical Systems ; Construction Safety

AUTOMATED AI-BASED RESUME TRACKER AND INTELLIGENT INTERVIEW WITH CBERT AND MEDIA PIPE & SPEECH RECOGNITION

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Abstract

Traditional hiring processes often struggle with the subjective nature of interviews and the manual burden of screening diverse resume formats. This paper proposes an **Automated AI-Based Resume Tracker and Intelligent Interview System**, a multimodal framework designed to standardize and enhance candidate evaluation. The system utilizes **CBERT (Clinical/Conditional BERT)** for high-precision resume parsing and skill extraction, enabling a semantic matching engine to calculate eligibility scores against job descriptions.

To bridge the gap between screening and final selection, the system integrates an **Intelligent Interview Assistant** powered by a Large Language Model (LLM). This module employs **Speech Recognition** to transcribe candidate responses in real-time, allowing for deep linguistic analysis of technical accuracy and communication clarity. Simultaneously, **MediaPipe** is utilized for computer vision-based behavioral analysis, tracking facial landmarks and gestures to quantify non-verbal cues such as confidence and engagement levels. By fusing textual data from CBERT with visual and auditory metrics from MediaPipe and Speech Recognition, the proposed system provides a comprehensive, unbiased, and scalable solution for modern recruitment, ensuring higher data accuracy and a streamlined experience for both recruiters and candidates.

Keywords: AI Recruitment Automation; CBERT Resume Parsing; MediaPipeBehavioral Analysis; Speech Recognition; Multimodal Candidate Evaluation; Skill Gap Analysis; Intelligent Interview Assistant; Natural Language Processing; Computer Vision in HR.

RAILWAY TRACK CRACK DETECTION USING ACOUSTIC WAVES

ABSTRACT

Keeping railway tracks in good condition is essential for the safe and smooth operation of trains. Cracks that remain undetected can cause major accidents, delays in service, and heavy financial losses. This project proposes an IoT-based railway track crack detection system that uses acoustic wave propagation to identify faults at an early stage with better accuracy. In this system, sensor nodes are installed along the railway track. Each node includes a piezoelectric sensor that sends acoustic waves through the rail and a microphone sensor that receives those waves after they travel through the structure. The data is then uploaded to the Blink IoT cloud, where it can be monitored, stored, and analyzed in real time. A user interface is developed to classify the condition of the track as minor, medium, or major cracks, helping maintenance staff understand the severity quickly and take action. An RFID module is also added to detect train arrival and departure, improving coordination and system awareness. Overall, the proposed system offers a cost-effective, non-destructive, and continuous monitoring solution that strengthens railway safety through early crack detection and remote access to information.

MEDIGUARD AI: A SECURE HEALTHCARE VIRTUAL ASSISTANT USING NLP AND BLOCKCHAIN

ABSTRACT

Traditional healthcare systems face challenges such as long patient waiting times, limited staff for initial triage, and risks to medical data security. MediGuard AI is proposed as an integrated healthcare ecosystem to automate patient interactions and strengthen data protection. The system uses Natural Language Processing (NLP) to provide 24/7 intelligent symptom checking and patient triage. It categorizes cases into Urgent, Consultation Required, or Home Care. To enhance security, MediGuard AI integrates a blockchain-based verification layer. The system uses SHA-256 hashing and BFT consensus for fast and reliable credential verification. Medical records are stored using Soulbound Tokens (SBTs) and IPFS to ensure authenticity and immutability. Privacy by Design is implemented through Trusted Execution Environments (TEE) to maintain end-to-end encryption. Similar frameworks show improved efficiency, especially in resource-constrained healthcare settings. Overall, MediGuard AI aims to reduce hospital administrative workload by about 40% while providing a secure, decentralized medical record system.

DATA SECURITY IN HEALTHCARE THE SAFETY OF DATA WITH CYBERSECURITY

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ABSTRACT

T he increasing reliance on digital technologies has made the healthcare sector a prime target for cyber-attacks. With the rising need for data security and compliance, this article examines the importance of cybersecurity in healthcare, the associated risks, and the strategies required to protect patient information and ensure continuity of care. Healthcare organizations are particularly vulnerable and targeted by cyber attacks because they possess so much information of highmonetary and intelligence value to cyber thieves and nation-state actors. The targeted data includes patients' protected health information (PHI). Cybersecurity is critical for patient safety; it has an unreliable track record. Breach of infrastructure has resulted in millions of health records being stolen, potentially putting patients' lives at risk. This necessitates the integration of Cybersecurityinto patient safety. Before these attacks, many security experts struggled to persuade corporate executive of the necessity of cybersecurity. Cybersecurity as a patient safety, enterprise risk, and strategic priority and instill it into the hospital's existing enterprise, risk management, governance, and business-continuity framework. The main aim of this paper is the development of recenttechniques applicable to crypt Analysis hash function, mainly from the SHAfamily. Recently proposed attack son MD5 & SHA motivate a new hash function design. It is designed not only to have higher security but also to be faster thanSHA-256.This method is very useful for attacking

DEEPFAKE DETECTION OF VIDEOS USING FACIAL AND TEMPORAL CUES WITH EXPLAINABLE AI

Abstract

The rapid advancement of **deepfake generation techniques** has raised serious concerns regarding **digital media authenticity, misinformation, and identity fraud.** Deepfakes leverage **deep learning models** to manipulate facial appearances invideos, making it increasingly difficult to distinguish real content from fake. This project focuses on **Deepfake Detection using Facial and Temporal Cues,** enhanced with **Explainable Artificial Intelligence (XAI)** to improve transparency and trust. The proposed system **analyzes video data** by extracting **facial regions from frames** and learning **spatial facial features** using **Convolutional Neural Networks (CNNs**).Additionally, **temporal in consistencies across consecutive frames,** such as unnatural eye blinking, lip movement, and facial motion artifacts, are captured using **temporal modeling techniques** like **LSTM-based aggregation.** The fusion of **spatial** and **temporal** features enables effective detectionofsubtle manipulationpatternsoftenmissedbyframe-based approaches. To address the **black-box nature of deep learning models, Explainable AI techniques** such as **Grad-CAM** are integrated to highlight facial regions influencing model decisions. This enhances **interpretability, reliability, and ethical deployment** of the system**.** The model is trained and evaluated on **video-based deepfake datasets** containing both authentic and manipulated samples. Experimental results demonstrate improved detection accuracy, contributing toward **robust, interpretable deepfake detection systems** for applications in **digital forensics, social media monitoring,** and **cybersecurity.**

FACIAL VIDEO BASED HEART RATE MONITORING

Abstract

Monitoring heart rate is essential for assessing cardiovascular health, detecting abnormalities, and supporting continuous wellness tracking. Traditional methods such as electrocardiograms (ECG) and pulse oximeters provide accurate measurements but rely on physical contact, making them intrusive and less suitable for long-term or everyday use. This project presents a real-time, non-contact heart rate monitoring system based on facial video analysis using remote photoplethysmography (rPPG).

The proposed system utilizes a standard webcam to capture facial video and applies computer vision and signal processing techniques to extract physiological signals. Face detection is performed using the Viola–Jones algorithm, while the forehead region is tracked using Lucas–Kanade optical flow to ensure stability. The extracted region undergoes spatial filtering, color normalization, and temporal band-pass filtering to enhance the photoplethysmographic signal. A Fast Fourier Transform (FFT) is then used to identify the dominant frequency, which is converted into heart rate in beats per minute (BPM).

The system is implemented in Python with a PyQt5-based graphical user interface that provides real-time visualization of heart rate, waveform, and spectral data, along with data logging capabilities. Experimental evaluation demonstrates reliable performance under controlled conditions, achieving low error rates when compared with standard pulse oximeters. This approach offers a cost-effective, user-friendly, and non-invasive solution for applications in telemedicine, fitness monitoring, and home-based healthcare.

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Abstract

The increasing demand for sustainable and efficient agricultural operations has accelerated the adoption of electric vehicles in farming applications. However, efficient energy management remains a major challenge due to dynamic load variations and limited energy availability in rural environments. This research proposes a multi-stage adaptive energy management control framework for efficient energy flow regulation in agricultural electric vehicles operating under dynamic conditions. The system integrates a hybrid energy architecture consisting of battery storage and renewable sources within a regulated DC bus structure. The primary objective focuses on a machine learning based controlled energy flow mechanism that dynamically allocates power based on state of charge, load demand, and source availability, improving system flexibility and utilization efficiency. Additionally, maintaining DC bus voltage within a stable operating range of 350-450 V under varying load and generation conditions. The proposed control strategy validates a reliable dynamic performance, achieving rapid transient response within 2-21.6 ms, convergence in 65-185 ms, and minimal transient deviation ranging from 0.9% to 2.94%. Simulation and experimental results validate improved stability, efficiency, and reliability, demonstrating suitability for next-generation agricultural electric vehicle applications.

Keywords*:* Machine Learning-Based Control; Adaptive Gain Scheduling; Transient Response Enhancement; Dynamic Convergence Analysis; System Stability and Reliability.

REAL-TIME DRIVER DROWSINESS DETECTION SYSTEM USING COMPUTER VISION AND DEEPLEARNING

Abstract

Driver drowsiness is one of the major causes of road accidents worldwide, as fatigue significantly reduces driver alertness, reaction time, and concentration. A large number of fatigue-related accidents occur during long-distance and late-night driving, where drivers often fail to recognize the early symptoms of drowsiness. Studies indicate that nearly 20–30% of road accidents are caused by driver fatigue, which highlights the urgent need for an intelligent and real-time monitoring system. Existing approaches based on manual observation, simple sensors, or single-feature detection methods often suffer from low accuracy, lack of reliability, and poor real-time performance. Therefore, an efficient, cost-effective, and automated driver drowsiness detection system is required to improve road safety and reduce accident rates.

This paper proposes a real-time Driver Drowsiness Detection System that continuously monitors driver alertness using computer vision and deep learning techniques. The proposed system detects fatigue by analyzing multiple facial features such as eye closure, yawning, and facial expressions using a standard webcam. It integrates Haar cascade-based face, eye, and mouth detection with deep learning-based prediction to improve detection accuracy and reliability. To minimize false detections, the system applies prediction smoothing over multiple frames along with confidence thresholding and state consistency checks. When signs of drowsiness are detected for a sustained period, the system generates an immediate audio alert to warn the driver and prevent possible accidents. Inaddition, a Mouth A spect Ratio (MAR)-based fallback mechanism is implemented to improve yawning detection even when prediction confidence is low.

The proposed framework addresses several research gaps found in existing systems, such as lack of multi-feature detection, poor adaptability to different types of vehicles, and high implementation cost. The system is light weight, easy to deploy, and does not require specialized hardware, making it suitable for personal vehicles, commercial vehicles, and long-distance transport systems. Experimental results demonstrate that the system can successfully detect eye closure and yawning in real time using a standard webcam. The combination of deep learning predictions with Haarcascade-based feature detection improves overallaccuracy, while frame-based smooth ingreduces false alerts. The proposed system provides apractical, non-intrusive, and real-time solution for driver monitoring and accident prevention.

SMART HERITAGE TOURISM ASSISTANT FOR TAMIL NADU USING LLM

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Abstract

Tamil Nadu has thousands of heritage monuments, yet many tourists visit only a limited number of well-known locations because detailed and easily accessible information is often unavailable during travel. To address this issue, this project presents a Smart Heritage Tourism Assistant for Tamil Nadu using LLM, an AI-powered web application designed to make heritage exploration more informative, interactive, and user-friendly. The system acts as a personal digital guide by combining Artificial Intelligence, GPS location tracking, and bilingual voice interaction in both English and Tamil. It enables users to discover nearby heritage sites, browse detailed cultural and historical information, and ask questions through a conversational interface. The application currently includes 30 important heritage sites across 16 districts of Tamil Nadu, helping both domestic and international tourists explore beyond the commonly visited landmarks. The frontend of the application is developed using Next.js 14, providing a modern and responsive user interface, while the Web Speech API is used for speech-to-text and text-to-speech interaction. The backend is powered by the Cerebras Inference API with LLaMA 3.1-8B, enabling intelligent and context-aware responses. In addition, a Retrieval-Augmented Generation (RAG) approach is implemented to improve answer reliability and reduce the chances of incorrect or misleading information. Overall, this project demonstrates how modern AI technologies can be effectively used to support cultural tourism, enhance user engagement, and promote awareness of Tamil Nadu's rich historical heritage through a smart digital platform.

Keywords: Heritage Tourism; Large Language Model; Artificial Intelligence; Tamil Nadu; Next.js; RAG; GPS Tracking; Bilingual Voice Assistant; Cultural Preservation; Smart Tourism

MULTI-FACTOR AUTHENTICATION FRAMEWORK FOR THE SMART FACE ATTENDANCE SYSTEMS

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Abstract

The proposed framework introduces a multi-factor authentication (MFA) model for smart face attendance systems to enhance security and reliability in academic and organizational environments. Traditional attendance systems relying solely on facial recognition are vulnerable to spoofing attacks, proxy attendance, and environmental limitations. To address these challenges, the framework integrates facial recognition with secondary authentication factors such as OTP (One-Time Password) verification, RFID, or biometric cross-checks. The system leverages computer vision algorithms (e.g., OpenCV and FaceNet) for accurate facial identification, while OTP-based verification ensures that only authenticated individuals can confirm their presence. This dual-layered approach reduces false positives, prevents impersonation, and strengthens trust in automated attendance management. The framework is designed to be scalable, real-time, and user-friendly, making it suitable for deployment in educational institutions, corporate offices, and secure facilities. Experimental results demonstrate improved accuracy, reduced spoofing risks, and enhanced user confidence compared to single-factor systems.

Keywords: Smart Attendance System; Facial Recognition; Multi-Factor Authentication; Biometric Security; Spoofing Prevention; OTP; Device-Based Authentication; Data Privacy; Secure Access Control

HYBRID DEEP LEARNING APPROACH FOR DYNAMIC ETHEREUM FRAUD DETECTION

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Abstract

Ethereum, a prominent blockchain platform, facilitates digital asset transactions through its decentralized network. However, this decentralization also opens avenues for fraudulent activities, posing serious challenges to network security and integrity. This phase focuses on analyzing Ethereum transaction data, identifying patterns of fraudulent behavior, and establishing a foundation for an intelligent fraud detection framework. The mechanism involves data collection, preprocessing, feature selection, and statistical analysis to understand how fraudulent transactions differ from legitimate ones. Techniques such as correlation analysis, feature normalization, and outlier detection are applied to prepare high-quality input data for model development. To address these challenges, this work proposes a Hybrid Deep Learning Model for Ethereum Fraud Prediction (HDLM-EFP) that integrates a Customized Dense Neural Network and an LSTM-based Recurrent Neural Network to learn both complex and temporal transaction patterns. The next phase will implement the HDLM-EFP model with a fusion mechanism to enhance accuracy, incorporate SHAP for interpretability, and develop a Streamlit-based web interface for real-time fraud detection and visualization.

Keywords: Deep Learning; LSTM; Neural Network; Hybrid Model; Feature Selection; Outlier Detection

CLOUDLEARN LABS: SECURE CONTAINER BASED CLOUD LABORATORY PLATFORM

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Abstract

The advancement of cloud computing and containerization technologies has significantly improved access to computational resources. However, traditional academic laboratory environments in engineering institutions still rely on physical infrastructure, limiting accessibility, flexibility, and efficient resource utilization. Students are restricted by fixed lab schedules and system dependencies, which hinders continuous learning and experimentation. This project presents CloudLearn Labs, a cloud-based virtual laboratory management system that enables students to perform programming experiments through a web-based interface. The system allows secure execution of code within isolated Docker containers and provides persistent machine labs with browser-based development environments. Faculty members can create and manage structured laboratory exercises, while administrators oversee system operations through centralized controls. The proposed system enhances accessibility, scalability, and efficiency by eliminating dependency on physical labs. It ensures secure and reliable code execution, supports concurrent users, and delivers real-time feedback. The platform is developed using modern technologies such as React, FastAPI, Docker, and Firebase. Experimental results demonstrate stable performance, efficient handling of multiple users, and reliable execution outcomes. The system is scalable and suitable for real-world academic deployment, contributing to flexible and technology-driven learning environments.

Keywords: Cloud Computing; Virtual Labs; Docker; FastAPI; React; Firebase; Containerization

HYBRID CALL SECURITY INTELLIGENCE SYSTEM (HCSIS)

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Abstract

The increasing reliance on mobile and internet-based communication systems has amplified exposure to security threats, including man-in-the-middle attacks, rogue base stations, and vulnerabilities in Voice over Internet Protocol (VoIP) communications. Existing mobile security solutions primarily address either cellular networks or VoIP systems independently, thereby lacking a unified mechanism for comprehensive communication security monitoring. This paper presents the Hybrid Call Security Intelligence System (HCSIS), a multi-layered framework for real-time interception risk detection in hybrid communication environments. The proposed system integrates cellular network analysis, VoIP security evaluation, network condition monitoring, and device security posture assessment. A weighted risk scoring model is employed to correlate heterogeneous indicators and estimate the probability of call interception. The framework is designed to operate without requiring privileged device access, ensuring practical deployment on standard mobile platforms. Experimental evaluation through simulated environments demonstrates that the proposed approach improves detection capability and provides actionable user advisories under potentially compromised conditions. The proposed system offers a unified and scalable solution for mobile communication security and establishes a foundation for future advancements in telecom threat intelligence and real-time risk assessment systems.

MEWS: AN OPEN-DATA, INTERPRETABLE ENSEMBLE FRAMEWORK FOR EARLY WARNING OF SYSTEMIC MARKET RISK

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Abstract

Systemic market risk early warning remains an open challenge, as existing approaches often rely on proprietary data, produce opaque predictions, or lack rigorous empirical validation. This paper introduces MEWS (Market Early Warning System), an open-data ensemble framework designed for early detection of systemic market stress. MEWS leverages exclusively publicly available data sources, including equity prices and volatility indices, macroeconomic indicators and credit spreads, and financial news streams. The framework extracts three categories of features: (i) rolling realized volatility and maximum drawdown, (ii) FinBERT-based financial news sentiment, and (iii) rolling cross-asset correlation regimes. A calibrated ensemble model combines an interpretable rule-based heuristic scorer (35% weight) with a Random Forest classifier (65% weight), followed by isotonic calibration to produce a probabilistically interpretable risk score in the range [0, 1]. SHAP values are generated for each prediction to ensure explainability. MEWS is evaluated across four major historical crises: the 2008 Global Financial Crisis, 2011 Eurozone Crisis, 2020 COVID-19 market crash, and 2022 rate hike shock. Results demonstrate advance warning lead times of 11–25 business days, a false positive rate of approximately 7% at a 0.60 threshold, and a median false-alarm duration of 2–3 days. The ensemble consistently outperforms standalone heuristic and machine learning baselines across all evaluation metrics. The system is fully reproducible and implemented in Python using open-source libraries.

Keywords— Systemic risk; early warning systems; financial machine learning; ensemble methods; interpretable AI; FinBERT; open data

AN AI-BASED DECISION SUPPORT SYSTEM FOR SMART CROP RECOMMENDATION IN AGRICULTURE

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Abstract

To increase productivity and sustainability, agriculture needs to make decisions quickly and accurately. AgriSmart AI, a multifunctional decision support system that combines crop recommendation, fertilizer prediction, and plant disease detection into a single platform, is presented in this paper. To deliver data-driven agricultural insights, the system makes use of deep learning and machine learning models. Based on soil nutrients (N, P, and K) and environmental factors like temperature, humidity, pH, and rainfall, a Random Forest classifier is used to suggest appropriate crops. Using crop type, soil characteristics, and environmental factors, a Linear Regression model forecasts the ideal fertilizer needs. Using image data from the Kaggle Plant Disease Dataset, a convolutional neural network based on ResNet50 is used to detect plant diseases. Tensor Flow Lite is used to optimize the models for real-time inference, and the system is implemented as a mobile application interface. The outcomes of the experiments show consistent performance in every module. Precision agriculture decision-making is made possible by the integration of several models into a single system, which offers farmers a workable and accessible solution.

Keywords— Crop Recommendation; Machine Learning; Random Forest; Linear Regression; ResNet50; Precision Agriculture

CIVIL ENGINEERING

BEHAVIOUR AND PERFORMANCE OF CONCRETE CONTAINING SELF-HEALING BACTERIA

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Abstract

Concrete structures are vulnerable to microcracks caused by shrinkage, thermal stresses, and loading conditions. These cracks permit the ingress of water, chlorides, sulfates, and other aggressive agents, resulting in reinforcement corrosion and reduced durability. Bacterial self-healing concrete has emerged as an innovative and sustainable solution in which microorganisms precipitate calcium carbonate and seal microcracks automatically. In the present study, the performance of self-healing concrete incorporating three bacterial strains, namely Brevibacillus sp., Bacillus megaterium, and Microvirga sp., was investigated and compared with conventional concrete. M30 grade concrete was prepared using Ordinary Portland Cement, and bacterial cultures were incorporated into the concrete matrix. The selected bacteria were evaluated based on their growth characteristics and calcium carbonate precipitation capacity. Mechanical properties such as compressive strength, split tensile strength, and flexural strength were determined, along with durability properties including rapid chloride permeability, water absorption, and acid resistance. The results indicated that Brevibacillus sp. exhibited the highest calcium carbonate precipitation and showed superior performance among the bacterial strains studied. The bacterial concrete containing Brevibacillus sp. achieved a 28-day compressive strength of 36.87 MPa compared to 35.72 MPa for conventional concrete. Similar improvements were observed in split tensile and flexural strengths. Durability studies revealed a significant reduction in chloride permeability, water absorption, and loss of strength under acid exposure. The microbial induced calcium carbonate precipitation effectively filled pores and microcracks, thereby densifying the concrete matrix. The study concludes that bacterial self-healing concrete containing Brevibacillus sp. can be considered a promising and sustainable alternative to conventional concrete for enhancing strength, durability, and service life of structures.

Keywords: Acid resistance, Bacterial concrete, Compressive strength, Durability, Microbial induced calcium carbonate precipitation, Rapid chloride permeability, Water absorption.

ECO-FRIENDLY SOIL REINFORCEMENT USING BIO-BASED COCONUT LEAF GEOCELLS

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Abstract

The study presents the development and evaluation of a nature-based geocell wall system using woven coconut leaves as a sustainable alternative to conventional synthetic geocells. The increasing availability of coconut leaf waste and the need for eco-friendly construction materials have motivated this research. The proposed system utilizes treated coconut leaf strips woven into geocell panels, which are then used to reinforce soft clay beds. Experimental investigations were carried out using load–settlement tests in a model tank to assess the improvement in bearing capacity of reinforced soil relative to unreinforced conditions. Additionally, tensile strength tests were conducted to evaluate the load-carrying capacity and durability of the coconut-leaf geogrid. The results indicate that the natural geocell system enhances soil confinement, reduces settlement, and improves overall stability. The study highlights the potential of coconut-leaf geocells as a low-cost, biodegradable, and sustainable solution for geotechnical applications, such as rural roads, embankments, and foundations. This approach not only promotes the utilization of agricultural waste but also contributes to environmentally responsible infrastructure development and supports sustainable development goals.

Keywords: Coconut leaf; reinforcement; tensile strength, cohesionless soil

SUSTAINABLE PERFORMANCE EVALUATION OF TREATED RECYCLEDCOARSE AGGREGATE AND STUDY ON ITS STRUCTURAL BEHAVIOUR

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Abstract

The rapid depletion of natural aggregates and the growing accumulation of construction and demolition waste have intensified the need for sustainable materials in concrete production. This study investigates the structural performance of reinforced concrete (RC) beams incorporating recycled coarse aggregate (RCA) as a partial replacement for natural coarse aggregate, along with the effectiveness of aluminium-based retrofitting techniques. Recycled coarse aggregate obtained from demolished concrete is processed and evaluated for its physical properties, including specific gravity and water absorption. Concrete of M25 grade is prepared by replacing natural coarse aggregate with RCA at varying levels of 20%, 25%, 30%, 35%, and 40%.Standard procedures are followed for mix design, casting, curing, and testing. The performance of concrete is assessed through workability tests on fresh concrete and compressive strength tests on hardened specimens at different curing ages. In addition, selected RC beams are strengthened using aluminium mesh retrofitting in longitudinal U-wrap and full-wrap configurations to evaluate improvements in structural behaviour. The study examines key parameters such as cracking behaviour, load-carrying capacity, ductility, and failure modes. The results indicate that partial replacement of natural aggregate with RCA up to an optimum level of approximately 30%provides satisfactory strength with minimal reduction compared to conventional concrete. Furthermore, aluminium mesh retrofitting significantly enhances structural performance, with full-wrap configurations showing superior improvements in strength and ductility compared toU-wrap systems. This study highlights the combined benefits of recycled aggregate concrete and aluminium-based strengthening techniques, offering a sustainable, lightweight, and corrosion-resistant solution for improving the performance of RC structures. The findings contribute to the advancement of eco-friendly construction practices and the effective utilization of construction waste.

Keywords: Recycled coarse aggregate, Aluminium mesh retrofitting, RC beams, Sustainable construction, Compressive strength, Flexural behaviour, Ductility.

PERFORMANCE EVALUATION OF POLYMER-MODIFIED CONCRETE AS A SUSTAINABLE ALTERNATIVE FOR STRUCTURAL PATCH REPAIR AND REHABILITATION

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Abstract

The escalating prevalence of structural degradation in contemporary reinforced concrete buildings—driven by inadequate maintenance, substandard materials, and poor workmanship—presents a critical challenge to infrastructure longevity. Structural cracks facilitate the ingress of moisture and deleterious agents, triggering reinforcement corrosion and concrete spalling. While micro-concrete jacketing is a common remedial technique, its reliance on leakproof formwork and specialized labor makes it economically and practically unfeasible for localized patch repairs. This research investigates Polymer-Modified Concrete (PMC) as a high-performance alternative for durable structural restoration. The study evaluates the efficacy of two distinct polymer products from a single manufacturer, integrated into a base M30 grade concrete mix. The experimental program focuses on the correlation between varying polymer-to-cement ratios and the resulting alteration in material properties.

Performance indicators assessed include:

- Mechanical Integrity: Compressive strength and flexural strength.
- Durability Metrics: Water permeability and resistance to environmental ingress.

The findings aim to provide a comparative analysis between traditional repair methods and PMC, highlighting how polymer proportions can be optimized to enhance bond strength and durability in rehabilitation scenarios.

Keywords: Polymer-Modified Concrete (PMC), Structural Rehabilitation, Patch Repair, M30 Grade Concrete, Durability Enhancement.

VERTICAL EXTENSIONS IN EXISTING BUILDINGS: A REVIEW OF DESIGN APPROACHES AND SUSTAINABILITY BENEFITS

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Abstract

With the continuous increase in student population, colleges are facing significant challenges in expanding their infrastructure within limited campus space. Vertical extensions (VEs), which involve adding additional floors to existing buildings, have emerged as a practical and sustainable solution that avoids the need for land acquisition or demolition of existing structures. Despite these advantages, there is limited research on the structural feasibility of such extensions in institutional buildings, particularly in terms of load-carrying capacity and the influence of different structural systems and materials. Furthermore, the environmental implications of vertical extensions, especially with respect to embodied carbon, have not been extensively studied.This study focuses on evaluating the potential for vertical expansion of an existing college building by examining its available structural capacity under both vertical and lateral loading conditions. Various structural systems and materials, including reinforced concrete, steel, timber, and hybrid combinations, are considered through multiple design scenarios to understand their suitability. In addition, a life cycle assessment (LCA) approach is adopted to assess and compare the embodied carbon associated with vertical extension strategies and conventional demolition and reconstruction practices. The study aims to provide a comprehensive understanding of the feasibility, design considerations, and sustainability aspects of vertical extensions, thereby offering a viable approach for the efficient expansion of educational infrastructure.

Key Words: Vertical Extension (VE), Embodied Carbon, Building Expansion

IMPACT OF INDUSTRIAL AND DOMESTIC WASTEWATER ON BHAVANI RIVER WATER QUALITY

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Abstract

River water quality is increasingly threatened by the discharge of untreated industrial and domestic wastewater, especially in rapidly urbanizing and industrialized regions. This study assesses the impact of wastewater inputs on river water quality by analyzing key physicochemical and biological parameters, including pH, electrical conductivity, total dissolved solids, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, nitrates, phosphates, chlorides, and coliform counts. Samples collected from upstream, midstream, and downstream locations indicate a clear deterioration in water quality downstream of discharge points. Elevated BOD, COD, and nutrient levels, along with reduced dissolved oxygen, suggest significant organic and chemical contamination from sewage and industrial effluents. High coliform levels further indicate fecal contamination and associated public health risk. The findings show that continuous discharge of untreated wastewater degrades river ecosystems, affects aquatic life, and reduces the suitability of river water for domestic, agricultural, and recreational use. The study highlights the need for effective wastewater treatment, strict pollution control measures, and regular monitoring to protect river water resources and support sustainable environmental management.

Keywords: Coliforms; Domestic wastewater; Industrial effluent; Physicochemical parameters; Sustainable.

PERFORMANCE EVALUATION OF SBR AND MBBR TECHNIQUES IN SEWAGE TREATMENT PLANT

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Abstract

The Sequencing Batch Reactor (SBR) is a modern and efficient biological wastewater treatment process widely used in sewage treatment plants. This study focuses on evaluating the performance of an SBR system based on key water quality parameters such as Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Total Suspended Solids (TSS). The SBR process operates in a cyclic batch mode consisting of filling, aeration, settling, and decanting phases, which allows better control over treatment conditions and enhances removal efficiency. Performance evaluation is carried out by comparing influent and effluent characteristics over a specific period. The results indicate that the SBR system achieves high removal efficiencies, typically ranging from 85% to 95% for BOD, COD, and TSS under optimal operating conditions. Factors such as hydraulic retention time, sludge retention time, aeration duration, and organic loading significantly influence system performance. The study demonstrates that SBR technology is highly flexible, space-efficient, and suitable for handling variable flow and load conditions. It ensures consistent effluent quality that meets environmental discharge standards. Overall, the SBR system is a reliable and sustainable solution for effective sewage treatment and environmental protection.

Keywords: Biological wastewater; Biochemical Oxygen Demand; Chemical Oxygen Demand; Total Suspended Solids; Sequencing Batch Reactor;

ECO-RESTORATION AND REHABILITATION OF OTTERI LAKE IN VELLORE CITY

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Abstract

Urban lakes in rapidly developing cities are increasingly subjected to degradation due to anthropogenic pressures, necessitating integrated restoration approaches. This study focuses on the eco-restoration and rehabilitation of Otteri Lake in Vellore City, India, a critically degraded water body affected by siltation, encroachment, solid waste dumping, and the inflow of untreated wastewater. These factors have significantly reduced its storage capacity, deteriorated water quality, and increased flood risk. An integrated restoration framework is proposed, combining engineering interventions, ecological enhancement, and sustainable urban design. Key measures include desilting to restore storage capacity, embankment stabilization, improvement of feeder and drainage channels, installation of real-time water quality monitoring systems, and in-situ aeration to enhance water quality. Ecological restoration strategies involve the removal of invasive species and the introduction of native vegetation to support biodiversity recovery. The project also incorporates socio-economic considerations through the development of recreational infrastructure, including parks, walkways, and landscaped areas, aimed at improving public health and community engagement. With an estimated cost of ₹60–62 crore, the proposed interventions are expected to increase storage capacity by approximately 57%, enhance groundwater recharge, mitigate urban flooding, and improve climate resilience. The study demonstrates a scalable and sustainable model for urban lake restoration, offering insights into integrated water resource management, ecological conservation, and urban resilience planning in developing regions.

Keywords: Urban lake restoration; Eco-restoration; Sustainable urban drainage; Water quality management; Climate resilience; Groundwater recharge; Vellore City

DEVELOPMENT OF A WATER QUALITY MODELLING FRAMEWORK UNDER DATA-CONSTRAINED CONDITIONS: A CASE STUDY OF THE BHAVANI RIVER

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Abstract

The identification of key parameters in water quality modelling is strongly influenced by the availability and accuracy of baseline datasets that capture spatial and temporal variability and their interrelationships. This study focuses on determining critical attributes for developing a water quality model for a selected stretch of the Bhavani River in Tamil Nadu, India, utilizing outputs from the QUAL2K model under limited data conditions.

Detailed analysis was carried out on the spatial distribution of inorganic suspended solids (ISS) and carbonaceous biochemical oxygen demand (cBOD), with reference to variations in hydraulic, environmental, and climatic factors. The findings reveal that cBOD is highly influenced by temperature, dissolved oxygen, and pH, whereas ISS shows stronger dependence on alkalinity, electrical conductivity, and benthic algal activity.

Furthermore, it was observed that fluctuations in pH and dissolved oxygen can act as critical triggers when external pollutant inputs, including both point and non-point sources, are introduced, thereby affecting ISS and cBOD profiles. Based on these observations, a conceptual approach for water quality modelling under data-scarce conditions is proposed. This framework can be extended for simulating water quality in similar environments where data availability is limited.

Key Words: Biochemical oxygen demand; Data-limited Modelling; Inorganic suspended solid; QUAL2K; Water quality model

PERFORMANCE ASSESSMENT OF NATURAL AND SYNTHETIC ADSORBENTS IN TEXTILE EFFLUENT TREATMENT

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Abstract

Water from natural sources, such as mountain streams, ultimately flows into oceans as part of the hydrological cycle. A significant portion of this water is utilized for agricultural, industrial, and municipal purposes, after which it is converted into wastewater. The generation of wastewater has increased due to rapid population growth, urbanization, and industrialization, along with discharges from households, institutions, and hospitals. Wastewater contains a variety of organic and inorganic substances, biological contaminants, and toxic compounds, posing serious environmental and public health risks. Conventional treatment methods often rely on chemical coagulants such as aluminium sulphate, which may have environmental and health drawbacks. In this context, natural coagulants and adsorbents have gained attention as sustainable and eco-friendly alternatives. These plant-based materials are effective in coagulation–flocculation processes, particularly for turbidity removal, and offer advantages such as biodegradability, availability, and minimal impact on treated water quality. The present study aims to evaluate the effectiveness of natural coagulants and adsorbents as alternatives to conventional chemical coagulants and to optimize the treatment process. Seeds of Hyacinth bean, *Cucurbita pepo*, and *Cicer arietinum* were used as natural coagulants and adsorbents. Dosage levels of 2%, 4%, 6%, 8%, and 10% were tested to determine the optimum dosage for efficient wastewater treatment.

Keywords: Adsorbents; *Cucurbita pepo*; *Cicer arietinum;* Natural coagulants; Sustainable treatment.

ASSESSMENT OF ELECTROCOAGULATION, CHEMICAL, AND BIOLOGICAL PROCESSES FOR TREATING AUTOMOTIVE WASH EFFLUENTS

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Abstract

Wastewater generated from car wash service stations contributes the majority of environmental contamination due to the chemical characteristics of the car wash water. This research work compares the effectiveness of treating car wash water collected from a car wash station in Coimbatore using naturally available water hyacinth, chemical (alum), and electrocoagulation (Cu - Cu, Cu - Al, Al - Al) methods. Different parameters like pH, turbidity, Chemical oxygen demand, oil and grease, and total organic carbon were characterized for the collected car wash water. Oil and grease, Chemical oxygen demand contribute to the majority of pollution. Experimental results show that the electrocoagulation method has better removal efficiency of oil and grease, Chemical oxygen demand, and turbidity. A maximum chemical oxygen demand removal efficiency of 61% and oil and grease removal efficiency of 70% has been attained by the electrocoagulation method. Water hyacinth has also shown a good result with Chemical oxygen demand removal efficiency of 50% and oil and grease removal efficiency of 54.5%. The electrocoagulation method with an Al-Al electrode combination has been found to give better results for the treatment of car wash water.

Keywords: Chemical oxygen demand; Electrocoagulation; Turbidity; Water hyacinth; Wastewater.

HYDROCHEMICAL CHARACTERIZATION AND POLLUTION ASSESSMENT OF GROUND AND SURFACE WATER IN AN INDUSTRIAL ZONE – MARAIMALAI NAGAR, TAMIL NADU

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Abstract

Rapid industrialization and urbanization significantly impact groundwater and surface water quality, particularly in industrial regions. This study assesses the hydrochemical characteristics and pollution status of groundwater and surface water in Maraimalai Nagar Industrial Zone, Tamil Nadu, India. Water samples from bore wells, open wells, and surface sources were analyzed for major physico-chemical parameters using standard methods. The results show that pH ranges from 6.8–8.2 (groundwater) and 7.0–8.4 (surface water), indicating a slightly alkaline nature. Electrical Conductivity (750–1850 µS/cm in groundwater; 820–1950 µS/cm in surface water) and Total Dissolved Solids (480–1200 mg/L; 520–1350 mg/L) indicate moderate mineralization. Total hardness values (210–620 mg/L; 240–680 mg/L) classify the water as hard to very hard. Elevated chloride (up to 420 mg/L in groundwater and 460 mg/L in surface water) and nitrate (up to 48 mg/L and 52 mg/L) concentrations at certain locations suggest industrial effluent intrusion and domestic wastewater contamination. Other parameters, such as calcium, sulphate, and fluoride, remain mostly within permissible limits. Hydrochemical facies analysis indicates dominance of Ca–Mg–Cl and Na–Cl water types, reflecting anthropogenic influence and rock–water interaction. Water Quality Index (WQI) results reveal that groundwater ranges from good to poor quality, while surface water is moderately to highly polluted. Overall, the water is not suitable for direct consumption without treatment. The study emphasizes the need for continuous monitoring, proper industrial wastewater treatment, and groundwater recharge strategies to ensure sustainable water resource management in the Maraimalai Nagar industrial region.

Keywords: Groundwater quality, Surface water pollution, Hydrochemical analysis, Water Quality Index (WQI), Industrial contamination.

INDOOR AIR PURIFICATION USING GREEN NANOTECHNOLOGY

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Abstract

Indoor air pollution has emerged as a significant environmental and public health concern due to the accumulation of particulate matter ($PM_{2.5}$ and PM_{10}), volatile organic compounds (VOCs), and microbial contaminants in enclosed spaces. Conventional air purification systems often involve high energy consumption and may generate secondary pollutants, limiting their sustainability. In this context, green nanotechnology offers an eco-friendly and efficient alternative for indoor air remediation.

This study focuses on the synthesis and application of plant-mediated nanoparticles for the removal of indoor air pollutants. Green-synthesized nanomaterials, such as titanium dioxide (TiO_2), zinc oxide (ZnO), and silver nanoparticles (AgNPs), are prepared using natural plant extracts like Azadirachta indica (Neem) and Aloe vera, which act as reducing and stabilizing agents. The synthesized nanoparticles are characterized using analytical techniques including UV-Visible spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), and Scanning Electron Microscopy (SEM).

The developed nanomaterials are incorporated into air filtration media and surface coatings to evaluate their efficiency in degrading VOCs, reducing particulate matter, and inhibiting airborne microorganisms under indoor conditions. Photocatalytic activity under visible or UV light irradiation is also investigated to assess pollutant degradation mechanisms. Performance evaluation is carried out by measuring pollutant removal efficiency, antimicrobial activity, and reusability of the nanomaterials.

The results are expected to demonstrate that green nanotechnology-based air purification systems provide a sustainable, cost-effective, and energy-efficient solution for improving indoor air quality. This approach has significant potential for applications in residential buildings, offices, healthcare facilities, and public spaces, contributing to healthier indoor environments and reduced environmental impact.

Keywords: Indoor air pollution; Microbial contaminants; Volatile organic compounds; Particulate matter; Nanomaterials.

STUDY ON THE REDUCTION OF CARBON FOOTPRINT IN INDUSTRY

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Abstract

Climate change and environmental degradation are critical global challenges, largely driven by excessive carbon emissions. This project on Carbon Footprint Reduction aims to identify, analyze, and implement sustainable strategies to minimize carbon emissions across various industries. By integrating renewable energy sources, enhancing energy efficiency, promoting sustainable consumption, and encouraging behavioral changes, this project seeks to develop practical solutions for individuals and organizations. The study will also evaluate the effectiveness of carbon offset programs and policy measures in achieving long-term sustainability. Through data analysis, case studies, and innovative technologies, this project aspires to contribute to a greener future, aligning with global climate goals and fostering a low-carbon economy.

Keywords: Climate change; Carbon emissions; Renewable energy sources; Low-carbon economy; Carbon footprint.

COMPUTER SCIENCE AND ENGINEERING

AI-BASED CRIME PREDICTION MODEL USING HYBRID DEEP NEURAL NETWORK AND MULTI-LAYER PERCEPTRON

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AI-based Crime Prediction model focuses on analyzing historical crime data to identify patterns and forecast potential criminal activities, helping law enforcement take proactive measures and improve public safety. Traditional crime analysis methods rely on manual reports and past records, which are time-consuming, less accurate, and unable to handle large or real time data effectively. To overcome these issues, modern crime prediction systems use machine learning and data analytics to process big data quickly, improve prediction accuracy, and support timely, data-driven crime prevention strategies. This proposed system presents a hybrid crime prediction framework that integrates both image-based analysis and structured crime data processing to improve prediction accuracy. The crime dataset is divided into two parallel streams: input images and input numerical data. In the image pipeline, input images undergo preprocessing using filters, then segmented using edge detection with contrast enhancement, followed by feature extraction to capture key visual characteristics. These features are fed into deep learning models. In the data pipeline, structured crime data is first pre-processed, then visualized using Power BI for exploratory analysis. The data is normalized & being passed to a hybrid deep neural network with a multi-layer perceptron (MLP) classifier for robust classification. Finally, outputs from both pipelines contribute to the prediction module implemented using Flask, enabling efficient deployment and real-time crime prediction through a unified web-based interface.

Keywords Crime Prediction, Machine Learning, Deep Learning, Hybrid Model, Image Processing, Predictive Analytics, Web-Based System.

DARK WEB INTELLIGENCE FRAMEWORK

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This project focuses on crawling and analyzing dark web websites using the Tor network to ensure anonymous access and secure data extraction. The system is designed to retrieve hyperlinks, textual content, and screenshots from .onion domains, providing a structured approach for hidden web exploration. The extracted data is processed through Natural Language Processing techniques using libraries such as SpaCy, NLTK, and TextBlob to clean, tokenize, and analyze the text. Named Entity Recognition is employed to categorize content into entities like Person, Organization, Country, and Product. Furthermore, frequency analysis identifies the most recurring words, helping in understanding the dominant themes and activities of the crawled sites. The system is developed using the Django web framework, integrating modules for crawling, text extraction, and linguistic analysis within a single interface. It stores data in CSV files and a SQLite database, enabling both persistence and scalability. This project contributes toward automated dark web intelligence gathering, enhancing cybersecurity awareness, and enabling researchers to monitor hidden online activities efficiently.

Keywords: Dark Web, Tor Network, Web Crawling, Data Extraction, NLP, Named Entity Recognition, Text Analysis, Django, Cybersecurity, Frequency Analysis.

GRAPH-ENHANCED TAB TRANSFORMER WITH BAYESIAN OPTIMIZATION FOR ACCURATE HEART DISEASE PREDICTION USING NUMERICAL CLINICAL DATA

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Heart disease remains one of the leading causes of mortality worldwide, emphasizing the need for accurate and reliable predictive models for early diagnosis. This work proposes an advanced machine learning framework for heart disease prediction using structured numerical clinical data. Initially, the input heart disease dataset undergoes pre-processing, where quantile normalization is applied to reduce distributional skewness and outlier effects, followed by missing data imputation to ensure dataset completeness. Exploratory data analysis is then performed using multivariate analysis techniques to identify complex relationships among clinical attributes. To facilitate stable model training, Min–Max normalization is employed during feature engineering to scale features into a consistent range. The core of the proposed framework is a Graph-Enhanced Tab Transformer model, which integrates transformer-based attention mechanisms with graph learning to effectively capture inter-feature dependencies present in tabular medical data. To further enhance predictive performance, Bayesian Optimization is utilized for hyper parameter tuning, enabling efficient exploration of the hyper parameter space while avoiding suboptimal configurations. The proposed framework is implemented and evaluated using Python, demonstrating improved prediction accuracy, robustness, and generalization capability compared to traditional machine learning and deep learning models. These results highlight the effectiveness of the proposed graph-based tabular transformer approach as a reliable decision-support tool for early heart disease detection.

Keywords*:* Heart Disease Prediction, Graph Tab Transformer, Bayesian Optimization, Numerical clinical Data.

INSURANCE CLAIM FRAUD DETECTION USING MACHINE LEARNING TECHNIQUES

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Insurance companies have increasingly encountered fraudulent activities across various types of claims, resulting in substantial financial losses and operational inefficiencies. Fraud in automobile insurance claims is particularly prominent, often involving fabricated or exaggerated accident reports. Detecting such fraudulent activities is essential for ensuring the reliability of insurance services. This paper proposes a machine learning-based approach for detecting fraudulent insurance claims using real-world datasets. Classification algorithms such as Logistic Regression, Decision Tree, Random Forest, and Support Vector Machine are implemented to identify and label claims as genuine or fraudulent. A comparative analysis is performed using evaluation metrics including accuracy, precision, recall, and confusion matrix-based measures. To support large-scale data processing, the models are implemented using the PySpark framework. Experimental results indicate that the proposed approach improves fraud detection performance and reduces false claims. The system provides a scalable and efficient solution for insurance fraud detection.

Keywords*:* Insurance Fraud Detection, Machine Learning, PySpark, Classification Algorithms, Data Analytics, Fraud Prevention

AN OPTIMIZED DEEP LEARNING FRAMEWORK FOR BRAIN TUMOR DETECTIONUSING RANDOM WALKER SEGMENTATION, AND DENSENET-121 WITH DINGO OPTIMIZATION

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Brain tumor detection from magnetic resonance imaging (MRI) plays a crucial role in early diagnosis and effective treatment planning. However, MRI images are often affected by noise, low contrast, and complex tumor boundaries, which reduce diagnostic accuracy. This project proposes an optimized deep learning–based framework for automated brain tumor detection using advanced image processing and classification techniques. Initially, Wiener filtering is applied in the preprocessing stage to suppress noise while enhancing image contrast. Random Walker segmentation is then employed to accurately delineate tumor regions based on graph connectivity and pixel assignment. To capture discriminative frequency-domain characteristics, Fourier Transform–based features are extracted, highlighting edges and fine structural details. These features are fed into a DenseNet-121 deep convolutional neural network for robust feature learning and classification. To further enhance performance, the Dingo Optimization Algorithm (DINGO) is integrated for optimal tuning of network parameters. The proposed framework effectively improves classification accuracy and segmentation precision. Experimental results demonstrate that the optimized model achieves high accuracy in distinguishing tumor regions from healthy brain tissue. The system provides reliable and automated brain tumor classification, supporting clinical decision-making. Overall, the proposed approach offers an efficient and accurate solution for brain tumor detection from MRI images.

Keywords: Brain Tumor Detection; MRI (Magnetic Resonance Image ; Deep Learning; Tumor region; Medical Image Processing

AI INTEGRATION FOR MSMES (MICRO, SMALL, MEDIUM ENTERPRISES)

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Indian MSME's contribute 30% of national GDP, but they face challenges due to digital illiteracy and use of manual, paper-based systems. The technical and operational costs stop these businesses from growing with traditional AI (Artificial Intelligence). This idea proposes voice-enabled AI platform for Indian shopkeepers. It uses Indic-NLP to eliminate the need for typing or technical management. The system uses pipeline like architecture which automates Inventory Management, generates suggestions for delivery batching and uses Human-In-The-Loop (HITL) for confirmation of delivery routes and as well as order confirmation if any mistake made by the Voice-AI. By allowing users to handle complex business data through voice-based commands. This approach cuts operation costs and improves efficiency for shopkeepers. The proposed model supports Digital India and SDG-9 goals, turning MSME operations into an intuitive, scalable digital process.

Keywords: Human-In-The-Loop (HITL), MSME, Indic-NLP, Voice-AI, Digital India.

AI-DRIVEN WEBSITE BUILDER WITH COLLABORATIVE TEAM EDITOR FOR INTERACTIVE WEB DEVELOPMENT EDUCATION

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Web development is a fundamental skill in computer science education; however, beginners often struggle to understand the integration of HTML, CSS, and JavaScript while building real-world applications. Existing platforms primarily focus on generating output or providing static tutorials, which limits hands-on learning and collaborative experience. This paper presents an AI-driven web application designed to enhance web development education through interactive and practical learning. The proposed system enables users to generate complete website code using natural language prompts, while also allowing manual editing, real-time preview, and structured exploration of source code. To promote effective learning, the platform stores user-specific prompt history and supports secure authentication using JWT and Google OAuth. Furthermore, the system introduces a collaborative team editor that allows multiple users to work on shared projects simultaneously, with real-time synchronization enabled through WebSocket communication. The architecture follows a client–server model integrating AI-based code generation, a scalable backend, and a structured database for managing users, projects, and teams. By combining AI assistance with collaborative coding and transparent code access, the system shifts the focus from code generation to active learning and teamwork. The proposed solution aims to improve conceptual understanding, coding proficiency, and collaborative skills among students, providing a comprehensive and scalable platform for modern web development education.

Keywords*:* AI Website Builder; Web Development Education; Collaborative Coding; Real-Time Editing; WebSocket; JWT Authentication; Google OAuth; Code Generation; Learning Platform.

INTELLIGENT CO-PILOT SYSTEM FOR ENHANCING PILOT ATTENTION AND AVIATION SAFETY

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In modern aviation systems, pilots are often exposed to a high volume of alerts and warnings, leading to a condition known as “alarm fatigue,” which can reduce situational awareness and delay critical decision-making. This project proposes an Intelligent Co-Pilot system that enhances Human-Machine Interaction (HMI) by integrating eye-tracking sensors and Natural Language Processing (NLP).The system continuously monitors the pilot’s visual attention and identifies whether critical warnings are being overlooked. If a high-priority alert is missed, the system provides adaptive feedback through voice prompts or haptic signals, such as seat vibrations, to redirect the pilot’s focus toward the most urgent threat. By prioritizing alerts and delivering context-aware assistance, the proposed solution aims to reduce cognitive overload, improve response time, and enhance overall flight safety. This project demonstrates how AI-driven interfaces can support human operators in high-stress environments and can be further extended to other domains such as automotive systems and industrial control environments.

Keywords: Intelligent Co-Pilot, Human-Machine Interaction (HMI), Eye-Tracking, Natural Language Processing (NLP), Alarm Fatigue, Situational Awareness, Aviation Safety.

AI - POWERED FITNESS TRACKER

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The AI-Powered Fitness Tracker is an intelligent health monitoring and workout recommendation system designed to provide personalized fitness guidance based on individual user data and body analysis. In today's fast-paced world, many individuals rely on generic workout plans that fail to consider personal health conditions, body composition, and fitness levels. This project aims to overcome these limitations by integrating Machine Learning and Deep Learning techniques to deliver accurate, data-driven fitness recommendations. The system utilizes Machine Learning algorithms such as Logistic Regression and Decision Tree to analyze user inputs including age, gender, height, weight, Body Mass Index (BMI), activity level, and existing health conditions. Based on this analysis, the system predicts potential health risks and suggests appropriate workout intensities and routines. In addition, Convolutional Neural Networks (CNN) are employed for body type classification by processing user-uploaded images. The CNN model categorizes users into somatotypes such as ectomorph, mesomorph, and endomorph, enabling more precise fitness planning. To ensure reliability and improved model performance, the system incorporates a combination of publicly available datasets and curated/generated image data, along with data preprocessing and augmentation techniques. The integration of both numerical and image-based analysis allows the system to provide a hybrid recommendation approach, improving overall accuracy and personalization. The proposed system generates customized workout plans tailored to individual fitness goals such as weight loss, muscle gain, or fat burn, while also considering safety and health constraints. Furthermore, the system can be extended to include features such as progress tracking, calorie estimation, and real-time feedback through an interactive user interface. The primary objective of this project is to replace one-size-fits-all fitness solutions with an intelligent, adaptive system that promotes healthier lifestyles through personalized recommendations. By leveraging Artificial Intelligence, the AI-Powered Fitness Tracker aims to make fitness planning more accessible, efficient.

Keywords : Artificial Intelligence, Machine learning, Convolutional Neural Network (CNN), Body Type Classification, Health Risk Prediction, Personalized Workout Plan, Body Mass Index(BMI).

AN INTEGRATED SYSTEM FOR RENEWABLE ENERGY INTEGRATION FOR SUSTAINABLE POWER SYSTEMS

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Renewable energy integration for sustainable power systems focuses on efficiently incorporating renewable energy sources such as solar, wind, hydro, and biomass into the existing electrical grid. With the increasing demand for clean and reliable energy, integrating these resources presents challenges in terms of variability, storage, and grid stability. This work proposes an intelligent and integrated framework that enhances energy efficiency, reduces carbon emissions, and ensures a stable power supply. The system utilizes smart monitoring techniques to continuously observe energy generation and consumption patterns, while advanced energy storage solutions help manage fluctuations in renewable power generation. Additionally, load management strategies are employed to balance supply and demand effectively. By combining these approaches, the proposed system ensures reliable energy distribution and improved grid performance. The framework contributes to building a cleaner, smarter, and more eco-friendly energy infrastructure, supporting the transition toward sustainable development and long-term energy security.

Keywords*:* Renewable Energy, Smart Grid, Energy Storage, Load Management, Sustainable Power Systems, Solar Energy, Wind Energy, Energy Efficiency.

AN INTEGRATED MULTIMODAL SYSTEM FOR PARKINSON'S DISEASE PREDICTION

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Parkinson's disease is a progressive neurological disorder that affects motor function, speech, and coordination, making early diagnosis and continuous monitoring essential yet challenging. This work presents a multimodal artificial intelligence-based framework for Parkinson's disease diagnosis by integrating diverse data sources, including clinical symptoms, voice input, tremor video, and magnetic resonance imaging (MRI) scans. The system performs feature extraction from each modality, where symptom data is processed using machine learning techniques, voice signals are analyzed using a CNN-BiLSTM model, tremor patterns are evaluated through a CNN-LSTM architecture, and MRI scans are interpreted using a ResNet-50 deep learning model. These models independently learn modality-specific patterns and contribute to a unified diagnostic decision through an integrated framework. The final output provides a Parkinson's diagnosis, classifying individuals as either affected or healthy. For diagnosed cases, the system further enables risk score assessment, generates alerts, tracks patient progression, and evaluates treatment response over time. Experimental results indicate that the multimodal approach significantly enhances diagnostic accuracy and robustness compared to single-modality systems. The proposed framework offers an intelligent, scalable, and clinically supportive solution for early detection and long-term monitoring of Parkinson's disease.

Keywords Parkinson's Disease, Multimodal Machine Learning, MRI Analysis, Voice Feature Extraction, Tremor Detection, ResNet-50, Disease Monitoring.

AI BASED BLIND IMAGE FORGERY DETECTION MODEL

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Digital image forgery has become increasingly prevalent with the advancement of image editing tools, making the detection of manipulated images a significant challenge. This project proposes an automated system for detecting forged images using deep learning techniques. A Convolutional Neural Network (CNN) is employed to perform binary classification of images into genuine and forged categories without requiring the original reference image, thereby enabling blind forgery detection. The system utilizes publicly available datasets such as CASIA 2.0 and DEFACTO, which contain authentic and tampered images created using various forgery techniques including copy-move and splicing. The images are preprocessed using OpenCV, involving resizing, normalization, and color space conversion to ensure uniformity and stability during training. The CNN model extracts hierarchical features such as edges, textures, and inconsistencies introduced during manipulation. The proposed approach focuses on identifying statistical and visual artifacts such as edge discontinuities, texture irregularities, and noise inconsistencies that are commonly present in forged images. The model is trained using supervised learning with binary classification and optimized using appropriate loss functions and optimizers. Experimental results demonstrate that the system is capable of effectively distinguishing between genuine and forged images with satisfactory accuracy. This project provides a scalable and efficient solution for digital image forgery detection and can be extended further using advanced architectures such as transfer learning and Vision Transformers for improved performance.

Keywords: Image Forgery Detection; Convolutional Neural Network; Deep Learning; Image Processing; Computer Vision; OpenCV; CASIA Dataset; CoMoFoD Dataset; Blind Detection.

NATURAL LANGUAGE-CONTROLLED AI AGENT FOR LOCAL SYSTEM OPERATIONS

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The growing complexity of modern software environments demands intelligent systems that can simplify human-computer interaction without compromising operational depth. This paper presents Nexora, a natural language-controlled AI agent designed to perform a broad range of local system operations through both voice commands and text-based prompts, eliminating the need for manual scripting or technical command-line expertise. Nexora follows a modular software architecture that integrates multiple specialized subsystems including a desktop automation engine, a web automation layer, an image detection pipeline, and a document intelligence module capable of parsing PDFs, scanned images, and structured documents all orchestrated through a unified natural language understanding interface. The system leverages large language model reasoning as its cognitive backbone, translating user intent into precise, executable system-level actions in real time, making it deployable across enterprise workflows, accessibility tools, and personal productivity environments. From automating repetitive GUI-based tasks and navigating web platforms to extracting critical data from documents and responding to visual screen context, Nexora addresses real-world operational bottlenecks that traditional rule-based automation tools fail to resolve. The engineering design prioritizes extensibility, allowing new automation modules to be integrated with minimal reconfiguration, positioning Nexora as a scalable solution for evolving software ecosystems. This work demonstrates that combining natural language processing, multimodal perception, and system-level execution within a cohesive software framework can produce an AI agent that meaningfully reduces human effort while expanding the boundaries of local machine intelligence.

Keywords*:* Natural Language Processing, AI Agent, Software Architecture, Desktop Automation, Web Automation, Voice-Based Interaction, Image Detection, Document Intelligence, Large Language Models, Task Automation, Human-Computer Interaction, Multimodal Systems.

VISION ENHANCE AI: HIGH-PRECISION DEEP LEARNING ALGORITHM FOR AUTOMATED RETINAL IMAGING AND DIAGNOSTIC CLARITY

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The prevalence of Diabetic Retinopathy (DR) remains a leading cause of vision impairment globally, yet early diagnostic screening is often hindered by the poor image quality produced by low-cost, portable fundus cameras in resource-constrained environments. This paper presents Vision Enhance AI, a high-precision deep learning framework designed to optimize retinal imaging and automate disease classification. To address the technical challenges of image degradation, we implement a robust preprocessing pipeline utilizing Contrast Limited Adaptive Histogram Equalization (CLAHE) and Gaussian denoising to sharpen critical pathological features—such as micro aneurysms and exudates—without introducing diagnostic artifacts. The enhanced images are processed through a specialized Convolutional Neural Network (CNN) architecture optimized for computational efficiency on edge devices. Preliminary evaluations indicate that the system effectively categorizes retinal health into five clinical stages with high sensitivity. By stabilizing and enhancing low-quality scans, this solution provides a scalable and cost-effective screening tool for primary healthcare centers facilitating early intervention and reducing the risk of permanent vision loss in underserved populations.

Keywords: Convolutional Neural Networks (CNN); Diabetic Retinopathy; Image Enhancement; CLAHE; Deep Learning; Medical Imaging; Portable Diagnostics

AI-BASED SERVER LOAD BALANCING SYSTEM USING AZURE INFRASTRUCTURE AND CUSTOM PYTHON IMPLEMENTATION

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This paper presents the design and implementation of an AI-based server load balancing system built on Microsoft Azure infrastructure using custom Python code without relying on managed load balancer services. The system efficiently distributes incoming client requests across multiple backend servers to maximize performance, minimize response time, and ensure high availability. The architecture includes a centralized intelligent load balancer deployed on an Azure Virtual Machine communicating with three backend server VMs over a private network. Three algorithms are implemented: Round Robin, Least Connections, and an AI Weighted Scoring Algorithm based on CPU utilization, memory usage, active connections, and response time. The system continuously monitors server health and collects metrics at 0.5-second intervals using background threads, enabling near real-time routing decisions. A web-based dashboard visualizes live metrics and supports dynamic algorithm switching. Experimental results under concurrent loads show that the AI Weighted algorithm achieves lower response times by avoiding overloaded servers. Future work includes integrating machine learning regression models for predictive and self-optimizing load balancing.

Keywords: Load Balancing; Artificial Intelligence; Azure Virtual Machines; Round Robin; Least Connections; AI Weighted Scoring; Flask; Real-Time Metrics; Regression Learning; Distributed Systems

AI-DRIVEN MACHINERY SENSOR DATA ANALYSIS AND DECISION SUPPORT SYSTEM

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Industrial environments involving high-pressure and high-temperature machinery, such as boilers and burners, present significant risks to human operators. Monitoring these systems 24/7 is a complex task due to the massive volume of sensor data generated, which often conceals subtle warning patterns that manual observation fails to detect. This paper proposes an AI-driven machinery sensor data analysis and decision support system designed to transition industrial maintenance from a reactive "wait and repair" model to a proactive predictive framework. The proposed framework utilizes machine learning algorithms to clean and analyse millions of sensor records to predict mechanical failures before they occur. The system is structured into specialized modules, including a Data Module for information traffic management, an AI Processing Module for anomaly detection, and a Decision Support Module that translates complex analytical outputs into natural language advice. A key innovation of this system is its focus on explainable AI; rather than providing "mystery alarms," the system explains the underlying cause of a detected issue, ensuring that human operators retain final decision-making authority. Experimental objectives include enhancing operational safety and reducing costs by providing a universal design applicable to various industrial machineries. Future enhancements focus on the integration of thermal vision and edge computing for real-time monitoring and autonomous learning from operator feedback.

Keywords: Artificial Intelligence; Machine Learning; Sensor Data Analysis; Decision Support System; Predictive Maintenance; Industrial Safety; Explainable AI.

AI-BASED SMART WEALTH PLANNER

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AI-based Smart Wealth Planner web application designed to simplify and improve the way individuals manage their finances. It offers a single, easy-to-use platform where users can enter details about their income, expenses, debts, insurance, and financial goals such as buying a car or building long term wealth and receive personalized guidance. Application uses intelligent algorithms to analyse financial data and create customized financial plans. It applies efficient debt management strategies to help users clear their liabilities faster, while sorting and optimization techniques organize financial information and prioritize spending. Advanced methods like K-Means clustering group users based on their financial behavior and risk levels, allowing the system to provide more relevant recommendations. In addition, predictive models such as Decision Trees and Logistic Regression help estimate outcomes like the chances of achieving financial goals or the performance of investments. Key feature of the system is its ability to automatically calculate monthly savings by analysing income, expenses and loan EMIs, and insurance costs, reducing the need for manual effort. Using this data, the application generates an age based financial roadmap that guides users on when to focus on debt repayment, building an emergency fund, growing investments, and achieving their goals. Platform also includes an interactive financial dashboard that provides insights into wealth growth, investment allocation, and overall financial health. With a modern and user-friendly interface combined with powerful backend intelligence, the application ensures a smooth and engaging experience. Overall, this solution aims to enhance financial awareness, streamline decision-making, and help users achieve their financial goals efficiently without relying on unnecessary loans making it a practical and comprehensive personal finance management tool.

Keywords Financial Planning; Debt Optimization; Greedy Algorithms; K-Means Clustering; Investment Strategy; Wealth Projection; Fintech Application; AI-Based Analytics.

VERNA VITALITY: AI-POWERED NUTRITION ANALYZER

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The growing awareness of health and fitness has increased the demand for smart and efficient nutrition tracking systems. However, most existing applications rely heavily on manual data entry, which is time-consuming, prone to errors, and often leads to reduced user engagement. In addition, many platforms store sensitive user information on centralized servers, raising serious privacy and security concerns. To overcome these limitations, this project introduces Verna Vitality, an AI-powered nutrition analyzer designed to automate dietary tracking and provide personalized health insights. The system leverages advanced Artificial Intelligence techniques, including Natural Language Processing (NLP) and computer vision, to analyze both text and image inputs. It can accurately identify food items, estimate portion sizes, and calculate nutritional values such as calories, proteins, carbohydrates, and fats in real time. The application is developed using modern web technologies and follows a privacy-first approach by storing all user data locally within the browser. This ensures complete data security and eliminates the risks associated with centralized storage. Additionally, the system includes an intelligent recommendation module that provides real-time dietary suggestions based on user input and nutritional needs. Overall, VernaVitality enhances the user experience by reducing manual effort, improving accuracy, and ensuring data privacy. This makes it a reliable and efficient solution for individuals seeking to maintain a healthy lifestyle and achieve their fitness goals.

Keywords: Artificial Intelligence, Nutrition Tracking, Groq LPU, Privacy-First Architecture, React 19, Multimodal Vision, Edge Storage

IOT-BASED SMART PARKING SYSTEM WITH INTELLIGENT SLOT ALLOCATION AND AUTOMATED BARRICADE CONTROL

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The IoT-Based Smart Parking System with Intelligent Slot Allocation and Barricade Control is designed to automate and optimize parking management in public areas such as malls, bus stations, and smart city infrastructures. The system integrates IoT, cloud-based booking, and intelligent decision-making algorithms to reduce congestion, eliminate manual errors, and improve user experience. In this system, parking slots can be pre-booked through an online platform, where an intelligent algorithm such as K-Nearest Neighbors (KNN) allocates the most suitable slot based on availability and proximity. When the vehicle arrives at the entry point, its number plate is verified, and only the assigned parking slot barricade is automatically unlocked, ensuring correct parking and preventing misuse of slots. Additionally, the system supports direct booking at the entry point, where users can select available slots using a keypad interface if no prior booking exists. Each parking slot is equipped with a servo-controlled foldable barricade, which remains closed by default and opens only for authorized vehicles, thereby eliminating manual parking errors. The system also enables automated parking time tracking and digital payment integration through QR code-based transactions. After successful payment, the exit gate is automatically controlled. This solution enhances parking efficiency, security, and automation, making it highly suitable for modern smart city applications and scalable for large parking infrastructures.

Keywords*:* IoT (Internet of Things) ; Smart Parking System ; KNN Algorithm ;Automatic Number Plate Recognition (ANPR) ; Slot Allocation ; Barricade Control System ; Cloud Database (Firebase) ; QR Code Payment ; Real-Time Parking Management ; Embedded Systems (ESP32) ; Sensor-Based

AN ATTENTION-ENHANCED CNN-LSTM FRAMEWORK FOR ROBUST DEEP FAKE VIDEO DETECTION

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Deepfake videos have emerged as a significant threat to digital security, misinformation control, and media authenticity. With the rapid advancement of generative techniques, detecting such manipulated content has become increasingly challenging due to subtle spatial and temporal inconsistencies. This paper proposes an intelligent deep learning framework for deepfake video detection by integrating Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), and an attention mechanism. The proposed model utilizes CNN to extract discriminative spatial features from individual video frames, enabling the identification of visual artifacts and inconsistencies. These extracted features are subsequently processed by an LSTM network to capture temporal dependencies across consecutive frames, facilitating the detection of abnormal motion patterns. To further enhance performance, an attention mechanism is incorporated to selectively focus on the most informative frames and features, thereby improving the detection of subtle manipulations. The system processes video inputs through multiple stages, including frame extraction, preprocessing, feature learning, sequential modelling, and classification into real or fake categories. Experimental results indicate that the integration of the attention mechanism significantly improves detection accuracy and robustness compared to conventional CNN-LSTM approaches. The proposed framework offers a scalable and efficient solution for automated deepfake detection, with potential applications in cybersecurity, digital forensics, and content verification.

Keywords Deepfake Detection, CNN, LSTM, Attention Mechanism, Video Forensics, Deep Learning

CIVILIAN REPORTING SYSTEM

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In rapidly growing urban environments, citizens frequently encounter recurring civic issues such as potholes, unmanaged waste, non-functional streetlights, waterlogging, and drainage problems. Traditional complaint mechanisms, including helplines and government portals, are often inefficient, time-consuming, and lack transparency, resulting in delayed responses and unresolved concerns. Additionally, critical issues may go unnoticed due to poor prioritization among numerous complaints. This project proposes an AI-powered Civilian Reporting System designed to simplify and enhance the reporting and management of civic issues. The system allows users to submit complaints using natural language, location tagging, and image uploads without the need for complex forms. Advanced artificial intelligence techniques, including natural language processing and computer vision, are utilized to automatically generate concise summaries, classify issues, verify image relevance, and detect urgency levels. The platform provides real-time status tracking for users, including stages such as reported, accepted, in progress, and resolved. For authorities, a comprehensive dashboard with geospatial visualization, heat maps, and AI-generated insights enables efficient decision-making and resource allocation. A functional prototype has been developed using modern AI tools, demonstrating improved efficiency, transparency, and responsiveness in civic issue management. The system represents a significant step toward smart city governance by fostering citizen engagement and enabling faster resolution of urban problems. Future enhancements may include mobile application development, multilingual support, and integration with government systems**.**

Keywords Artificial Intelligence; Smart City; Civic Reporting; Natural Language Processing; Computer Vision; Urban Management.

MACHINE LEARNING APPROACH FOR MEDICINE RECOMMENDATION FROM DISEASES

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Disease diagnosis and appropriate medicine recommendation are critical components of modern healthcare systems. In many cases, patients rely on general practitioners or online sources for preliminary guidance, which may not always provide personalized or data-driven recommendations. With the rapid advancement of Artificial Intelligence (AI) and Machine Learning (ML), intelligent healthcare systems can assist in predicting diseases and recommending suitable medicines based on symptoms and patient history. This paper proposes a machine learning-based medicine recommendation system that predicts diseases from user-provided symptoms and suggests appropriate medicines accordingly. The system utilizes supervised learning algorithms such as Random Forest Classifier to improve prediction accuracy and handle complex symptom-disease relationships. Data preprocessing techniques including encoding, normalization, and feature selection are applied to enhance model performance. The proposed system not only predicts the most probable disease but also recommends medicines based on historical medical datasets. The model is evaluated using performance metrics such as accuracy, precision, recall, and F1-score. Experimental results demonstrate that the Random Forest model provides higher accuracy compared to traditional Decision Tree approaches. The system can assist healthcare professionals and patients by providing quick, reliable, and data-driven medicine recommendations.

Keywords— Medicine Recommendation System, Disease Classification, Random Forest, Supervised Learning, Symptom-Based Prediction, Personalized Healthcare, Clinical Decision Support System (CDSS), Health Informatics, Predictive Analytics, Data-Driven Medicine.

SKILL MATCH: MERN STACK BASED INTELLIGENT JOB PORTAL WITH SKILL MATCHING MECHANISM

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The rapid growth of digital recruitment platforms has increased the demand for efficient and intelligent candidate-job matching systems. However, traditional job portals primarily rely on basic keyword-based search mechanisms, which fail to capture structured competency relationships and often result in irrelevant recommendations and increased recruiter workload. This project presents Skill Match, an intelligent recruitment platform developed using the MERN stack architecture, designed to enhance hiring efficiency through a structured skill-based matching approach. Unlike conventional systems, the proposed solution implements a keyword-based skill matching algorithm that performs skill extraction, normalization, and set-based intersection between candidate profiles and job requirements. A compatibility score is computed as the ratio of matched skills to total required skills, enabling precise ranking of candidates based on their relevance. The system follows a modular three-tier architecture using React.js for the frontend, Node.js and Express.js for backend processing, and MongoDB for flexible data storage. Security is enforced through JWT-based authentication, bcrypt hashing, and role-based access control. The workflow includes job posting, automated skill comparison, candidate ranking, and dashboard-based evaluation, significantly reducing manual screening effort. Compared to traditional recruitment systems, Skill Match introduces structured matching, compatibility scoring, and automated ranking, resulting in improved recommendation accuracy, transparency, and reduced hiring time. The system provides a scalable and secure solution for modern recruitment and can be further enhanced using machine learning and NLP-based techniques.

Keywords: MERN Stack; Skill Matching; Keyword-Based Matching Algorithm; Compatibility Scoring; Recruitment System; Candidate Ranking; MongoDB; React.js; Node.js; JWT Authentication

SOC MINI LAB – SSH BRUTE-FORCE DETECTION AND SIEM DASHBOARD

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Secure Shell (SSH) services play a critical role in modern computing environments by enabling secure remote access and encrypted communication between systems. However, due to their exposure to public networks, SSH services are highly vulnerable to brute-force attacks, where attackers repeatedly attempt multiple username and password combinations to gain unauthorized access. Detecting such attacks is challenging because they often resemble normal login behavior and can be distributed across multiple sources. This project presents a Security Operations Center (SOC)-based solution designed to detect and mitigate SSH brute-force attacks in real time. The system utilizes a Python-based log monitoring engine that continuously analyzes authentication logs generated by the Linux operating system. A sliding window detection mechanism is implemented to track failed login attempts within a specific time interval, enabling the identification of suspicious patterns based on predefined thresholds. Detected activities are classified into severity levels such as LOW, MEDIUM, and HIGH to support effective prioritization of threats. For high-severity incidents, the system automatically blocks malicious IP addresses using iptables, ensuring rapid response and minimizing potential damage. Additionally, the system generates structured alerts in JSON format, enabling seamless integration with SIEM platforms. A SIEM-style dashboard is also developed to provide real-time visualization of attack patterns, including frequency, severity distribution, and source IP analysis. Overall, the proposed system offers a cost-effective, scalable, and efficient approach to real-time threat detection, automated response, and enhanced security monitoring within a SOC environment.

Keywords: SSH; Brute-force attack; SOC; SIEM; Log monitoring; Cybersecurity; Intrusion detection; iptables

PATTERN RECOGNITION-BASED SYSTEM FOR SIGN LANGUAGE AND EMOTION DETECTION

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Pattern recognition plays a crucial role in enabling intelligent systems to interpret human communication beyond traditional text and speech. This paper presents a web-based system that utilizes pattern recognition techniques to recognize sign language gestures and analyze human emotions in real time. The proposed model leverages image processing and machine learning algorithms to detect hand gestures and facial expressions, converting them into meaningful text outputs. The system aims to bridge the communication gap between hearing-impaired individuals and the general population by providing an intuitive and accessible platform. By integrating pattern recognition with modern web technologies, the application ensures real-time processing, user-friendly interaction, and scalable deployment. Additionally, emotion detection enhances the system by providing contextual understanding, improving the accuracy and effectiveness of communication. This work demonstrates how pattern recognition can be effectively applied in assistive technologies, offering a smart and inclusive solution for human-computer interaction and contributing to advancements in AI-driven accessibility tools.

Keywords: Pattern Recognition, Sign Language Recognition, Emotion Detection, Machine Learning, Computer Vision. Human-Computer Interaction, Assistive Technology, Image Processing, Real-Time Gesture Recognition, Facial Expression Analysis

SMART NOTE COLLAB

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Smart Note Collaboration is a web-based application designed to enable real-time collaborative note-taking among multiple users. In modern digital environments, effective collaboration is essential for improving productivity and communication, especially in academic and organizational settings. Traditional note-taking systems lack real-time interaction and synchronization, making collaborative work inefficient. This paper proposes a scalable and efficient system that allows users to create, edit, and manage notes simultaneously in a shared environment. The system is developed using React for the frontend, Node.js with Express for backend processing, and MongoDB for database management. Real-time synchronization is achieved using Socket.IO, ensuring that updates made by one user are instantly reflected across all connected users. The application also incorporates secure authentication using JSON Web Tokens (JWT) to protect user data and restrict unauthorized access. The proposed system follows a client-server architecture, enabling efficient handling of requests and improved scalability. Experimental usage demonstrates that the system enhances collaboration, reduces communication delays, and maintains data consistency. The Smart Note Collaboration system provides a simple, efficient, and reliable solution for real-time teamwork and can be further extended with advanced features such as AI-based suggestions and offline support.

Keywords Smart Note Collaboration, Real-Time Collaboration, Web Application, Socket.IO, JWT Authentication, MongoDB, Node.js, React, Client-Server Architecture, Collaborative Systems.

PNEUMONIA DETECTION USING DEEP LEARNING AND ENSEMBLE LEARNING

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Pneumonia is a life-threatening respiratory disease that requires early and accurate diagnosis to prevent severe complications. With the rapid growth of artificial intelligence in healthcare, automated detection using medical imaging has become highly effective. This project proposes an advanced system for pneumonia detection from chest X-ray images using deep learning and ensemble learning techniques. A pre-trained Convolutional Neural Network model, VGG19, is utilized for feature extraction from chest X-ray images. The model captures high-level features such as texture patterns, lung opacities, and abnormalities associated with pneumonia. The dataset consists of labeled chest X-ray images categorized into normal and pneumonia classes. Preprocessing techniques such as image resizing, normalization, and noise reduction are applied to improve data quality and model performance. Instead of relying solely on deep learning classification, the extracted features from VGG19 are fed into ensemble learning algorithms such as XGBoost and Random Forest for final classification. This hybrid approach combines the strengths of deep learning and machine learning, resulting in improved accuracy, robustness, and generalization. Ensemble learning helps reduce overfitting and enhances prediction reliability by combining multiple decision models. The system is trained using supervised learning techniques and optimized with suitable evaluation metrics. Experimental results demonstrate that the proposed hybrid model outperforms individual classifiers and achieves high accuracy in pneumonia detection. This approach provides an efficient and scalable solution for assisting medical professionals in early diagnosis and decision-making. Future enhancements may include real-time deployment and integration with clinical systems.

Keywords: Pneumonia Detection; VGG19; Deep Learning; Ensemble Learning; XGBoost; Random Forest; Chest X-ray; Medical Imaging; Computer Vision; Image Processing.

AI-DRIVEN MULTI-SOURCE PREDICTIVE ANALYTICS SYSTEM FOR GOLD AND STOCK MARKET FORECASTING

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Financial markets like gold and stocks change a lot because of many factors such as past prices, economic conditions, news, and public opinions. Most existing prediction systems only use past price data, so they are not very accurate. This project introduces a smart AI-based system that predicts gold and stock market trends more accurately by using different types of data together. It combines several advanced techniques like LSTM (for time-based data), Random Forest and Gradient Boosting (for classification), and Reinforcement Learning (for making trading decisions).The system also uses Natural Language Processing (NLP) to analyze news and social media to understand market sentiment. Additional forecasting methods like ARIMA and Prophet help improve predictions .Data is collected in real-time from sources like Yahoo Finance and social media platforms. The system processes this data and shows results through an interactive dashboard, giving suggestions like Buy, Sell, or Hold, along with risk analysis. Overall, this system is more accurate, reliable, and useful for both beginners and professional investors because it combines multiple AI techniques and data sources into one platform.

Keywords Gold Rate Prediction, Stock Market Forecasting, LSTM, Sentiment Analysis, Reinforcement Learning, Multi-Source Data, Real-Time Analytics, Portfolio Management.

PORTABLE VIBRATION-DAMPING MATERNITY SUPPORT SEAT

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This paper presents a smart portable cushion system designed to improve comfort and safety for pregnant women during travel without altering existing seating. Travel often causes discomfort, lower back pain, and motion-induced nausea due to continuous vibrations and inadequate support. The proposed system integrates a lightweight, foldable frame with high-resilience memory foam to provide adaptive enhancing stability and reducing motion sickness. A built-in heating pad with an adjustable thermostat offers controlled warmth for muscle relaxation, powered by a rechargeable battery enclosed in a waterproof and insulated casing for safety. Additionally, an adjustable lower abdominal support belt provides gentle lift and weight distribution to reduce pressure during later pregnancy stages. The cushion features a non-slip base for secure placement on existing seats, while all electronic components are designed with water resistance and proper insulation to ensure safe operation. By combining vibration control, thermal comfort, ergonomic design, and safety features, this system offers a practical, portable, and user-friendly solution to enhance travel comfort and well-being for pregnant women.

Keywords*:* Maternal ergonomics, portable assistive seating system, vibration attenuation, biomechanical support, motion sickness mitigation, thermoregulatory cushioning, adaptive memory foam, abdominal load redistribution, human-centered design, travel stability enhancement, embedded heating system, safety-compliant wearable support.

AI-BASED CHABOT'S IN CUSTOMER COMMUNICATION - A COMPARATIVE STUDY OF INDIA AND GERMANY

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This study examines the implementation, adoption, and effectiveness of AI-powered Chabot's in customer communication by conducting a systematic comparative analysis between India and Germany — two economies representing markedly different technological maturity levels, regulatory philosophies, and cultural orientations. Drawing on a structured literature review (2018–2025) and eight semi-structured expert interviews with practitioners from multinational technology companies, digital transformation agencies, and AI product firms operating in both markets, this research identifies the key technological, institutional, and socio-cultural determinants shaping Chabot deployment. The findings reveal that India's adoption is driven by a mobile-first infrastructure, multilingual NLP innovation, cost-efficiency imperatives, and a young digitally native population, while Germany's approach remains anchored in GDPR compliance, enterprise-grade security, institutional trust-building, and risk-averse innovation culture. Critically, this paper introduces three original contributions absent in prior comparative Chabot studies: (1) a Multilingual Fragmentation Index (MFI) to measure NLP deployment complexity across linguistically diverse markets; (2) a Regulatory-Cultural Adoption Matrix (RCAM) that maps Chabot readiness along dual axes of regulatory permissiveness and cultural openness; and (3) a Cross-Market Deployment Framework (CMDF) offering strategic guidance for multinational organizations deploying AI Chabot's across divergent regulatory and cultural landscapes. The study further examines the emerging role of agentic AI, voice-first interfaces, and large language model (LLM) localization in shaping the next phase of customer communication in both markets.

Keywords: AI Chabot's, Customer Communication, India, Germany, Multilingual NLP, Regulatory Frameworks, Cultural Adoption, Cross-Market Deployment, Agentic AI, LLM Localization.

AI-POWERED OVARIAN CANCER RISK PREDICTION AND HEALTH MONITORING SYSTEM WITH DIGITAL TWIN INTEGRATION

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Ovarian cancer is a life-threatening disease that originates in the ovaries, where abnormal cells grow uncontrollably and form tumors. Detecting this cancer at an early stage is extremely difficult due to the lack of noticeable symptoms, which often leads to delayed diagnosis and reduced survival rates. This project proposes an intelligent AI-based healthcare system designed to support early risk prediction, continuous monitoring, and awareness of ovarian cancer. The system provides two primary modes of interaction: symptom-based input (voice/text) and medical report-based input (such as blood tests, ultrasound, CT scan, and MRI). In the first module, users enter details such as age, family history, and symptoms through voice or text input.. Based on the user-provided data, machine learning models such as Random Forest, Support Vector Machine (SVM), and Logistic Regression are used to analyze the inputs and perform early risk assessment. Additionally, the system includes a comprehensive guide that explains ovarian cancer, its causes, symptoms, and diagnostic procedures in an easy-to-understand manner. In the second module, users can upload medical reports, which are analyzed using advanced AI techniques such as Optical Character Recognition (OCR) and Natural Language Processing (NLP). The system extracts relevant medical information and generates a health score (0–100) along with a risk level categorized as low, moderate, or high. Based on the identified risk level, the system provides personalized recommendations, including suggested actions, diet plans, and nearby hospital suggestions for further medical consultation. The system also offers simple, human-understandable explanations of medical reports, helping users understand abnormal values and their possible causes without requiring medical expertise. A key feature of the system is the automatic generation of a downloadable “health report card” that summarizes the user’s condition, similar to a doctor’s report. Furthermore, the system integrates an intelligent chatbot to provide real-time assistance and answer user queries. An innovative Digital Twin feature creates a virtual representation of the user’s health profile, enabling continuous monitoring and prediction of future disease risks. The system also includes an auto-learning mechanism that continuously improves prediction accuracy by learning from new data. Additionally, it securely stores personal health history, which can be accessed by healthcare professionals for better diagnosis, long-term tracking, and improved medical decision-making. Overall, this system enhances early detection, increases awareness, supports proactive healthcare decisions, and provides a user-friendly platform for effective ovarian cancer risk management.

Keywords: Ovarian Cancer, Artificial Intelligence, Machine Learning, Early Detection, Risk Prediction, Natural Language Processing (NLP), OCR, Digital Twin, Health Monitoring, Healthcare System.

A COMPARATIVE DEEP LEARNING FRAMEWORK FOR MULTI-CLASS SOLAR PANEL FAULT DETECTION

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The Solar PV systems are one of the major contributors to renewable energy. However, efficiency is impacted by factors like dust accumulation, bird droppings, snow, as well as physical and electrical failures. This paper proposes an automated fault detection system based on deep learning techniques along with an ensemble approach. Pre-trained models like VGG16, EfficientNet-B3, and MobileNetV2 are employed for multi-class classification of faults in solar panels. A stacking ensemble approach, where Logistic Regression acts as a meta-learner, is employed to improve accuracy, along with a soft voting mechanism. The model categorizes panel conditions into six classes: Bird-Drop, Clean, Dusty, Electrical-Damage, Physical-Damage, and Snow-Covered. There is also a website where people can upload images and receive predictions along with confidence values and actions. Experiments demonstrate that the proposed model achieves good and reliable performance, making it suitable for real-time solar panel monitoring.

Keywords: Deep Learning, Solar Photovoltaic Systems, Fault Detection, CNN, VGG16, EfficientNet-B3, MobileNetV2, Ensemble Learning, Logistic Regression, Flask Web Application

REAL TIME MONITORING HELMET FOR MINERS USING IOT

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Mining is one of the most hazardous industries, exposing workers to toxic gases, poor air quality, and low-visibility environments. To enhance miner safety, we have developed a prototype of smart miner's safety helmet equipped with an MQ-2 gas sensor, humidity sensor, and an automatic LED lighting system. The gas sensor detects carbon monoxide (CO) and flammable gases, triggering an alarm when dangerous levels are detected. The humidity sensor monitors environmental conditions to help assess potential risks underground. Additionally, a darkness detection system automatically activates LED strip lights in low-light conditions, improving visibility in tunnels and deep mining areas. This prototype is powered by Node MCU ESP8266, enabling real-time monitoring and alerting. By integrating IoT technology and sensor-based automation, this helmet aims to provide early warnings and enhance worker safety in mining operations. The system is designed to be lightweight, efficient, and scalable for future enhancements.

AI DRUG DISCOVERY SYSTEM: AI-BASED DRUG DISCOVERY AND ACTIVITY PREDICTION

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Finding the drug compounds with certain biological activity is time consuming and expensive process in drug discovery. Traditional approaches mostly utilize labor intensive experimental methods requiring a long duration. An AI Based Drug Discovery and Activity prediction system has been designed using machine learning algorithms that aims to increase the speed at which drug candidates can be identified. It determines the biological activity by using chemical compound data based on trained machine learning models. This includes different stages like data preprocessing, feature extraction, training the model and prediction. Using different algorithms like regression and classification model can find trends in molecular data and determine whether the compounds will be effective. The implemented system can bring down the duration and cost involved in drug discovery, thereby achieving a more precise prediction.

Keywords*:* Drug Discovery, Machine Learning, Activity Prediction, AI in Healthcare, Data Analysis, Molecular Data

DIGITAL IMAGE CORPUS-BASED PRECISION AGRICULTURE WITH EFFECTIVE CROP HEALTH MONITORING AND WEED CONTROL STRATEGIES

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Precision agriculture has emerged as a transformative approach to modern farming, leveraging advanced technologies to optimize crop production while minimizing resource utilization. This paper presents a novel methodology for precision agriculture by utilizing a digital image corpus for efficient crop health monitoring and weed control strategies. The proposed system employs advanced image processing techniques, machine learning algorithms, and remote sensing technologies to analyze high-resolution agricultural images. The core of this approach lies in the development of a comprehensive digital image corpus containing diverse datasets of crops, diseases, pests, and weeds. Through the application of deep learning models, such as Convolutional Neural Networks (CNNs), the system can accurately identify and classify crop health conditions, enabling early detection of diseases and nutrient deficiencies. Furthermore, real-time monitoring and predictive analytics assist farmers in making informed decisions, reducing crop losses, and improving yield quality. In addition to health monitoring, the system incorporates intelligent weed detection mechanisms to differentiate between crops and invasive weed species. By leveraging semantic segmentation techniques, the model ensures precise weed localization, facilitating targeted herbicide application and promoting eco-friendly farming practices. The study demonstrates the effectiveness of the proposed methodology through experimental evaluations in various agricultural environments. The results indicate significant improvements in disease detection accuracy, weed identification precision, and overall resource efficiency. This research contributes to the advancement of sustainable agriculture by integrating digital imaging technologies with precision farming practices, ultimately supporting food security and environmental sustainability.

Keywords: Precision Agriculture, Convolutional Neural Networks, Semantic Segmentation

EXPLAINABLE DEEP LEARNING FRAMEWORK FOR MULTI-CLASS LUNG DISEASE CLASSIFICATION USING CHEST X-RAY IMAGES

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Chest imaging using X-ray images is widely used for the detection of various lung diseases such as COVID-19, pneumonia, viral pneumonia, and lung opacity. In recent years, deep learning techniques have shown strong performance in medical image classification. However, many deep learning models behave as “black boxes,” making it difficult for doctors to understand how the model arrives at a particular prediction, which can reduce trust in automated systems. This study proposes an explainable deep learning framework for multi-class classification of chest X-ray images. A transfer learning approach using the ResNet50 convolutional neural network is employed to extract important features and classify the images. To improve transparency and interpretability, Gradient-weighted Class Activation Mapping (Grad-CAM) is used to generate heat maps that highlight the regions of the X-ray image influencing the model’s predictions. This approach helps provide visual explanations for the model’s decisions and supports more reliable and interpretable medical diagnosis.

MULTI-MODEL MACHINE LEARNING FRAMEWORK FOR HUMAN DISEASE PREDICTION BASED ON GENETIC BIOMARKERS

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Genomic biomarkers offer crucial data for precision medicine and early disease prediction. This work suggests a machine learning-based framework that uses gene-level molecular features to classify human genomic diseases. The goal is to assess how well various supervised learning algorithms can differentiate between disease conditions based only on genomic characteristics. To guarantee objective and consistent evaluation, a structured preprocessing pipeline was put in place that included label encoding, feature standardization, and stratified data partitioning. Within a single experimental framework, three supervised machine learning models—Random Forest (RF), Support Vector Classifier (SVC), and Gaussian Naive Bayes (NB)—were separately created and evaluated. Accuracy, precision, recall, F1-score, confusion matrix analysis, and multiclass Receiver Operating Characteristic (ROC) curves with Area Under the Curve (AUC) were utilized to assess the model's performance. Additionally, each model's training and testing times were measured independently in order to assess computational efficiency. The experimental findings show that machine learning models based on genomic features can precisely and highly reliably classify disease conditions. The comparative analysis sheds light on how probabilistic, kernel-based, and ensemble-based methods behave in genomic disease forecasting tasks. The suggested framework emphasizes the use of machine learning techniques in genomic-driven systems for diagnosis and provides a scalable and methodical approach for genomic disease classification.

Keywords: Genomic Biomarkers, Supervised Learning, Random Forest (RF), Support Vector Classifier (SVC), Gaussian Naïve Bayes (NB)

HEART STROKE PREDICTION USING MACHINE LEARNING WITH BMI-BASED HEALTH COUNSELING WEB APPLICATION

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Stroke is one of the leading causes of death and long-term disability worldwide, claiming approximately 6.6 million lives annually. Despite its devastating impact, medical research confirms that up to 80% of strokes are preventable through timely identification of risk factors and early clinical intervention. StrokeGuard AI is a machine learning-powered web application designed to bridge the gap between clinical research and public health awareness by offering accessible, real-time stroke risk prediction to individuals. The system employs a Soft Voting Ensemble model comprising four state-of-the-art classifiers: XGBoost, LightGBM, Gradient Boosting Classifier, and Random Forest. The ensemble is trained on a synthetically generated dataset of 20,000 samples, incorporating 10 base clinical features along with 7 engineered interaction features such as age-group tiers, glucose risk categories, BMI classification, and composite risk scores. Class imbalance is addressed using a SMOTETomek resampling strategy, and the trained model achieves a prediction accuracy exceeding 95%, with an AUC-ROC score above 0.98.The web application is developed using the Flask framework, exposing a RESTful API that processes user-submitted health data and returns stroke probability scores, risk level classification (Low, Moderate, High, or Very High), a visual risk meter, and personalised health recommendations tailored to the individual's risk profile. The frontend features a dark medical theme with an animated ECG monitor, vitals display, and a responsive user interface built with HTML, CSS, and JavaScript. The application additionally incorporates a Body Mass Index (BMI) Calculator with a six-tier WHO classification system — ranging from Underweight to Obese Class III — and delivers category-specific dietary and lifestyle counselling to each user. All computations are executed locally, ensuring complete data privacy. StrokeGuard AI demonstrates the practical value of ensemble machine learning in preventive healthcare and serves as an educational tool to raise stroke risk awareness among the general public.

Keywords: Stroke Prediction, Machine Learning, Ensemble Classifier, XGBoost, LightGBM, Flask, BMI Calculator, Preventive Healthcare, Risk Assessment

EDUVISION - AI-BASED ATTENDANCE AND FEEDBACK SYSTEM USING FACE RECOGNITION AND HAND GESTURES

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Conventional methods for attendance tracking and feedback collection in educational institutions are often inefficient, prone to inaccuracies and vulnerable to proxy attendance. Additionally, manual feedback processes increase administrative effort and limit timely analysis. To overcome these limitations, this paper presents an Automated Attendance and Feedback System that integrates face recognition and gesture recognition techniques. The proposed system utilizes deep learning based facial recognition to detect and identify students in real time, enabling automatic attendance recording without manual intervention. Furthermore, a vision-based hand gesture module is incorporated to capture student feedback in a contactless and user-friendly manner. The collected attendance and feedback data are securely maintained and visualized through a web based dashboard to support monitoring and decision-making. Experimental outcomes indicate that the system enhances accuracy, efficiency and scalability, making it a practical AI-driven solution for smart classroom environments

Keywords Face Recognition, Gesture Recognition, Automated Attendance System, Deep Learning, Computer Vision.

GRABEZ – A VISUAL FLOW-BASED BUILDER FOR INTELLIGENT SYSTEMS AND LEARNING PIPELINES

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Nobody drops hard-coding in the industry today. Applying AI assistants and tools to finish our code, projects and tasks is the reality of today's tech world. This dancing method is referred to as the Vibe Code. This is what vibe coding is all about and it does focus on program synthesis, which enables the construction of algorithms, models for learning and applications without having to write programs from scratch. Agents, chat bots, models etc are made with simply dragging the blocks and connecting them to each other; and you can even see their code and change it (and download the wireframe) or use as a template for your own project. In this lesson, you are going to play around a playground build with ReactFlow and add drop different blocks of code for specific tasks (AI / ML apps) like building a house with steps. This is the main purpose of the project to be simply a tool for this, for the students and researchers learn with ease about flow of models, algorithms and applications visually and technically. This application is extended to support with next level advanced tasks which may involve deep learning, or pipe line kind of operation and also provide an extension that allows the users to make use of it in any IDE they are comfortable.

Keywords*:* AI and ML; ReactFlow; learn visually; Vibe Coding; drag and drop; deep learning pipeline; extension.

A SURVEY ON AGENTIC AUTOGEN USING DAVIA (DYNAMIC AGENT-BASED VIRTUAL INTELLIGENT ASSISTANT)

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Artificial Intelligence has changed a lot. It is not just about following simple rules anymore. Now it is about making systems that can think and do things on their own. The new AutoGen systems that work together are a deal in this field. They let many Artificial Intelligence agents work together to do tasks. The DAVIA model is an example of this. It brings together agents that work together with a way of handling memory and understanding the context. It is also designed to be user-friendly. This paper is a look at the systems that make this work. It talks about how they came to be how they are built what research has been done and what problems they face. The study also looks at how DAVIA makes traditional AutoGen systems better. It does this by making them adapt to situations using memory to make smart decisions and giving users a easy to use interface to manage tasks. Artificial Intelligence and the DAVIA model are making changes, in this field.

AI - ENHANCED VIRTUAL ASSISTANTS WITH EMOTION SENSING CAPABILITIES

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Human emotions play a crucial role in how we communicate and make decisions, yet most traditional chatbots and computer systems fail to understand this emotional aspect. They typically respond only to textual input, often resulting in replies that feel mechanical and lack empathy. To overcome this limitation, this project introduces EmotiAI: An AI-Based Emotion Recognition and Wellness Assistant, a web-based system designed to understand user emotions and respond in a more supportive and human-like manner. The system analyzes user input to detect emotions such as happiness, sadness, anger, fear, and neutral mood. It uses a DistilBERT-based model for text emotion classification and a Vision Transformer (ViT) model to interpret facial expressions, combining both approaches to achieve more accurate and reliable emotion detection.

The application is developed as a full-stack web system using React for the frontend and FastAPI for the backend, with SQLite used to store user data and conversation history. Once the system identifies the user's emotional state, it generates thoughtful responses and offers wellness recommendations, including relaxation techniques, motivational messages, and emotional support. By making virtual assistants more emotionally aware, this project aims to improve human–computer interaction and create more meaningful user experiences. Such systems can be highly beneficial in areas like mental wellness support, intelligent chatbots, educational tools, and interactive digital assistants.

Keywords Emotion Recognition, Artificial Intelligence, Multimodal Learning, DistilBERT, Vision Transformer (ViT), Natural Language Processing (NLP), Facial Expression Analysis, Mental Wellness, Human–Computer Interaction, Chatbot, FastAPI, React, Machine Learning, Emotion Classification, AI Assistant.

AI SMART GLASS WITH DIRECTION AWARE AND MULTILINGUAL VOICE ASSISTANCE

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This study introduces an advanced AI-driven assistive system in the form of smart glasses designed to support visually impaired individuals through real-time scene understanding, object recognition, and multimodal guidance. The proposed system integrates multiple sensing technologies, including thermal sensors, high-resolution cameras, and GPS modules, along with embedded artificial intelligence units to provide comprehensive environmental awareness across diverse conditions. By combining visual and thermal data, the system ensures reliable performance in both well-lit and low-visibility environments, thereby enhancing user safety and confidence during navigation. One of the key innovations of this work is the implementation of local AI inference using an optimized deep learning model, which reduces dependency on cloud computing and enables faster processing with minimal latency. The system delivers real-time auditory feedback through bone-conduction speakers, allowing users to receive navigation instructions and object descriptions without obstructing their natural hearing. Additionally, the system supports multilingual voice guidance, making it more accessible and user-friendly, especially in regional contexts such as Tamil Nadu. The architecture of the proposed solution follows a modular design, ensuring scalability, cost-effectiveness, and ease of customization. This makes the system suitable not only for assistive purposes but also adaptable to other application domains. Experimental evaluation demonstrates that the system achieves a real-time response delay of less than 200 milliseconds, ensuring smooth and uninterrupted interaction. The integration of sensor fusion techniques significantly improves object detection accuracy and environmental perception compared to traditional single-sensor systems. Furthermore, the system operates in a completely hands-free manner, enabling users to navigate independently without additional physical effort. The inclusion of GPS-based location awareness enhances contextual guidance, allowing users to identify their surroundings more effectively. Compared to existing assistive technologies, the proposed system provides improved reliability, efficiency, and user autonomy. Overall, this research establishes a strong foundation for the development of next-generation wearable assistive technologies. Beyond aiding visually impaired individuals, the system has potential applications in elderly care, industrial safety monitoring, and emergency response scenarios, where real-time awareness and guidance are critical.

Keywords Visually impaired, smart glasses, thermal imaging, AI navigation, scene understanding, assistive technology, sensor fusion, multilingual voice guidance, real-time systems, wearable computing.

AI CAREER GUIDANCE SYSTEM

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Career Nest is a web-based platform designed to help users explore career opportunities and job options. The system allows users to create profiles, analyze their skills, and receive suitable career suggestions. It provides a centralized platform for career guidance, job discovery, and skill development resources. The application aims to simplify career decision-making and connect job seekers with relevant opportunities.

Keywords AI Career Coach, Resume Scorer, JD Matcher, Interview Prep.

A REAL-TIME MULTIMODAL AI ASSISTANT USING HAND GESTURES AND SPEECH TOGETHER

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This project develops a high-performance multimodal Human-Computer Interaction (HCI) framework for low-latency, system-wide desktop control using Python, JavaScript/TypeScript, and C#. The system uses MediaPipe and OpenCV to detect 21-point hand landmarks in real time (60 FPS) and applies a weighted smoothing algorithm for stable cursor movement. Voice commands are processed using an offline Vosk-based natural language understanding engine that converts speech into system actions. A Node.js System Bridge enables fast bidirectional communication through WebSockets between the detection system and the operating system. To bypass browser security restrictions and allow global system control, a C# Interop and PowerShell backend interacts with user32.dll for native mouse and keyboard simulation. The interface is built with a Next.js/React Heads-Up Display (HUD) that provides real-time system feedback. By integrating these technologies, the framework enables responsive, touchless, and hardware-independent desktop interaction across applications.

AIR CAST PREDICTIVE MODEL FOR AIR POLLUTION LEVELS USING SUPERVISED MEANING LEARNING

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Air pollution is a problem these days especially in cities that are growing really fast. You can see how it affects peoples health and daily life. If we can predict when the air will be bad it can make a difference. This helps the people in charge and the public do something about it before it gets really bad. This project is about making a model that can predict air pollution. We use something called supervised machine learning to do this. We look at data about the environment to forecast what the air will be like. The model looks at things like temperature, humidity, wind speed and bad things in the air like PM2.5 PM10, NO_2 and CO. All these things are important for air quality. First we get the data from sources. Then we clean it up. Make sure it is all consistent. We pick the important things to look at and split the data into two groups. One group is used to build the model. The other group is used to test it. We try a different ways to make the model like Decision Tree, Linear Regression and Random Forest. Random Forest works well because it reduce errors, handles complex patterns, and avoids over fitting better than many simpler models. We use the model to guess the Air Quality Index (AQI). We check how good it is by looking at things like Mean Absolute Error and R^2 score. The results are good. The model is already capable of predicting air pollution effectively. By enhancing it with real-time data and turning it into a website or mobile app, it could become an extremely useful tool for monitoring air quality. People can use it to check the air quality and make decisions every day. The Air Quality Index is a thing and our model can help with that. We are talking about air pollution. How our model can predict it. Air pollution is a deal and we need to do something about it.

Keywords Air Pollution, AQI Prediction, Machine Learning, Supervised Learning, Random Forest, Environmental Data, Data Preprocessing, Feature Selection, Prediction Model, Air Quality Monitoring.

HARNESSING AI AND DEEP LEARNING TO COMBAT CYBERBULLYING DETECTION WITH MULTIMODEL APPROACH

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Cyberbullying is now a big problem in society because of the way people use the internet a lot, like social media, video sites, and online groups. This project introduces a com prehensive system for identifying cyberbullying across various data types—video, images, and text—by utilizing advanced deep learning and natural language processing methods. For video analysis, the YOLOv8 model is used to spot bullying and harmful actions as they happen. It looks at faces, body movements, and how people interact in each frame of the video. In image analysis, MobileNetV2, which is a light but strong type of neural network, is trained using transfer learning to identify images that show aggressive or harmful visuals connected to cyberbullying. For text-based detection, natural language processing (NLP) methods are utilized to detect abusive language, threats, and bullying patterns within textual data. The system brings together these three types of input into one platform that can handle different kinds of media.

Keywords— Cyberbullying, social media, Abusive comments, Multimodel.

GEN AI-DRIVEN PLATFORM FOR DOMAIN-BASED PLACEMENT PREPARATION, MOCK TESTING, AND AUTOMATED HR EVALUATION

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The rapid growth of artificial intelligence technologies has created new opportunities to enhance student preparation for campus recruitment processes. Traditional placement preparation methods often lack personalized guidance, real-time feedback, and realistic interview practice, which can limit students' readiness for technical and HR evaluations. This paper proposes a Generative Artificial Intelligence (GenAI) driven platform designed to support domain-based placement preparation through adaptive mock testing and automated interview assessment. The proposed system integrates natural language processing, machine learning techniques, and generative AI models to simulate real-world interview scenarios and provide intelligent feedback. The platform includes modules for domain-specific question generation, adaptive mock test evaluation, conversational HR interview simulation, and performance analytics. By analyzing user responses and interaction patterns, the system identifies strengths and areas for improvement while delivering personalized recommendations to enhance technical knowledge, communication skills, and problem-solving ability. The architecture emphasizes scalability, interactive learning, and secure data handling to ensure reliable user experience. Preliminary evaluations indicate that the platform improves student engagement and provides effective preparation support compared to conventional methods. The proposed solution demonstrates the potential of generative AI in creating intelligent educational tools that enhance employability and streamline placement preparation processes.

Keywords Generative AI, Placement Preparation, Mock Interviews, Natural Language Processing, Automated Evaluation.

INTEGRATING SENTIMENT ANALYSIS WITH MACHINE LEARNING FOR CYBERBULLYING DETECTION ON SOCIAL MEDIA

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The way we talk to each other has changed a lot because of the media. Now people can share what they think and how they feel away. With media around there is also more bullying on the media. This bullying on the media is a problem that affects people health and their social lives. It is hard to find and stop bullying on the media. This paper is about a system that uses tools to figure out how people feel and machine learning to find bullying on the media especially on Twitter. This special tool helps us understand how people feel about things on the media. It looks at what people say. Decides if it is good, bad or nothing.

The system collects tweets makes them clean and uses a tool called TextBlob to see how people feel about each tweet on the media. This helps find things that can tell us if a tweet is bullying or not on the media. Then it uses these things with machine learning to find bullying on the media. The system also looks at hashtags. Who people talk to. It looks at what's popular to understand what people are talking about on the media.

By looking at tweets about people and things on the media the system can find content on the media. The results show that this way works better than ways to find bullying on the media. Using the tool and machine learning together helps find different kinds of bullying on the media.

In the end this research gives us a way to find bullying on the media. It helps make the media a safer place by finding interactions early on the media. May be someday we can use machine learning to understand how people feel in languages and make a system that tells us right away when there is bullying on the media. This can help us find bullying, on the media. We can make the system work on media platforms.

Keywords Cyberbullying Detection, Sentiment Analysis, Machine Learning, Twitter Data, TextBlob, Social Media Analysis, Natural Language Processing.

SMART AI-POWERED INTERACTIVE DRIVING PLATFORM WITH REAL-TIME VOICE COMMANDS AND GUIDANCE

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Driving a car safely requires you to pay attention to the road all the time make decisions and react fast to what's happening. We have things like navigation apps and telematics that can help us after we finish driving or give us some warnings. These things do not really help us while we are driving a car. They do not give us real-time help or advice. We cannot talk to them. We really need something that can help us while we are driving a car something that's smart and easy to use. This is why we made a driving helper that uses a smartphone camera and sensors to watch the road all the time. The driving helper can see cars people walking, lanes, traffic signs and how the driver is behaving. Then it tells the driving helper user what to do using voice commands so the driver can react properly to the situation.

The driving helper does more than just give us directions while we drive a car. It also tells us when we do something answers our questions and helps us get better at driving a car over time. The driving helper uses computer models like YOLOv8 to see things OpenCV to understand lanes and behaviour and natural language processing to talk to us. All the information is kept safe so we can look at it later and get advice on how to improve our driving. Overall this special driving helper makes driving a car safer and more fun. It shows us how powerful real-time machine learning can be in making driving systems better. The driving helper is, like a companion that helps us while we are driving a car.

Keywords Real-Time Driving Assistance, AI Driving Companion, Object Detection, YOLOv8, Lane Detection, Voice Interaction, Driver Feedback, Machine Learning, Driver behaviour Analytics, Deep Learning, Performance Monitoring, Interactive Guidance, Intelligent Driving System.

FACIAL VIDEO-BASED HEART RATE MONITORING

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Monitoring heart rate is essential for assessing cardiovascular health, detecting abnormalities, and supporting continuous wellness tracking. Traditional methods such as electrocardiograms (ECG) and pulse oximeters provide accurate measurements but rely on physical contact, making them intrusive and less suitable for long-term or everyday use. This project presents a real-time, non-contact heart rate monitoring system based on facial video analysis using remote photoplethysmography (rPPG). The proposed system utilizes a standard webcam to capture facial video and applies computer vision and signal processing techniques to extract physiological signals. Face detection is performed using the Viola–Jones algorithm, while the forehead region is tracked using Lucas–Kanade optical flow to ensure stability. The extracted region undergoes spatial filtering, color normalization, and temporal band-pass filtering to enhance the photoplethysmographic signal. A Fast Fourier Transform (FFT) is then used to identify the dominant frequency, which is converted into heart rate in beats per minute (BPM). The system is implemented in Python with a PyQt5-based graphical user interface that provides real-time visualization of heart rate, waveform, and spectral data, along with data logging capabilities. Experimental evaluation demonstrates reliable performance under controlled conditions, achieving low error rates when compared with standard pulse oximeters. This approach offers a cost-effective, user-friendly, and non-invasive solution for applications in telemedicine, fitness monitoring, and home-based healthcare.

SMART FARMING SAFETY SYSTEM FOR HEAT STRESS AND PESTICIDE RISK DETECTION

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The problems of pesticide poisoning and heat stroke are two of the biggest occupational health hazards to farmers in the developing world. Approximately 385 million farmers or 44% of the total farming population in the world experience unintentional pesticide poisoning every year, resulting in over 11,000 fatalities annually.

Unfortunately, the farming population in the rural areas has access to no such real-time tools to assess the health risks and take immediate action to ensure their safety. Hence, the problem remains to be a grave and unaddressed concern. The Smart Farming Safety System for Heat Stress and Pesticide Risk Detection is a free

Artificial Intelligence-powered real-time health risk assessment and emergency response system developed using the Python programming language and Google Colab. The system works on a basic smartphone and internet connection. The system fetches real-time weather information using the Open Meteo API and a WHO- classified pesticide toxicology database to generate a comprehensive safety score for the farmers. A new heat absorption multiplier determines the effect of temperature on the absorption rate of pesticides by the human body, thus providing a more accurate health risk assessment than any other existing free system. The system carries out several simultaneous tests including real-time heat stress computation using the wet bulb globe temperature index, pesticide exposure risk analysis, adequacy of protective gear, and tracking of monthly exposure levels in order to alert workers of impending chronic diseases. In the event of danger being sensed, the system will immediately provide workers with pesticide-specific first aid tips, locations of nearby hospitals, emergency contact information, calculate the amount of water intake needed according to the worker's weight and the temperature, calculate the time it will take for workers to return to the field after spraying, and keep a log of workers' daily health. The system will help in the achievement of United Nations Sustainable Development Goal 3.

Keywords: Heat Stress, Pesticide Poisoning, Agricultural Workers, Occupational Safety, Real Time Risk Assessment, Temperature, Heat Absorption Multiplier,, Emergency Alert System, Smart Farming.

SECURE AI DIGITAL TWIN FOR PREDICTING MACHINE FAILURES IN SMART INDUSTRY

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Modern factories need systems that can predict when machines will fail. These systems must be private and trustworthy. This paper talks about a system called Federated Blockchain-Secured Vision-Enabled Digital Twin or FBVDT for short. The FBVDT system uses four technologies to work together. Firstit uses something called Long Short-Term Memory networks to figure out how longer a machine will last, based on what sensors tell us. Second it uses Convolutional Neural Networks. To look at pictures of machine parts and find any defects. Third it uses something called Federated Learning, which lets different factories work together to train the system without sharing all their data. Lastly it uses a kind of blockchain to keep track of everything that happens so we know it is all honest and fair. The FBVDT system also has a Digital Twin engine that looks at real-time data from sensors and makes a copy of the machine. This virtual copy helps us keep an eye on the machines health simulate what might happen to it and plan maintenance ahead of time. We tested the FBVDT system using some data from NASA. It worked really well. It was able to predict when a machine would fail with good accuracy and it was also good at finding defects in pictures. The system was able to learn and get better within a few rounds of training even when we simulated it working across four different factories. The results show that the FBVDT system is just as good as systems that are not private and trustworthy but it also keeps data private and secure which is very important for factories. This makes the FBVDT system a good choice for making factories smarter, in the future.

Keywords Predictive maintenance, Federated learning, Blockchain security, Digital twin model, LSTM network, Visual defect detection, Machine health monitoring.

TRUTHLENS: AN EXPLAINABLE AI FRAMEWORK FOR ONLINE CONTENT CREDIBILITY ANALYSIS

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The fast circulation of misleading information across online platforms has created an urgent demand for dependable and transparent fact-checking solutions. TruthLens is designed as an explainable, AI-powered web application that evaluates digital claims by integrating intelligent machine learning models with real-time evidence retrieval. The platform processes user-entered statements using a transformer-driven language model to estimate credibility while concurrently collecting supporting information from credible news outlets and verified fact-checking organizations. Transparency is achieved through SHAP-based interpretability, enabling users to clearly see which specific words or phrases impacted the final decision. A locally hosted AI engine produces summaries grounded strictly in retrieved evidence, ensuring that conclusions remain factual and source-based. Temporal validation mechanisms assess whether the supporting information is current and contextually appropriate, while MongoDB ensures secure and structured data management. By combining automated reasoning with verified evidence analysis, TruthLens enhances reliability, clarity, and user confidence beyond traditional AI-based verification systems.

Keywords Fake News Detection, Explainable Artificial Intelligence (XAI), Claim Verification, Evidence Retrieval, Transformer Models, SHAP Explainability, Semantic Similarity, Natural Language Processing, Evidence-Grounded Summarization, Temporal Validation.

AI-BASED SMART BLOOD DONATION PREDICTION SYSTEM

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The prompt availability of blood is among the most vital elements in preserving lives during medical emergencies, including accidents, surgical procedures, and critical health issues. Nevertheless, numerous current blood bank systems continue to depend on conventional or semi-digital approaches, which frequently lack adequate coordination, real-time updates, and the capacity to foresee future needs. These shortcomings can result in delays in identifying appropriate donors and shortages of necessary blood types at pivotal times.

To tackle these issues, this paper introduces an AI-Based Smart Blood Donation Prediction System that employs machine learning techniques to enhance the efficiency of blood donation and distribution. The suggested system evaluates key donor-related factors such as age, health status, blood type, geographical location, and prior donation history to ascertain donor eligibility and forecast their future availability. Furthermore, the system leverages historical data to predict blood demand trends, allowing hospitals and blood banks to organize and manage their inventory more proficiently. A user-friendly web-based platform is incorporated with the predictive model, facilitating real-time interaction among donors, recipients, and healthcare professionals. Features like location-based searches and automated alerts assist in swiftly identifying appropriate donors and addressing emergency requests. The findings demonstrate that the system markedly enhances donor matching precision and diminishes the time needed to find available blood.In summary, the proposed method merges artificial intelligence with contemporary web technologies to establish a more dependable and effective blood management system. It not only minimizes manual labor but also improves decision-making, ultimately leading to enhanced healthcare services and the preservation of lives.

Keywords Artificial Intelligence, Machine Learning, Blood Donation Prediction, Predictive Analytics, Real Time Monitoring, Web -Based Application, Healthcare Data Management.

DECENTRALIZED SMART VOTING SYSTEM USING BLOCKCHAIN AND DEEPLEARNING

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The rapid growth of digital technology has improved automation and connectivity. However, traditional voting systems still face challenges like security gaps, lack of transparency, centralized control, and risk of fraud. This paper proposes a Decentralized Smart Voting System that uses Blockchain and Deep Learning to ensure secure and transparent electronic voting.

The system combines deep learning-based facial biometric authentication with blockchain technology to verify voter identity and maintain vote integrity. Facial recognition authenticates voters, ensuring that only eligible individuals can take part in the election process. Once authenticated, votes are encrypted and recorded as transactions on a blockchain network. This provides immutability, transparency, and auditability while keeping voter anonymity.

Smart contracts automate the voting process, prevent duplicate voting, and enable reliable vote counting. The decentralized architecture removes single points of failure and lowers the risk of unauthorized manipulation. Experimental evaluations show effective voter authentication and secure vote storage, highlighting the feasibility of this approach for secure digital voting systems.

Keywords: Blockchain, Electronic Voting, Deep Learning, Facial Recognition, Smart Contracts, Biometric Authentication.

MEDSYNC: AN ACCESSIBLE SMART MEDICATION MANAGEMENT AND REMAINDER SYSTEM

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Skipping meds causes serious harm to how well patients get better. A tool called MedSync steps in - built into phones, it nudges people when pills are due. Instead of just alerts, it logs each dose taken, forming a clear timeline. Pictures of medicines appear inside the app, so users spot the right one fast. Mix-ups drop because what you see matches what was prescribed. Behind the scenes, pattern recognition learns from habits over time. Alerts shift on their own, fitting real-life routines more closely. No two schedules look exactly alike, yet the system keeps up without asking. Errors fade when visuals meet smart timing. Health improves not by chance, but through steady, guided support. Right off the bat, smart help built into the app makes things easier by responding like a thoughtful guide. When someone forgets their medicine at the planned time, alerts go straight to caregivers without delay. Built with Flutter, it runs smoothly while depending on Firebase for instant updates behind the scenes. Instead of guessing, users get consistent support exactly when needed. Tests showed people stuck to their doses more closely, found navigation simpler, and noticed faster responses overall.

Keywords Medicine Reminder, Healthcare App, Machine Learning, Flutter, Firebase, Medication Tracking, Image Recognition, AI Interaction, Caretaker Alert System

QUOTEVERDICT - AI POWERED BANKING INTELLIGENCE REVOLUTION

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The rapid growth of startups and emerging business ventures has increased the complexity of banking risk assessment and lending decisions. Traditional evaluation methods are manual, time-consuming, and heavily dependent on structured historical data, making them unsuitable for early-stage businesses with limited financial records.

This project presents QuoteVerdict, an AI-powered banking viability engine designed to automate and enhance business proposal evaluation by combining **Generative AI** and **real-time market intelligence**. The system follows a **multi-modal assessment** approach, where structured financial data, unstructured business descriptions, PDF pitch decks, and video pitches are jointly analyzed using **Gemini 2.5 Flash** and **LangChain-based** reasoning pipelines.

QuoteVerdict employs a **5D Scoring Algorithm** to evaluate Market, Financial, Team, Product, and Risk dimensions, generating both a quantitative viability score and an explainable verdict. External market data from financial and news APIs is integrated to ensure context-aware analysis. An **Explainable AI (XAI) layer** provides transparent reasoning behind each decision, improving trust and regulatory compliance.

All evaluations and metadata are securely stored using cloud-based databases, supported by an **enterprise-grade 8-layer security architecture**. The proposed system reduces subjectivity, improves decision speed, and strengthens data protection, making QuoteVerdict suitable for real-world banking and financial decision-support applications.

IOT-BASED SOIL MOISTURE PREDICTION FOR SMART FARMING

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Traditional agricultural practices often rely on manual observations and fixed irrigation schedules, leading to inefficient water usage, reduced crop yields, and limited scalability. Farmers lack real-time data-driven insights to make timely decisions regarding irrigation and crop health. The absence of automation and predictive analysis in rural farming contributes to inconsistent productivity and wastage of resources. This paper aims to solve these challenges by designing an intelligent soil moisture and crop management system that uses embedded systems to collect environmental data's such as moisture, temperature, and humidity and employs machine learning models to analyze this data and predict irrigation needs. It improves water usage efficiency, promotes sustainable farming practices, and reduces human efforts. The embedded system is designed to be compact, low-power, and user-friendly, supporting both offline and online operation modes. For remote monitoring, data is transmitted via Wi-Fi or GSM modules to a mobile application interface, where farmers can view insights, receive alerts, and manually override automatic irrigation systems if needed. Methodology of this paper is approached to precision agriculture through the development and integration of an advanced agricultural sensors. This paper showcases how combining of AI and IOT technologies can transform traditional agriculture into a smarter and resource-efficient.

Keywords: Machine Learning, Embedded System, GSM, Artificial Intelligence, Internet Of Things.

MIND LINK EEG: A REAL-TIME MENTAL FATIGUE AND COGNITIVE MONITORING SYSTEM

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An iPad and desktop version of Mind Link EEG is a real-time mental fatigue monitoring system. It processes raw 512Hz EEG signals by connecting via Bluetooth to the NeuroSky TGAM1 headset. The app computes cognitive metrics like attention and meditation and extracts frequency bands using on-device FFT analysis using Apple's Accelerate framework. A rule-based engine classifies mental states from low to critical by calculating fatigue scores and cognitive drift. Animated wave gauges, live ECG-style waveforms, session history with wellness grading, and a multi-channel alert system with push, email, and in-app notifications are some of the main features. Mind Link provides low-latency, private, and portable cognitive monitoring for maximum productivity during work or study sessions by integrating a full signal processing pipeline natively in Swift.

CHAOS: DESIGN AND IMPLEMENTATION OF A HYBRID OffIINE CROSS-PLATFORM MESSAGING SYSTEM USING BLE, JWT AUTHENTICATION

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Most modern communication platforms are built on a simple assumption that users will always have access to stable internet connectivity. Chaos challenges this assumption by presenting a hybrid, offline-first social messaging architecture that combines secure JWT-based authentication, Bluetooth Low Energy (BLE) device- to-device messaging, real-time WebSocket communication, a profile-centric progressive privacy model, and a machine learning-driven recommendation engine all within a single cross-platform React Native codebase. This paper details the motivations behind the design, the architectural decisions that underpin each subsystem, the implementation strategies employed across the frontend and backend, and the results obtained from initial system testing. The architecture demonstrates how modern mobile applications can remain functional and socially engaging even in connectivity-constrained environments, and establishes a foundation for future work in end-to-end encryption, BLE mesh networking, and deep learning-based personalization.

Keywords*:* React Native; Bluetooth Low Energy (BLE); JWT Authentication; Machine Learning Recommender Systems; Real-Time Messaging; WebSocket; Offline-First Architecture; Profile-Based Social Platforms; Privacy-First Design; Event-Driven Architecture

SOLVHUB: A COMMUNITY DRIVEN INCLUSIVE SERVICE PLATFORM

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SolvHub is a community-driven, multi-service digital platform designed to connect users with trusted local service providers while transforming the unorganized service sector into an inclusive and structured ecosystem. The platform supports a wide range of services including electrical, plumbing, carpentry, and appliance repair, while prioritizing employment opportunities for women, college students, retired government employees, and differently-abled individuals. A key innovation of SolvHub is the Unified Inclusion Dashboard, which integrates service access, workforce categorization, safety features, and earnings tracking into a single interface. Through location-based search, verified profiles, and secure booking mechanisms, the platform addresses challenges related to trust, accessibility, and fragmented service delivery.To ensure efficient and fair service allocation, SolvHub employs a location-based nearest neighbor matching algorithm to identify the closest available service providers and a priority-based ranking algorithm that considers factors such as distance, user ratings, availability, and inclusivity weightage. These algorithms enable intelligent and equitable job distribution while promoting opportunities for underrepresented groups. By combining smart algorithms with an inclusive design approach, SolvHub enhances service reliability, improves user experience, and fosters economic empowerment. The platform ultimately contributes to building a scalable and sustainable ecosystem that bridges the gap between local demand and skilled workforce supply.

Keywords*:* SolvHub; Multi-Service Platform; Inclusive Employment; Smart Service Matching; Location-Based Services; Digital Service Marketplace

SMART CLASS ATTENDANCE AND OCCUPANCY SYSTEM USING IOT AND FACIAL RECOGNITION

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The growth of Internet of Things (IoT) and artificial intelligence has created new possibilities for automation in education and institutional management. This project presents a Smart Attendance and Occupancy Monitoring System that uses ESP32-CAM, facial recognition, and local server processing to automate classroom attendance. Conventional attendance methods are manual, slow, and often affected by errors and proxy marking. The proposed system overcomes these issues by providing a fully automated and contactless solution.The system captures classroom images using the ESP32-CAM module and transfers them to a local server through Wi-Fi. OpenCV-based algorithms are used for face detection and recognition, and the identified students are automatically marked present with date and time. At the same time, the system counts the total number of faces to monitor real-time classroom occupancy. All attendance data and student details are stored in a database, and a web dashboard allows administrators to view records, analytics, and downloadable reports. The system reduces human effort, improves transparency, and prevents fraudulent attendance. Since it is built with lowcost IoT hardware and open-source software, it is suitable for easy deployment in educational institutions. In the future, the system can be enhanced with cloud support, mobile applications, and advanced deep learning models for better accuracy and scalability.

Keywords: IoT, ESP32-CAM, Facial Recognition, OpenCV, Automatic Attendance, Occupancy Monitoring, Smart Classroom, Machine Learning.

MINDSCRIBE – AN AI-POWERED STUDENT MENTAL WELLNESS COMPANION

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The mental health crisis among college students has intensified in recent years, with over 60% experiencing significant academic stress, anxiety, depression, or interpersonal conflicts, yet fewer than 20% seek professional help due to stigma, long waiting times, limited institutional resources, and cultural barriers particularly pronounced in diverse regions like India. Traditional counselling services are overburdened, while generic digital wellness apps often deliver impersonal, scripted responses lacking contextual relevance to student-specific stressors (e.g., exam pressure, peer dynamics, career uncertainty) and fail to prioritize robust data privacy. MindScribe is an innovative artificial intelligence- powered conversational agent designed as a confidential, 24/7 accessible mental wellness companion tailored exclusively for college students aged 18–25. The system employs a four-layer architecture: an NLP-based conversation engine utilizing transformer models for intent recognition, entity extraction, and multi-turn context tracking; an emotional state classifier combining fine-tuned RoBERTa on datasets like Go Emotions and custom academic stress data with SVM for urgency scoring, categorizing emotions (stress, anxiety, optimism, sadness) and intensity levels; a recommendation engine integrating evidence-based frameworks such as Cognitive Behavioral Therapy (CBT) for cognitive reframing, mindfulness-based stress reduction for relaxation techniques, and conflict resolution strategies, enhanced by generative empathetic responses; and a privacy and security layer enforcing AES-256 encryption, SHA-256 anonymization, end-to- end protection, no storage of personal identifiers, user- controlled data deletion/export, and GDPR-like compliance to foster trust in sensitive disclosures. By addressing key gaps in personalization, immediacy, cultural adaptability, and privacy unlike general-purpose tools (e.g., Woebot, Wayhaven) MindScribe serves as a scalable, low-cost adjunct to institutional. Cognitive Behavioral Therapy (CBT) for cognitive reframing, mindfulness-based stress reduction for relaxation techniques, and conflict resolution strategies, enhanced by generative empathetic responses; and a privacy and security layer enforcing AES-256 encryption, SHA-256 anonymization, end-to- end protection, no storage of personal identifiers, user- controlled data deletion/export, and GDPR-like compliance to foster trust in sensitive disclosures .Accessible via a responsive, multilingual (English + regional languages) chat interface on web and mobile platforms with theme customization for inclusivity, MindScribe processes free-form text inputs in real time, detects emotional cues, assigns urgency (casual to critical), and delivers personalized, culturally sensitive coping strategies (e.g., breathing exercises, journaling prompts, boundary-setting advice).The prototype demonstrates high performance: >90% intent recognition accuracy, >85% F1-score for emotion detection, and <2-second response times. Preliminary user interactions indicate improved emotional awareness, reduced perceived distress, and high satisfaction in stigma-free support.

REAL-TIME MULTI-MODAL DISTRESS CLASSIFICATION USING VOICE ACTIVATION AND OFFLINE BLE LOCATION ALERTING

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Existing personal safety applications including bSafe, Shake2Safety, and Himmat Plus rely exclusively on internet or cellular infrastructure to transmit emergency alerts and live GPS location data, rendering them non-functional in disaster zones, rural dead zones, network outages, and communication blackouts. This paper presents TERAX AI, an AI-driven personal safety ecosystem for Android that addresses this critical infrastructure dependency by introducing offline live location sharing via Bluetooth Low Energy (BLE 5.0) mesh networking as its primary novel contribution. In the proposed system, real-time GPS coordinates are encoded as compact 7-character Geohash strings and broadcast over BLE advertising channels within the 31-byte payload constraint, requiring no active connection between devices. Each proximate TERAX-enabled device autonomously functions as a store-and-forward relay node, propagating emergency location packets across a multi-hop mesh topology supporting up to seven hops and achieving an effective offline range of 700 meters to 1.4 kilometers under real-world conditions. All inter-node communication is secured using the Noise Protocol Framework, ensuring end-to-end encrypted relay across untrusted mesh participants. Beyond offline location broadcasting, TERAX AI integrates a multi-modal threat detection pipeline comprising continuous background keyword spotting for voice trigger phrases, OpenCV-based facial distress classification using TensorFlow Lite on-device inference, accelerometer-driven gesture recognition, and a countdown-based panic activation mechanism. Upon threat confirmation, the system initiates stealth operation through a fake power-off screen, silent audio-visual recording, and anti-theft photo capture on unauthorized access attempts. When network connectivity is restored, the system executes a parallel fallback pipeline dispatching alerts via SMS, WhatsApp API, and Firebase cloud synchronization. Experimental evaluation on a self-collected dataset of 412 real-world facial distress samples demonstrates end-to-end emergency activation within 2.8 seconds, outperforming manual SOS-based systems reporting 3.2-second alert delivery under equivalent network conditions, while uniquely maintaining full offline operability where apps such as Shake2Safety transmit no location data without active connectivity. Facial distress detection achieves 87.4% accuracy under unconstrained real-world noise conditions, with scope for improvement via transfer learning on larger corpora. TERAX AI establishes a reproducible framework for infrastructure-independent personal safety, with direct applicability to high-risk, low-connectivity, and multilingual environments.

Keywords: Bluetooth Low Energy Mesh Networking, Offline Emergency Response, Geohash Location Encoding, Noise Protocol Framework, Facial Distress Detection, Voice Trigger Recognition, Personal Safety AI, On-Device Machine Learning, TensorFlow Lite, Stealth Surveillance, Multi-Hop Relay Network, Human-Computer Interaction

SMART ALERTS: A PERSONALIZED DEAL FINDER POWERED BY AI, GEO-FENCING, AND REAL-TIME PUSH NOTIFICATION

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Smart Alerts is a mobile application designed to support small businesses and drive local economic activity by providing real-time updates on promotions and offers. With its user-friendly interface, it allows users to browse personalized deals from nearby retailers, saving time and money. Advanced features like AI-powered recommendations, geo-fencing, and real-time push notifications ensure users never miss out on valuable discounts, making shopping smarter and more convenient. For local businesses, Smart Alerts acts as a powerful tool to increase visibility, attract customers, and drive sales. By leveraging real-time promotions and social sharing, small shops can compete effectively with larger retailers while building a loyal customer base. The app also promotes sustainability by offering discounts on perishable items from grocery stores and restaurants, reducing food waste and encouraging eco-friendly shopping habits. Smart Alerts not only connects consumers to the best local deals but also fosters a vibrant and engaged community. By empowering small businesses and encouraging mindful consumerism, the app contributes to a thriving local economy. It's more than just a deal finder—it's a step toward a sustainable and connected shopping experience that benefits both shoppers and businesses.

MANGOMATE: THE AI-POWERED, SMART & SAFE, ECO-FRIENDLY PORTABLE CHAMBER FOR RIPENING AND PRESERVATION

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MangoMate was created to help solve a real challenge faced by mango farmers and small businesses in India: unsafe chemical ripening, fruit spoilage, and unpredictable quality that cut into profits and trust. With MangoMate, we introduce a portable, user-friendly chamber that takes the guesswork and chemical risks out of mango ripening. When needed, the chamber gently adds food-safe ethylene gas, adjusting the temperature and humidity so that fruits ripen together evenly and naturally without calcium carbide or unsafe shortcuts. At its core, the system uses a smart camera and simple artificial intelligence to keep an eye on every batch, checking how the mangoes look and feel. Once fully ripened, the chamber automatically cools and circulates fresh air to keep the fruit fresher for longer, giving growers extra days to get their mangoes to market. Farmers and MSMEs can control everything from their phone and choose the size of the chamber that suits their needs. By making safe, scientific ripening simple and affordable, MangoMate helps deliver better mangoes, less waste, and more income, while meeting modern food safety and export demands. In addition to streamlining the ripening process, MangoMate also logs data for quality tracking, making it easier for users to maintain consistency between seasons. Its energy-efficient features keep operating costs low, giving farmers long-term savings. With improved transparency and traceability, it also supports compliance with global export standards, unlocking new market opportunities. Ultimately, MangoMate empowers agricultural communities to work smarter, increase their earnings, and build a reputation for safe, top-quality mangoes both locally and abroad.

Keywords: AI powered Smart ripening chamber, Ethylene gas-controlled ripening, Mango peel colour detection, Portable fruit ripening system, post-harvest automation, MSME agro-innovation, Food-safe mango ripening, Image processing CNN, Sustainable agriculture.

INTENT-AWARE EXPLAINABLE PERSONALIZATION THROUGH COLLABORATIVE FEDERATED AUTOML SYSTEMS

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As personalized digital services have grown quickly, the need for smart systems that can adjust to user preferences while still protecting privacy and being open has grown as well. This paper presents an intent-aware explainable personalization framework developed on collaborative Federated Automated Machine Learning (FedAutoML) systems to meet these needs. Existing personalization methods have many problems, including concerns about data privacy, limited interpretability, data sparsity, and difficulty effectively capturing changing user intent in decentralized environments. An intent-aware mechanism is used to gather information about the user's context and behavior, and Explainable AI (XAI) techniques are used to make model predictions understandable to humans. The main goal of this method is to provide personalized, accurate recommendations that protect privacy and are easy to understand. The results show that the proposed framework improves personalization performance, enables models to perform better across distributed datasets, reduces communication overhead, and provides users with useful explanations for predictions.

HYBRID DEEP LEARNING MODEL FOR FAKE NEWS DETECTION USING BERT AND LSTM

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Online spaces grow fast, so false stories travel faster now, turning spotting them into something urgent. Instead of one method alone, this work mixes BERT with LSTM, two types of smart systems that learn differently. One reads whole pieces at once, while the other tracks word order like steps in time. By joining their abilities, the system sees deeper patterns than either could alone. Accuracy improves because context and sequence get equal attention during analysis. Detecting lies in text becomes more reliable when different thinking styles team up behind the scenes. Here, words get meaning from their surroundings using BERT, shaping deep word representations. Because context matters, meanings shift naturally across sentences. These representations move into an LSTM, one step later. Since order affects interpretation, the LSTM tracks how phrases unfold over time. Together, they handle flow and nuance without treating them separately. Meaning sticks close to structure in this setup. One step leads into another - first comes sorting raw data, then scrubbing messy text bits. After that, splitting sentences into chunks sets up the next move. Words become numbers through a ready-made BERT setup instead of building one fresh. From there, pattern tracking happens via an LSTM network linked to a dense output layer. Testing how well it works relies on clear measures like correct guesses, focused hits, coverage level, and balance score. Each number tells part of the story without overstating results. Tests show the new mix of methods works better than old machine learning or single deep learning setups. Because it runs fast, tools like live news checkers or platforms watching social feeds might use it to slow false claims. The moment it fits into daily tech, its strength becomes clear - handling facts sharper than before. Keywords—Fake News Detection, BERT, LSTM, Deep Learning, Natural Language Processing, Transformer Models, Sequence Learning, Machine Learning.

SMART VEHICLE CLASSIFICATION WITH RGB-D AND EDGE COMPUTING

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Detecting motion with RGB-D images is an effective way to classify vehicles. This method extracts color and texture information from RGB images and distance information from depth images. With this data, the system can understand its surroundings and operate accurately even in challenging conditions like low light, shadows, bad weather, and partial obstructions. This project focuses on creating an efficient system for detecting motion and classifying vehicles using RGB-D images. Image preprocessing techniques improve image quality and reduce noise. Background subtraction helps detect moving objects using a reference image. Depth image segmentation allows for object segmentation based on distance, leading to accurate detection of moving objects while minimizing false alarms from background disturbances. Once the system detects moving objects in the images, it identifies the region of interest. This step reduces computations, enhancing system efficiency. After finding the region of interest, the system employs a lightweight YOLOv8 deep learning model to classify objects. This choice improves system efficiency and effectiveness because the model uses little memory and provides real-time results without raising computation costs.The system runs on the MATLAB platform, which offers flexibility and power for developing and testing the models. Experimental results show that this system has better accuracy than traditional methods that rely only on RGB values. Additionally, it demonstrates strong performance in various environmental conditions. This reliability makes the system suitable for a wide range of applications. Moreover, the system delivers results with low latency, further enhancing its efficiency and effectiveness. It can be applied in several smart city contexts, including traffic management and accident detection systems. This capability makes it a valuable tool for developing intelligent transportation systems using edge computing and RGB-D sensor values.

Keywords: RGB-D Imaging, Motion Detection, Vehicle Classification, Image Preprocessing, Background Subtraction, Depth Image Segmentation, YOLOv8, MATLAB, Real-Time Detection, Intelligent Transportation Systems.

AN INTELLIGENT SYSTEM FOR FORECASTING MENTAL HEALTH RISKS IN WORKING INDIVIDUALS

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In the present scenario, mental health problems like stress, anxiety, and depression are common among working professionals in the fast-paced professional world. The factors that influence an individual's mental condition are working hours, task deadlines, and workload under pressure. The professional and personal life of the individual is affected due to mental health problems. The early symptoms of mental health problems are of utmost importance to avoid psychological problems and maintain a healthy lifestyle among individuals. An intelligent and human approach is proposed in the present study to predict the mental health problems among the working professionals using the techniques of machine learning and EEG signal processing.EEG signal processing plays a vital role in measuring electrical activity in the human brain, yielding valuable insights into mental health conditions. The proposed system uses EEG signal processing, and EEG signals are obtained for individuals performing tasks and also when they are resting. The EEG signal processing technique uses MATLAB software, and during processing, noise and disturbances are removed to obtain accurate signals. After signal processing, feature extraction techniques are used for representing mental conditions in a structured manner. For classification and prediction, various machine learning approaches such as Support Vector Machine, Random Forest, and K-Nearest Neighbors can be used. The extracted feature can be used for classifying individuals under different categories. The proposed approaches can be used for comparing and evaluating them to determine an accurate approach for mental health prediction. The experiment results indicate that the proposed system can be used for achieving reliable accuracy for detecting early symptoms of mental health risk, and this helps organizations to build a healthy professional environment.

Keywords: Mental Health Prediction, Machine Learning, Workplace Well-being, Predictive Analytics, Occupational Stress, Explainable AI, Employee Risk Assessment.

AI - POWERED PLANT DISEASE DETECTION FOR LOCAL FARMERS

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Plant diseases have been a serious menace to agricultural productivity and food security, especially where agricultural practices involve manual observation and traditional approaches used in plant disease diagnosis. Plant diseases that are not detected or identified on time result in high crop losses, high production costs, and high expenditures on chemical pesticides that adversely affect the soil and environmental conditions. It is against this background that the incorporation of artificial intelligence into agricultural practices has been presented as an effective approach that can enhance the efficiency and accuracy of plant disease diagnosis. This proposed research work aims to develop an AI-based plant leaf disease diagnosis system using deep learning techniques for the automatic identification of plant diseases from images of their leaves. The proposed system will use CNN models to extract the visual attributes of the plant leaves, such as the color, texture, and shape, to effectively identify healthy versus diseased plant leaves. Using the learned knowledge from the images of the plant leaves, the proposed system will be able to accurately identify several diseases. The proposed system has the overall objective of enabling farmers to easily recognize plant diseases.

IOT-BASED REAL-TIME ACCIDENT DETECTION AND NOTIFICATION SYSTEM

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Road accidents have become increasingly common in recent years, leading to a significant number of serious injuries and fatalities. In some cases people nearby may help, but many times accidents happen in isolated areas or at night time. At that time no one is there to help the injured person resulting in delays in emergency response and medical assistance. Because of this, help reaches very late and the situation becomes serious. So it is important to reduce the time taken to send accident information. This paper is made to solve this problem. It is a smart accident detection and alert system. The system detects accident automatically and sends the location details it is simple in design and low in cost, so it can be used in real time situations. The system uses ESP32, MPU6050 sensor and GPS module. The MPU6050 sensor checks sudden movement, vibration and tilt of the vehicle. If any unusual movement is detected, the system waits for few seconds. Then ESP32 sends an SMS with Google Maps link to the enabled network saved phone number. During testing, the system worked well and gave nearly 92 percent accuracy. This project helps to send help faster and improve rider safety.

AI-BASED TRAFFIC SIGNAL OPTIMIZATION USING IMAGEBASED VEHICLE DETECTION AND QUANTUM OPTIMIZATION

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With the growing importance of assistive technology, this project introduces an AI-powered Real-Time Object Detection and Audio Guidance System aimed at supporting visually impaired individuals in safe and independent navigation. The system utilizes the YOLOv8 deep learning model integrated with computer vision to detect surrounding objects through a live camera feed. Detected objects are announced via a text-to-speech (TTS) engine, providing realtime audio feedback to users. The system also estimates the distance of obstacles and offers directional guidance, such as “move left” or “move right.” Utilizing CUDA-enabled GPU acceleration, it ensures faster and more accurate processing. By combining artificial intelligence, speech synthesis, and visual perception, this project enhances environmental awareness, safety, and independence for visually impaired users.

Keywords: YOLOv8, Object Detection, Artificial Intelligence, Computer Vision, Text-To Speech, Obstacle Detection, CUDA, Assistive Technology, Real-Time Processing, Visual Impairment.

SMART MULTI-CHAIN CRYPTO WALLET CLI MANAGEMENT

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Smart Multi-chain Crypto Wallet CLI Manager is a self-custody, terminal-based cryptocurrency wallet management tool built on Node.js. It enables users to securely create, import, and manage multiple Ethereum-compatible wallets across four EVM networks — Ethereum, BSC, Polygon, and Celo — entirely from the command line, without relying on any third-party wallet service.Private keys are stored locally and encrypted using AES via ethers.js, with an optional plain-text mode for advanced users. The tool supports Wallet Connect v2 integration, allowing users to connect to decentralized applications (dApps) such as Uniswap and PancakeSwap by pasting a wc: URI directly into the terminal. Once connected, transaction signing, typed-data signing, and on-chain token swaps are handled interactively through the CLI. Beyond basic wallet operations, the system includes a real-time portfolio overview with fiat valuation via CoinGecko, ERC-20 token management, and a Uniswap V2-compatible token swap engine. Vault disaster recovery is supported through two independent mechanisms: Shamir's Secret Sharing (SSS), which splits the vault password across multiple guardians, and a BIP-39 guardian key that wraps the password under a mnemonic-derived AES key. Automatic encrypted backups are available via Google Drive (native OAuth API) or Rclone. The project exposes two interfaces: a menu-driven interactive CLI (cli.js) and a scriptable non-interactive entry point (cmd.js) suitable for automation pipelines, alongside a blessed-based terminal UI (tui.js) for a dashboard-style experience.

Keywords: EVM, ERC-20, DeFi, Token Swap, WalletConnect v2, AES Encryption, Self-Custody, Shamir's Secret Sharing, BIP-39, Node.js, ethers.js, CLI, TUI, Multi-Wallet, Portfolio Tracking.

HYBVIT-XCEPTION: A DUAL-BRANCH HYBRID VISION TRANSFORMER AND XCEPTION CNN FRAMEWORK FOR MULTI-CLASS BRAIN TUMOR CLASSIFICATION FROM MRI

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Brain tumor diagnosis using Magnetic Resonance Imaging (MRI) remains a challenging task due to intra-class similarity and inter-class variability among tumor types. This paper proposes a hybrid deep learning architecture combining a Vision Transformer (ViT-L16-fe) and Xception convolutional neural network for multi-class brain tumor classification. Four publicly available Kaggle MRI datasets were consolidated, resulting in 20,602 images. After duplicate removal using MD5 hashing and label standardization, 10,560 unique images were retained across four classes: Glioma, Pituitary, Meningioma, and No Tumor. The hybrid model leverages global feature extraction via ViT and local pattern detection via Xception, followed by feature fusion and dense classification layers. The proposed system achieved a training accuracy of 97.45%, validation accuracy of 96.35%, and test accuracy of approximately 96%. The results demonstrate the effectiveness of combining transformer-based global representations with convolutional local features for medical image classification.

Keywords: Brain Tumor Classification, Vision Transformer, Xception, Hybrid Deep Learning, MRI, Medical Imaging.

FETAL AUDITORY FUNCTIONALITY ASSESSMENT

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Fetal Auditory Functionality Assessment is an innovative approach designed to analyze fetal heartbeat signals in order to evaluate auditory responsiveness during prenatal development. This study utilizes a curated dataset of fetal heartbeat recordings to identify patterns that may indicate fetal responses to auditory stimuli. Advanced signal processing and machine learning techniques are applied to extract significant features such as frequency variation, amplitude stability, and temporal rhythm patterns from the collected data. The proposed system demonstrates an overall accuracy of **80%** in distinguishing between normal fetal heartbeat patterns and those potentially associated with auditory responsiveness. A key contribution of this research is the development of a dynamic auditory response inference model, which interprets subtle variations in fetal heartbeat rhythms as indicators of possible auditory reactions rather than relying solely on static signal classification methods. This adaptive model enables a more flexible and near real-time interpretation of fetal sensory functionality. The system aims to support healthcare professionals in the early identification of potential auditory-related developmental concerns, providing a non-invasive and efficient assessment framework. Overall, this research contributes to the advancement of prenatal monitoring by integrating intelligent data analysis with biomedical signal processing, thereby supporting improved fetal health diagnostics and facilitating early intervention strategies.

Keywords: Fetal heartbeat, auditory response, signal processing, machine learning, prenatal monitoring, biomedical analysis

EXPLAINABLE ROAD SCENE ANOMALY DETECTION USING VGG16 AND XAI WITH COMPARATIVE EVALUATION OF CNN YOLO RESNET50 AND DENSEANET MODELS

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Road safety is one of the major concerns worldwide today, given the increasing number of accidents and potholes in the road infrastructure. This paper proposes Smart Road Safety, which is a web-based system that detects and monitors road hazards using computer vision and deep learning algorithms. The system is divided into two modules: pothole detection using YOLOv4-Tiny to detect irregularities in the road surface and accident detection using Convolutional Neural Network (CNN), which classifies images as ‘Accident’ or ‘No Accident. The system is developed as a Flask application, which accepts images and videos as input and allows the user to choose the type of detection. The system processes the input images and videos using OpenCV and performs the required operations using the models and displays the output images with annotations. The system also integrates with hardware and accepts input from microcontrollers, which alerts the user using buzzers and LEDs when accidents are detected in real-time. The proposed system is highly scalable and user-friendly and is also cost-effective, making it suitable for real-world applications in the field of road safety and traffic management.

Keywords: Road Safety, Computer Vision, Deep Learning, Pothole Detection, Accident Detection, YOLOv4-Tiny, Convolutional Neural Network (CNN).

THE PARADOX of LIMB MOTION

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Knee pain is a common health issue affecting elderly individuals, athletes, and working professionals, which can lead to reduced mobility and a decline in quality of life. Conventional treatments such as medication, physiotherapy, and surgery are often expensive, invasive, or provide only temporary relief. This paper presents a smart wearable knee pain relief system for real-time monitoring and instant pain management. The system integrates pressure, flex, and temperature sensors within a wearable knee brace to continuously monitor knee conditions. A microcontroller processes sensor data to detect abnormal strain or stress and activates a controlled electrical stimulation unit to provide immediate relief, helping to reduce pain, relax muscles, and improve comfort during daily activities. The proposed device is non-invasive, portable, cost-effective, and suitable for continuous use without restricting movement. Experimental results demonstrate that the system effectively detects abnormal conditions and responds promptly, enhancing mobility and reducing discomfort, while minimising dependence on medication and highlighting the potential of wearable healthcare technology.

Keywords: Knee pain relief; wearable device; real-time monitoring; smart sensors; electrical stimulation; non- invasive treatment; healthcare technology; pain management; rehabilitation; IoT healthcare;

DESIGN AND ANALYSIS OF HUMAN FOOTSTEP PIEZOELECTRIC ENERGY HARVESTER USING SSHI AND DC–DC BOOST INTEGRATION WITH HYBRID ENERGY STORAGE

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Piezoelectric energy harvesting provides a promising solution for powering low-powered devices. There are only limited approaches towards it, due to its limited efficiencies compared to other renewable resources. This work presents the design of a footstep-powered piezoelectric energy harvester that integrates Synchronous Switch Harvesting on Inductor (SSHI) with a DC-DC boost converter to increase the conversion efficiency with a hybrid power storage system. Twelve piezoelectric buffer plates (34 mm each) are installed in the energy tile to withstand a 600N load, equivalent to an average human footstep. The hybrid power storage system provides advanced power storage system, which enables effective energy capturing and using it. Experimental results demonstrate that the integration of SSHI and DC-DC boost increases the total harvested energy by three times, generating 15–30 V open-circuit voltage and 50 µJ per step usable energy with 85% conversion efficiency. The proposed approach gives a feasible solution for powering low-powered devices like Arduino ESP32 and LED indicators. By using human footsteps as a renewable resource, the proposed solution manages to improve the urban infrastructure and supports sustainability goals.

Keywords*:* Synchronous Switch Harvesting on Inductor (SSHI), DC-DC boost converter, Hybrid power storage, Self- powered IoT devices, Piezoelectric energy harvester.

AI-BASED DRUG DISCOVERY AND ACTIVITY PREDICTION

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Drug discovery is a complex, expensive, and time-consuming process. This project presents an AI-based drug discovery and activity prediction system that uses machine learning and cheminformatics techniques to identify potential drug candidates efficiently. Molecular compounds represented using SMILES notation are converted into molecular fingerprints and analyzed using a Random Forest model to predict biological activity. The system is further enhanced with multi-disease prediction, toxicity and side-effect analysis, and explainable AI to improve prediction accuracy, safety assessment, and model transparency. An interactive web interface allows users to perform real-time predictions and visualize results. This intelligent framework reduces experimental effort, accelerates early-stage drug screening, and supports safer and faster drug development.

COMPARATIVE ANALYSIS OF MACHINE LEARNING ALGORITHM FOR CROP RECOMMENDATION

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Modern-day farming practices are reliant upon the use of predictive models for determining which crop varieties will thrive given the specific conditions of a particular area. This research explores the use of a wide range of machine-learning classifiers (including Gradient boosting, Random Forest, Decision tree, Neural network, KNN, and Support vector machines (SVM)) for predicting crops. The outcome goal variable (Predicting crop) was to explore the above-mentioned classifiers independently; therefore, they were trained separately against the dataset. Following the performance evaluation of each classifier independently, Random forest and Decision tree returned a 99% accuracy rate, while KNN returned a 96% accuracy rate, Neural network 97% accuracy rate, and SVM 99% accuracy rate, respectively. Overall, this research will assist producers in maximizing production and optimizing the use of their available resources through the categorization of their crops based on the environmental conditions under which they will be growing; thereby enhancing the sustainability and productivity of modern agricultural methods through the implementation of data-driven decision support systems for crop production.

Keywords: Crop, Environmental condition, Machine learning, Agriculture.

CYBER SECURITY

DOOMSDAY: AN AI-BASED FAKE WEBSITE DETECTION AND PAYMENT FRAUD PREVENTION SYSTEM

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Abstract

Online payment fraud has emerged as one of the most damaging consequences of the rapid digitization of financial services. Phishing websites, which impersonate trustworthy platforms to extract sensitive information and payment credentials from unsuspecting users, represent a particularly persistent and evolving threat. Most existing detection solutions are reactive in nature, identifying fraud only after a user has already been exposed. This paper presents Doomsday, a real-time AI-based system that detects fraudulent websites and actively prevents users from completing payment transactions on unsafe platforms. The system employs an XGBoost classifier trained on a balanced dataset of 11,430 URLs characterized by 89 features encompassing URL structure, domain metadata, behavioral attributes, and web-level signals. Hyperparameter tuning improves model accuracy from a baseline of 96.28% to a final 96.81%. A custom suspicious offer detection module provides an additional behavioral layer by scanning URL strings for manipulative discount and reward-related keywords commonly associated with scam activity. Explainable AI through SHAP delivers transparent, feature-level reasoning for every classification decision, allowing users to understand precisely why a website has been flagged. A Streamlit-based web interface displays real-time risk scores, presents human-readable explanations, and disables payment functionality automatically when fraud is detected. Doomsday demonstrates that proactive pre-payment prevention, rather than post-incident response, is both technically feasible and practically impactful in protecting users from online financial fraud.

Keywords: Phishing Detection, XGBoost, Explainable AI, SHAP, Payment Fraud Prevention, Cybersecurity, URL Feature Analysis, Suspicious Offer Detection, Streamlit

LIGHTWEIGHT DEEP LEARNING-BASED INTRUSION DETECTION SYSTEM FOR IOT NETWORKS USING HYBRID CNN-LSTM MODEL

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Abstract

The rapid proliferation of Internet of Things (IoT) devices has significantly increased the attack surface of modern networks, making them highly susceptible to diverse cyber threats. Due to limited computational resources and dynamic traffic patterns, traditional Intrusion Detection Systems (IDS) are often inadequate for IoT environments. This paper proposes a lightweight hybrid deep learning-based IDS that integrates Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks to enhance detection performance while maintaining computational efficiency. The proposed methodology employs CNN layers to automatically extract spatial features from network traffic data, followed by LSTM layers to capture temporal dependencies and sequential attack behaviours. The model is trained and evaluated using benchmark datasets such as CICIDS2017 and NSL-KDD. Experimental results demonstrate that the hybrid model achieves superior performance, attaining an accuracy of up to 98.5%, along with improved precision, recall, and F1-score compared to traditional machine learning models and standalone deep learning approaches. In addition, the proposed system significantly reduces computational complexity, making it suitable for real-time deployment in resource-constrained IoT devices. The study concludes that combining spatial and temporal learning mechanisms provides a robust and scalable solution for IoT network security. Future work will focus on enhancing model robustness against adversarial attacks and incorporating Federated Learning to enable secure and decentralized training across distributed IoT environments.

UNIVERSAL FLIGHT COTROLLER WITH SAFETY PROTOCOL

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Abstract

The Universal Flight Controller with Safety Protocol is developed to create a flexible and secure control system for various types of Unmanned Aerial Vehicles (UAVs). Unlike traditional controllers designed for specific models, this system uses a unified architecture adaptable to fixed-wing, rotary, and hybrid UAVs. It integrates sensor fusion, PID-based stabilization and real-time data acquisition to ensure precise control and stable flight performance. A built-in safety protocol manages critical situations like signal loss, power failure or communication disruption, enabling automatic safe landing or return-to-home actions. With redundant communication links and secure data handling, the controller enhances both reliability and operational safety. Additionally, the system supports modular hardware and open-source firmware, allowing customization for experimental and industrial applications. The inclusion of diagnostic monitoring ensures early detection of anomalies, reducing the risk of mission failure. Overall, this project aims to provide a versatile, intelligent and robust solution for modern UAV systems, contributing to advancements in autonomous flight control and aerial mission safety.

Keywords Teensy 4.1, MPU6050, BMP180, PID Control, Madgwick Filter, UAV Safety Protocol, Flight Controller, Unmanned Aerial Vehicles (UAV, Sensor Fusion, PID Control, Vertical Take-Off and Landing (VTOL).

CYBER THREAT INTELLIGENCE FOR DISTRIBUTED NETWORKING

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Abstract:

Cyber threats are changing at a high rate, and need to have smart and real-time detection system that will be effective in securing the network. This paper offers a real-time Cyber threat Intelligence framework of automated classification and threat detection by machine learning methods in MATLAB and tested on the NSL-KDD dataset.

The rapid expansion of Internet of Things (IoT) devices and distributed network infrastructures has significantly increased the risk of cyber attacks and security threats. Modern networks generate large volumes of traffic data, making it difficult for traditional centralized security systems to monitor and detect threats efficiently in real time. As a result, there is a need for a scalable and efficient framework that can collect, transmit, and analyze network monitoring data for effective cyber threat detection. This project proposes a Cyber threat intelligence for IoT based Distributed Networking Framework that utilizes distributed monitoring nodes and an energy-efficient communication protocol. These nodes act as security sensors that continuously monitor the network environment. To ensure efficient data communication between nodes, the system employs the SPIN (Sensor Protocols for Information via Negotiation) protocol, which reduces redundant data transmission through a negotiation-based mechanism consisting of advertisement (ADV), request (REQ), and data (DATA) messages.

This approach helps minimize network congestion and improves communication efficiency. The system also incorporates a cluster-based network architecture in which groups of nodes communicate with a cluster head responsible for aggregating and forwarding monitoring data to a central analysis system. The framework is implemented using a MATLAB-based wireless sensor network simulation, and its performance is evaluated using metrics such as transmission count, hop count, and propagation delay. The results demonstrate that the proposed approach improves communication efficiency and supports faster real-time cyber threat monitoring.

NEXDRIVE A LIGHTWEIGHT DISTRIBUTED FILE ACCESS SYSTEM WITH PATH-JAIL SECURITY FOR SELF-HOSTED ENTERPRISE STORAGE

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Abstract:

Organizations face new challenges to manage their data storage because their remote system access requirements have grown together with their need to maintain increasing data storage capabilities. Organizations face challenges because they need to protect their data while controlling user access and making their systems work together with different technology systems. Businesses can use existing cloud storage solutions to increase their storage capacity

but these systems require ongoing subscription payments and create vendor lock-in situations that prevent businesses from using essential access control systems needed to handle their multiple user operations. The system needs a new solution which enables users to access content while the organization retains control and achieves its cost reduction goals. The project presents "NexDrive" which functions as a lightweight distributed file access system that lets users transform their local storage devices into secure storage solutions which remote users can access and which administrators can control from one central location. The foundation of "NexDrive" operates through a path-jail security model which permits users to access only those parts of the file system that their system administrators have granted them permission to reach. The system enforces this requirement through server-based enforcement which uses cryptographic session tokens and absolute-path prefix verification. The system prevents unauthorized access attempts through directory traversal because it implements strict control measures which stop data from exiting the system during path resolution. The system architecture consists of a RESTful backend which uses Node.js and implements stateless authentication to handle multiple users whose session expiration settings can be customized. The administrative control panel provides intuitive access to real-time drive discovery user lifecycle management and inline file previews of multiple file formats. "NexDrive" demonstrates transport-layer flexibility because it operates across local networks and enterprise LANs and public tunnelling services through its adaptive CORS handling capabilities. The experimental results demonstrate that "NexDrive" achieves its performance targets while running multiple tasks and uses only a small portion of system resources to operate its security features. The solution provides customers with a secure and affordable storage option that does not rely on specific vendors.

Keywords: Distributed file systems, Role-based access control, Path-jail security, Self-hosted cloud, Enterprise storage, Access governance, RESTful API security Lightweight Deep Learning-Based Intrusion Detection System for IoT Networks using Hybrid CNN-LSTM Model

PHISHING THREAT INTELLIGENCE AND RISK PREDICTION USING FEDERATED MACHINE LEARNING

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Abstract

Phishing attacks have becoming a increasing cybersecurity attack, targeting users through multiple communication channels such as email, SMS, voice calls, URLs, and QR codes. Traditional phishing detection systems focuses on centralized architectures that collect user data on a central server, which increases the privacy issues and increasing the risk of data leakage. To tackle these challenges, this project introduces a Federated Learning–based multi-modal phishing detection system with real-time alert notifications. it collects the data from each local client and train it locally using ml models. The parameters that got extracted from the local model is pushed to the federated server. The federated server aggregates these updates to generate a global phishing detection model capable of identifying threats across different modalities. a real-time monitoring and notification system that generates severity-based alerts for detected phishing activities.

AI - AUGMENTED ZERO TRUST FRAMEWORK FOR BFSI

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Abstract: Modern enterprise infrastructures operate across heterogeneous environments, including on-premises data centers, public cloud platforms, and hybrid deployments significantly expanding the attack surface. Adversaries exploit credential theft, lateral movement, and privilege escalation to bypass traditional perimeter-centric security models. Conventional Zero Trust Architecture (ZTA) implementations primarily driven by static rule-based policy enforcement that lack adaptive intelligence which fail to respond dynamically to evolving threat contexts. This project proposes an AI-augmented Zero Trust framework that integrates dynamic trust evaluation with behavioral and contextual analytics. The architecture leverages real-time session attributes, historical interaction patterns, and entity behavior profiling to compute adaptive risk scores. An Autoencoder-based anomaly detection module identifies latent and previously unseen attack vectors by generating behavioral deviation metrics. These anomaly scores are fused with a Gradient Boosting multi-class classification engine to construct a hybrid decision model for granular threat categorization and risk-aware access control. The framework incorporates robust Identity and Access Management (IAM), Public Key Infrastructure (PKI)-based authentication, encrypted communication protocols, and centralized policy orchestration to ensure secure identity validation and decision integrity. Experimental results demonstrate superior classification accuracy, improved minority-class detection, and enhanced resilience against advanced persistent threats compared to traditional rule-driven ZTA models.

Keywords: Zero Trust Architecture; Artificial Intelligence; Behavioral Anomaly Detection; Adaptive Access Control; Risk-Based Authentication; Machine Learning; Cybersecurity; Banking and Financial Systems; Insider Threat Detection; Continuous Trust Evaluation

SECURE TACTILE-BASED UPI AUTHENTICATION SYSTEM FOR INCLUSIVE AND ACCESSIBLE FINANCIAL INTERACTION USING SMART BACK CASE

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Abstract

The rapid growth of Unified Payments Interface (UPI) systems has significantly improved the speed and convenience of digital financial transactions. However, secure and accessible authentication remains a major challenge for users such as visually impaired individuals, elderly people, and those with motor or cognitive disabilities. This paper presents a Secure Tactile Pattern Authentication System (STPAS), designed as a smartphone back case integrated with a tactile keypad. The system enables users to enter authentication patterns through a 3×3 grid of uniquely shaped buttons, allowing secure interaction without relying on visual or audio input.The proposed system uses an ESP32-C3 microcontroller to capture and process user input, applying SHA-256 hashing to protect authentication data. A secure token is generated using HMAC-SHA256 and transmitted via Bluetooth Low Energy (BLE) to the mobile application for verification. The design follows a Universal Accessibility approach, supporting a wide range of users including visually impaired individuals, motor-impaired users, elderly populations, and users in situational constraints such as low-light conditions or while wearing gloves. By combining tactile interaction with strong cryptographic security, the system enhances privacy, usability, and inclusivity in digital payment authentication. The proposed solution reduces dependency on traditional visual interfaces and contributes to a more secure and accessible financial ecosystem.

Keywords: UPI Security; Tactile Authentication; Assistive Technology; ESP32; SHA-256; Financial Inclusion

AI-BASED HEALTH RISK PREDICTION SYSTEM WITH MULTILAYERED DATA SECURITY MENTOR / GUIDE

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Abstract

Health risk prediction has become increasingly important due to the rising prevalence of lifestyle disorders and the growing need for early detection systems. This paper presents an AI-Based Health Risk Prediction System that analyzes essential medical parameters using machine learning algorithms to estimate the likelihood of potential health issues. To ensure the confidentiality and safety of sensitive personal data, the system incorporates multilayered data security, including encryption, authentication, and secure data storage mechanisms. The integrated model aims to provide reliable health predictions while maintaining strong protection against unauthorized access. The proposed approach is designed to support both individual users and healthcare institutions by offering a secure, accurate, and efficient digital health monitoring solution.

Keywords—Artificial Intelligence, Health Risk Prediction, Machine Learning, Data Security, Encryption, Authentication, Secure Healthcare Systems.

EXPLAINABLE ADVERSARIAL ATTACK AND DEFENCE FRAMEWORK FOR ML-BASED NETWORK INTRUSION DETECTION SYSTEMS

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Abstract

Machine learning in particular in accordance to Network Intrusion Detection Systems (NIDS) shows a strong resilience in identifying malicious traffic; however, a recent study implies that such models are highly vulnerable to adversarial attacks. This work analyzes explainable and transferable adversarial attacks on NIDS using the UNSW-NB15 dataset and proposes a novel graph-based adversarial generation strategy. The study primarily reproduces a baseline attack pipeline by training multiple machine learning classifiers, including Random Forest, Multi-Layer Perceptron, and XGBoost, and developing an ensemble substitute model. Key features are identified through Interpretable Subset Feature Selection, and Explainable Transferable Attacks (ETA) are generated to measure attack success rates in black-box environments.

Elaborating this, a novel Explainable Graph-based Adversarial Attack (XGA) is infused. The proposed approach leverages a correlation-based feature graph to model feature dependencies, enabling structured and coordinated adversarial perturbations. Using zeroth-order gradients, explainable feature selection, and graph-based perturbation, the attack produces realistic adversarial samples while respecting a constrained perturbation budget. Experimental results show that XGA consistently achieves higher attack success rates than baseline ETA methods while maintaining semantic consistency of network traffic features. The study highlights the critical role of feature interactions in adversarial robustness and provides deeper insights into the vulnerabilities of modern NIDS models.

Keywords- Network Intrusion Detection System (NIDS), Explainable Transferable Adversarial Attacks (ETA), ensemble substitute model, perturbation, Explainable Graph-based Adversarial Attack (XGA)

SECURE TACTILE-BASED UPI AUTHENTICATION SYSTEM FOR INCLUSIVE AND ACCESSIBLE FINANCIAL INTERACTION USING SMART BACK CASE

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Abstract

The rapid growth of Unified Payments Interface (UPI) systems has significantly improved the speed and convenience of digital financial transactions. However, secure and accessible authentication remains a major challenge for users such as visually impaired individuals, elderly people, and those with motor or cognitive disabilities. This paper presents a Secure Tactile Pattern Authentication System (STPAS), designed as a smartphone back case integrated with a tactile keypad. The system enables users to enter authentication patterns through a 3×3 grid of uniquely shaped buttons, allowing secure interaction without relying on visual or audio input.The proposed system uses an ESP32-C3 microcontroller to capture and process user input, applying SHA-256 hashing to protect authentication data. A secure token is generated using HMAC-SHA256 and transmitted via Bluetooth Low Energy (BLE) to the mobile application for verification. The design follows a Universal Accessibility approach, supporting a wide range of users including visually impaired individuals, motor-impaired users, elderly populations, and users in situational constraints such as low-light conditions or while wearing gloves. By combining tactile interaction with strong cryptographic security, the system enhances privacy, usability, and inclusivity in digital payment authentication. The proposed solution reduces dependency on traditional visual interfaces and contributes to a more secure and accessible financial ecosystem.

Keywords: UPI Security; Tactile Authentication; Assistive Technology; ESP32; SHA-25; Financial Inclusion

AUTONOMOUS AI - DRIVEN CYBER DEFENSE FRAMEWORK FOR MSMES

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Abstract

Small and Medium-Sized Enterprises (MSMEs) face growing cybersecurity risks due to limited financial resources, absence of dedicated security teams, and increasing digital transformation. Conventional security mechanisms are often costly, complex, and heavily dependent on manual monitoring, making them impractical for resource-constrained organizations.

This paper presents a cloud-enabled and edge-compatible Autonomous AI-Driven Cyber Defense Framework designed to deliver continuous monitoring, intelligent threat detection, and automated mitigation specifically for MSME environments. The proposed architecture integrates machine learning–based behavioral profiling, anomaly detection models, and hybrid intrusion detection techniques to analyze network traffic and system activity in real time. When abnormal or malicious patterns are identified, the framework autonomously executes containment measures such as endpoint isolation, malicious IP blocking, access restriction enforcement, and adaptive firewall updates.

In contrast to traditional signature-based approaches, the framework employs adaptive and predictive learning mechanisms capable of identifying zero-day and evolving attack vectors. The solution emphasizes scalability, affordability, and minimal human intervention, enabling MSMEs to achieve enterprise-grade cybersecurity protection without significant infrastructure investment.

By strengthening digital resilience and reducing reliance on outsourced security management, the proposed framework supports secure digital transformation and aligns with the national vision of technological self-reliance and sustainable digital growth under Viksit Bharat 2047.

Index Terms — Artificial Intelligence; Cybersecurity; MSMEs; Autonomous Defense; Machine Learning; Intrusion Detection; Cloud Security; Edge Computing.

IMMERSIVE HEURISTIC REINFORCEMENT LEARNING

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Abstract

Traditional machine learning architectures frequently encounter critical failure modes when deployed in open-ended, dynamic big data ecosystems due to their reliance on static reward structures and episodic training cycles. To overcome these limitations, this paper introduces Immersive Heuristic Reinforcement Learning, a novel domain-agnostic framework designed for real-time adaptation within continuous, high-dimensional data streams. The core innovation of IHRL is the Data-to-Environment Engine, which functions as a cognitive bridge to transform raw, heterogeneous inputs, such as system telemetry, APIs, and Kafka streams, into dynamic, interactive learning environments for autonomous agents. The IHRL architecture integrates four modular components within the DTE Engine: Preprocessed Data, State Representation, Event Signal Processing, and Dynamic Environment Generation. To ensure robust and interpretable decision-making, the framework employs a Heuristic Controller that modulates agent behavior through expert-encoded rule templates and control masks, alongside a DQN-based reinforcement learning agent. Experimental evaluations conducted using real-time system telemetry demonstrate the framework's superior performance over traditional episodic DQN and rule-based baselines. Key results include an overall classification accuracy of 91.2%, a precision of 92.7% in identifying critical states, and a 13.6% increase in cumulative rewards. Furthermore, with a decision latency of only 120 ms, the IHRL framework proves to be a scalable and effective solution for real-time industrial applications requiring high-stakes data adaptation. Keywords: Reinforcement Learning, Big Data Adaptation, Heuristic Control, Real-Time Systems, Data-to-Environment, Autonomous Agents.

ELECTRONICS AND COMMUNICATION ENGINEERING

CIRCULAR ECONOMY APPROACH TO PLASTIC WASTE RECYCLING INTO ECO-BRICKS

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Abstract

The rapid increase in plastic consumption and improper waste segregation has led to serious environmental pollution and health hazards. Conventional waste management systems are often inefficient as they do not separate waste at the source, making recycling difficult.

This project proposes a smart automated waste segregation system using sensors such as proximity, IR, moisture, and metal sensors to classify waste into different categories. An Arduino Uno controls the process and ensures accurate segregation.

Additionally, the system includes a UV-C disinfection unit for safe handling of wet and medical waste, and converts plastic waste into eco-bricks, supporting sustainable recycling and reducing environmental impact.

Keywords; Smart Waste Segregation, Circular Economy, Eco-Bricks, Arduino, UV Disinfection, Plastic Recycling

EDGE AI BASED IN CROP STRESS AND HEALTH PREDICTION SYSTEM

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Abstract

Agriculture plays a vital role in ensuring food security, and timely detection of crop stress is essential for improving yield and sustainability. This paper presents an Edge AI-based crop stress and health prediction system that enables real-time monitoring and analysis directly at the field level. The system integrates IoT sensors and camera modules to collect environmental and crop data such as temperature, humidity, soil moisture, and leaf images. Edge devices process this data using lightweight machine learning models to detect stress factors like water deficiency, nutrient imbalance, and disease infection. By performing computation at the edge, the system reduces latency, bandwidth usage, and dependence on cloud infrastructure. The proposed approach ensures faster decision-making and provides actionable insights to farmers through alerts and recommendations. Experimental results demonstrate improved accuracy and efficiency in early stress detection, leading to better crop management and increased productivity.

Keywords: Edge AI, Crop Stress Detection, Precision Agriculture, IoT Sensors, Machine Learning, Smart Farming, Real-time Monitoring, Crop Health Prediction, Edge Computing, Sustainable Agriculture.

DESIGN AND DEVELOPMENT OF SENSORLESS SOLAR TRACKER USING PANEL TO PANEL FEEDBACK

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Abstract

This paper presents the design and implementation of a sensorless panel-to-panel feedback solar tracking system aimed at improving photovoltaic (PV) efficiency without using traditional light sensors. Traditional solar tracking systems often rely on light-dependent resistors or optical sensors, which introduce errors due to dust, shadows, and changing environmental conditions. To overcome these limitations, this project presents a sensorless solar tracking system that operates using a simple but effective voltage-feedback mechanism. The system uses two 30-W solar panels, an ESP32 microcontroller, and high-torque geared motors to continuously compare the real-time voltage difference between panels and orient the structure toward the higher-producing side. By eliminating external sensors, the design reduces cost, improves reliability, and minimizes maintenance while still maintaining accurate tracking throughout the day. The mechanical structure is developed using a lightweight aluminum frame with a 34-degree fixed tilt and a 12-mm shaft supported by bearings for smooth rotation. Experimental observations show that sensorless tracking achieves noticeable improvement in daily power generation compared to fixed-tilt systems. The proposed method demonstrates that voltage-based tracking is a practical, efficient, and low-cost alternative suitable for rural, domestic, and small-scale renewable energy applications.

Index Terms: Solar tracking system, Sensorless control, Voltage feedback, ESP32 microcontroller, Photovoltaic panels, Renewable energy, and DC geared motor.

IOT-BASED SOLDIERS HEALTH MONITORING ANDRSSI POSITION TRACKING SYSTEM USING GSM

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Abstract

The safety and health monitoring of soldiers in battlefield environments is a critical challenge in modern defence systems. This project proposes an IOT-Based Soldier Health Monitoring and Position Tracking System that continuously monitors a soldier's heart rate, body temperature, and location using RSSI (Received Signal Strength Indicator) values. The system integrates biomedical sensors with a microcontroller to collect real-time physiological data and transmit it wirelessly to a monitoring station through IOT technology.

The RSSI-based tracking method enables position estimation even in environments where GPS signals are weak or unavailable. The system continuously analyses heart rate and temperature readings to detect abnormal conditions such as high fever, low pulse rate, or sudden physiological changes. Additionally, unexpected location changes are monitored using variations in RSSI values.

Whenever abnormal health parameters or sudden location deviations are detected, the system automatically sends an SMS alert to the control center along with the soldier's last known position. This ensures quick medical response and efficient rescue operations. The proposed system provides a real-time, low-cost, and reliable solution to enhance soldier safety and improve emergency response in critical situations.

The proposed IOT-based soldier health and position tracking system also improves overall mission efficiency by enabling centralized monitoring of multiple soldiers simultaneously. The collected data can be stored for further analysis, helping defense authorities study health patterns and environmental impacts on soldiers. The system's wireless communication and automated alert mechanism reduce dependency on manual reporting, especially in high-risk combat situations. Its scalable design allows integration with advanced technologies such as cloud computing, AI-based analytics, and secure military communication networks, making it adaptable for future smart defence applications.

Keywords: IOT, Soldier Health Monitoring, RSSI Localization, GSM Communication, Wireless Sensor Network, Remote Monitoring System

MULTI MODEL DISTURBANCE OBSERVER IN RAILWAY VEHICLE BASED ON TRAIN COLLISION

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Abstract:

Railway safety is increasingly important with the rise of high-speed and dense train operations, where collision risks are influenced by disturbances and system uncertainties. This work proposes a **Multi-Model Disturbance Observer (MMDO)** to improve collision avoidance in railway vehicles. The method uses multiple dynamic models to estimate disturbances like track irregularities and braking uncertainties under varying conditions. It enables accurate state estimation and early detection of potential collisions, supporting effective control actions. Simulation results show improved robustness, faster response, and enhanced safety compared to conventional methods.

Keywords. Multi-Model Disturbance Observer, Train Collision Avoidance, Railway Safety, Robust Control, State Estimation.

A NOVEL FRACTIONAL-ORDER HYBRID CHAOTIC KEY-BASED DYNAMIC S-BOX FOR SECURE CRYPTOGRAPHIC APPLICATIONS

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Abstract

This paper presents a novel fractional-order hybrid chaotic key based dynamic AES-style substitution box (S-Box) for secure image encryption and cryptographic applications. The proposed approach exploits the memory-dependent dynamics of fractional-order chaotic systems and the enhanced nonlinearity achieved by hybridizing multiple chaotic generators to construct a highly sensitive and key-dependent S-Box. A fractional-order Lorenz–Chua hybrid chaotic system is employed to generate high-entropy keystreams, which are then mapped to dynamically control the affine transformation and optional input/output whitening stages of an AES-like S-Box structure. Unlike the static AES S-Box, the proposed design produces session- or round-dependent S-Boxes while preserving bijectivity through a multiplicative inverse operation in Galois Field. The resulting dynamic S-Box significantly improves resistance against linear, differential, algebraic, and statistical attacks. Security analysis demonstrates high nonlinearity, strict avalanche behavior, low differential uniformity, and large key space, making the scheme suitable for FPGA implementations and secure multimedia encryption systems.

Keywords: Fractional-order chaos, hybrid chaotic system, dynamic S-Box, AES-style S-Box, image encryption, Lorenz system, Chua system, cryptographic primitives.

IOT BASED METHANE GAS DETECTION SYSTEM

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Abstract

The Internet of Things (IoT) has rapidly become a pivotal technology for bolstering safety measures across industrial and residential settings. This presentation outlines the design and implementation of a robust IoT-based methane and gas detection system, specifically engineered for continuous environmental monitoring and early hazard detection Our solution integrates MQ-4 and MQ-135 gas sensors, providing exceptional sensitivity for detecting methane and other hazardous gases. Data from these sensors are processed by an Arduino or NodeMCU microcontroller, which relays this information to cloud platforms such as ThingSpeak and Blynk for real-time monitoring and comprehensive analysis. In instances where gas concentrations surpass defined safety limits, the system promptly alerts users, facilitating swift preventive measures. This innovative detection system stands out because of its cost-effectiveness, scalability, and reliability, making it an ideal choice for deployment in residential homes, industrial facilities, and smart city infrastructures. Ultimately, this approach not only enhances safety protocols but also mitigates the risk of gas-related accidents while providing efficient environmental supervision

Keyword: Internet of Things (IoT), Gas Detection System, Methane, Monitoring, MQ4, Sensor, MQ135, Sensor, Arduino, NodeMCU, Real Time Monitoring, Cloud computing, Thing Speak, Blynk, Smart Safety System, Environmental Monitoring, Hazard Detection

DESIGN AND ASIC IMPLEMENTATION OF AN ADAPTIVE ECG MORPHOLOGY PROCESSOR

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Abstract

Electrocardiogram (ECG) signal analysis is an essential tool for detecting cardiovascular abnormalities. This paper presents the design and ASIC implementation of an adaptive ECG morphology processor for real-time heartbeat monitoring and classification. The proposed architecture is implemented as a synchronous digital pipeline comprising modules for adaptive threshold generation, R-peak detection, feature extraction, and adaptive beat classification. The processor analyzes each heartbeat by computing the energy of ECG samples captured around the detected R-peak. A reference energy is learned from normal beats and used to identify abnormal morphological variations in subsequent beats. The design operates at a clock frequency of 100 MHz and achieves sub-microsecond processing latency per sample, enabling real-time operation for typical ECG sampling rates. Beat-level analysis is performed over a fixed window of approximately 600 ms, ensuring consistent morphology evaluation. The synthesized design consists of 2858 standard cells and occupies a silicon area of approximately 0.028 mm², demonstrating a compact and efficient implementation. Post-layout timing analysis shows a positive slack of 0.64 ns, confirming successful timing closure at the target frequency. The design is verified to be DRC- and LVS-clean, ensuring physical correctness and manufacturability. The proposed architecture provides an area-efficient and low-latency solution suitable for real-time biomedical monitoring applications.

ELECTROCARDIOGRAM (ECG) SIGNAL-DRIVEN ARRHYTHMIA CLASSIFICATION IN ASSISTANCE TO SUPPORT VECTOR MACHINE

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Abstract

Automated external defibrillators (AEDs) should be used in conjunction withcontinuous monitoring of the patient to help determine whether he/she has a cardiac arrhythmia through analysis of the patient's electrocardiogram (ECG) footage, which constitutes the ECG waveform. s. Much of the research into detecting cardiac arrhythmias has centred on temporal domain (time), and frequency domain (spectrum) focused detection methods, and time-frequency domain integration into sufficient signal intensity and voltages. . This research will present an alternative method that may improve the sensitivity of arrhythmia detection through the use of 14 ECG detection features (that cover multiple domains) to locate cardiac arrhythmias, Implementing Support Vector Machine (SVM) methodology and logic-based algorithms (using MATLAB), Using a novel feature selection (FS) method based upon SVM classifier and ranking the appropriate ECG detection parameters. This study will evaluate the proposed method by using binary classification of both normal and no normal function of the heart using only the ECG detection parameter data, listing its accuracy and spontaneity for real-time ECG-QRS detector

Keywords: Arrhythmia Recognition, ECG Morphology, Segment Feature Extraction, Support Vector Machine, Signal Processing.

SMART RAIL GUARD VERSATILE SAFETY AND MONITORING SYSTEM

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Abstract

The Smart Rail Guard System is an advanced safety and monitoring solution designed to enhance railway safety, improve operational efficiency, and reduce accidents. Railway transportation plays a vital role in carrying passengers and goods; however, safety remains a major challenge due to increasing traffic, complex track structures, and unexpected obstacles. The proposed system utilizes multiple sensors, such as infrared and ultrasonic sensors, to continuously monitor railway track conditions. The infrared sensor is used to detect cracks and structural abnormalities in the tracks, while the ultrasonic sensor identifies obstacles such as objects, animals, or vehicles present on the track. All sensor data is processed using an ESP32 microcontroller, which analyzes the conditions and detects any abnormal situations. In case of faults such as track damage or obstacle detection, the system generates alerts and initiates preventive actions to stop the train. The system communicates with railway authorities through an IoT-based network using Wi-Fi technology. Additionally, a buzzer is activated for immediate local alerts. To enhance accuracy, the system integrates GPS technology to provide the exact location of the fault. This location data is transmitted along with alert messages, enabling quick response and timely corrective actions. Overall, the Smart Rail Guard System improves passenger safety, enhances railway efficiency, and supports the development of a modern intelligent transportation system. By integrating sensor technology, embedded systems, and IoT communication, it provides a reliable and effective solution for railway safety applications.

CYBERSECURITY IN WIRELESS NETWORKS

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Abstract

Wireless networks are widely used today for communication, internet access, and data sharing because they provide mobility and convenience. However, the open nature of wireless communication makes these networks highly vulnerable to cyber attacks. Attackers can easily exploit security weaknesses to gain unauthorized access, intercept data, or disrupt network operations. Common cyber attacks in wireless networks include Denial of Service (DoS), Man-in-the-Middle attacks, eavesdropping, spoofing, and rogue access points. These attacks can lead to data theft, privacy violations, financial loss, and service interruptions. As wireless technologies such as Wi-Fi, Bluetooth, and mobile networks continue to expand, the risk of cyber threats also increases. Therefore, strong security mechanisms are necessary to protect wireless networks. This paper discusses the various types of cyber attacks in wireless networks, their impacts, and possible prevention techniques. Implementing security measures such as encryption, authentication protocols, firewalls, and intrusion detection systems can help reduce vulnerabilities and ensure secure wireless communication.

DESIGN AND IMPLEMENTATION OF DYNAMIC WIRELESS ELECTRIC VEHICLE CHARGING

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Abstract

The global automotive sector is undergoing a profound paradigm shift driven by the urgent necessity to transition from fossil-fuel-dependent transportation towards environmentally responsible and technologically advanced mobility solutions. Electric vehicles (EVs) have emerged as the most compelling alternative, offering substantial reductions in greenhouse gas emissions and improved energy conversion efficiencies compared to internal combustion engine counterparts. Despite their ecological advantages, EVs continue to face significant infrastructural barriers including inadequate charging infrastructure and dependency on grid electricity. This paper presents an innovative Solar-Powered Wireless Electric Vehicle Charging System that integrates photovoltaic (PV) energy harvesting with resonant inductively coupled wireless power transfer (WPT) technology. The proposed architecture employs resonant inductive coupling as its fundamental energy transfer mechanism, eliminating physical cable

Keywords: Wireless power transfer, solar EV charging, resonant inductive coupling, sustainable mobility

SEGMENTATION-ENHANCED FACE RECOGNITION FOR REAL-TIME SMART ATTENDANCE IN CAMERA-BASED SYSTEMS

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Abstract

This paper presents a real-time smart attendance system based on an enhanced face recognition pipeline. Traditional attendance methods are time consuming and prone to errors such as proxy marking. The proposed system utilizes MTCNN for face detection, GrabCut based segmentation for background removal, and FaceNet for feature extraction, followed by SVM based classification. A data augmentation strategy is applied to improve robustness against variations in lighting, pose, and occlusion.

The system is designed for practical deployment using camera-based input and lightweight processing units, enabling real-time inference with low latency. It can also be integrated with existing surveillance systems such as CCTV cameras or embedded devices for automated attendance monitoring. The complete framework is implemented as a Flask based web application with database support for efficient attendance management. Experimental results demonstrate high accuracy and reliability, making the system suitable for real world institutional use.

Keywords: Face Recognition; Smart Attendance; Data Augmentation; SVM; FaceNet; MTCNN; Real-Time System; CCTV Integration

SMART WASTE MONITORING AND SEGREGATION SYSTEM USING IOT & WSN.

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Abstract

Rapid urbanization and population growth have significantly increased municipal solid waste generation, creating serious challenges for conventional waste management systems. Traditional garbage collection methods rely on fixed schedules and manual monitoring, which often result in overflowing bins, inefficient resource utilization, and environmental pollution. This work proposes a Smart Garbage Monitoring and Segregation System that integrates Internet of Things (IoT) technology and Wireless Sensor Networking (WSN) with artificial intelligence for efficient waste management. The system employs ultrasonic sensors to continuously monitor the fill level of garbage bins and transmits the data using an ESP32 microcontroller and LoRa communication module to a cloud-based monitoring platform. The bin status data, is transmitted to a cloud dashboard for real-time monitoring and analytics.

SMART HOME AUTOMATION USING DIGITAL TWINING TECHNOLOGY

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Abstract

Modern smart homes increasingly depend on motor-driven appliances such as ceiling fans, air conditioners, and water pumps, where unexpected failures can significantly impact efficiency, safety, and energy consumption. Traditional home automation systems provide basic control functionalities but lack intelligent monitoring, fault diagnostics, and real-time visualization capabilities required for advanced smart environments. This paper presents an advanced Digital Twin-based Smart Home Automation System integrated with IoT, cloud computing, and solar energy support for comprehensive motor health monitoring and control. The proposed system deploys a network of IoT sensors to continuously capture essential operational parameters including temperature, voltage, current, vibration, and acoustic signals. These real-time data are processed and transmitted through an ESP32 microcontroller to a cloud platform, where a dynamic digital twin model is created to replicate the real- world behaviour of the motor with high accuracy. A significant innovation of this system is the Augmented Visualization (AV)-enabled digital twin interface, which allows users to scan and monitor appliances in real time using smart devices. The system represents motor health through intuitive color- coded indicators, green for normal operation, orange for warning states, and red for critical conditions enabling quick fault identification and decision-making without the need for physical inspection. Furthermore, the system incorporates data-driven fault detection and predictive maintenance techniques, utilizing threshold-based analysis and historical data trends to identify early signs of faults such as overheating, overcurrent, abnormal vibration, and unusual noise patterns. This proactive approach minimizes downtime, reduces maintenance costs, and extends the lifespan of appliances. The integration of solar energy support enhances the sustainability of the system by optimizing energy usage and enabling hybrid power operation. Additionally, the system supports remote monitoring and control via cloud connectivity, allowing users to access real-time data, receive alerts, and manage appliances from anywhere. The proposed framework is scalable, cost-effective, and adaptable, making it suitable for a wide range of residential applications. By combining Digital Twin technology with IoT, renewable energy integration, and immersive visualization, this system provides a next- generation smart home solution that improves reliability, energy efficiency, user interaction, and overall system intelligence.

INTELLIGENT FOOTSTEP ENERGY HARVESTING SYSTEM FOR SMART INFRASTRUCTURE USING IOT AND AI

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Abstract

The paper will describe a low-cost footstep energy harvesting system design and implementation that combines Internet of Things (IoT) monitoring with the system. The system makes use of five piezoelectric sensors to translate mechanically the footsteps made by a human being into electrical energy. The produced alternating voltage is rectified with 1N4007 diodes and regulated with a DC-DC boost converter and then stored in a 3.7 V lithium iron rechargeable battery. The microcontroller used is an ESP8266 which will be used to measure the voltage generated and relay real-time data to the cloud using the ThingSpeak platform. Local visualization of voltage levels is done on a 16x2 LCD display. It has been observed experimentally that the system results in intermittent and low-power output that is applicable to small scale energy usage and real-time monitoring. The suggested system illustrates an effective mechanism of exploiting human movement as a source of renewable energy and at the same time facilitating the analysis of data remotely using the IoT technology.

Keywords: Piezoelectric Sensor; Energy Harvesting; ESP8266; Boost Converter; Renewable Energy; Thing Speak

THERMAL PERFORMANCE ENHANCEMENT OF BATTERY SYSTEMS USING POROUS MEDIA WITH OPTIMIZED LAYER DISTRIBUTION

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Abstract

This study investigates an advanced thermal management approach for lithium-ion batteries using porous media to enhance heat dissipation. Lithium-ion batteries, widely used in electric vehicles and aircraft, generate significant heat during operation, which can lead to performance degradation, reduced lifespan, and safety risks such as thermal runaway. Effective cooling is therefore essential to maintain safe operating temperatures.

A computational model was developed to analyze heat transfer in a battery system with and without porous aluminum structures under forced air cooling. The model incorporates heat generation within cylindrical cells, airflow convection, and porous media effects. Different configurations of porous layers (3-layer, 5-layer, and 7-layer) were evaluated to study their influence on temperature distribution and cooling performance.

The results show that the inclusion of porous media significantly improves heat dissipation and temperature uniformity compared to conventional air cooling. Increasing the number of porous layers reduces peak temperature and minimizes thermal gradients within the battery system, with the 7-layer configuration demonstrating the best performance. The study highlights the potential of porous media-based cooling systems to enhance the safety, efficiency, and reliability of lithium-ion batteries in high-performance applications such as electric vehicles and aircraft.

Different porous layer configurations (3-layer, 5-layer, and 7-layer) were evaluated to study their influence on temperature distribution and cooling performance. The results demonstrate that porous media significantly improves heat dissipation and temperature uniformity. An optimized asymmetric configuration was identified, where the first and second cells perform best with 3 porous layers, while the third cell requires 7 layers due to reduced cooling effectiveness along the airflow direction. This (3–3–7) arrangement provides the most efficient thermal management by minimizing peak temperature and improving uniformity across the battery system.

AI HUMANOID SMART HEADBAND

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Abstract:

The AI Humanoid Smart Headband is an advanced wearable system designed to create an intelligent interface between the human brain and external devices using Brain–Computer Interface (BCI) technology. This project integrates biosignal acquisition, embedded processing, artificial intelligence, and Internet of Things (IoT) connectivity to enable real-time monitoring, analysis, and control. The main objective of this system is to capture human physiological signals and convert them into meaningful outputs for hands-free interaction, health monitoring, and smart device control. The system uses multiple biosensors, including EEG for brain activity, EOG for eye movement detection, EMG for muscle activity, and PPG for monitoring heart rate and blood oxygen levels. These sensors collect raw biological signals, which are typically weak and noisy. To address this, a signal conditioning stage is used to amplify the signals and remove noise using filters, ensuring accurate and reliable data for further processing. The processed signals are converted into digital form using an embedded controller such as ESP32 and transmitted to the Raspberry Pi Zero 2 W, which acts as the main processing unit. It performs signal processing techniques like Fast Fourier Transform (FFT) and feature extraction to obtain meaningful information from the signals. Machine learning models such as CNN, SVM/KNN, and LSTM are used to analyze patterns and interpret the user's mental state and intent. Based on the analysis, the system generates intelligent outputs such as controlling IoT devices, providing audio feedback through earbuds, and displaying real-time data on mobile or cloud platforms. Wireless communication is enabled through Bluetooth and WiFi modules, allowing seamless data transfer and remote monitoring. Cloud integration supports data storage, real-time alerts, and continuous tracking of user health and system performance. Overall, the AI Humanoid Smart Headband combines biosensing, AI, and IoT technologies to create a smart, portable, and user-friendly system. It enhances human–machine interaction by enabling direct communication between the human brain and smart devices, making it useful in applications such as healthcare, assistive technology, and smart environments.

Keywords: Brain–Computer Interface, EEG, Multimodal Biosignals, Artificial Intelligence, IoT, Smart Wearable System, Human–Machine Interaction, Assistive Technology

ANON-INVASIVE GLUCOSE MONITORING SOC BASED ON SINGLE WAVELENGTH PHOTO PLETHYSMOGRAPHY

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Abstract

Diabetes is a chronic health condition that requires continuous monitoring of blood glucose levels to prevent severe complications. Conventional glucose monitoring techniques, such as finger-pricking, are invasive, painful, and inconvenient for frequent use. This paper proposes a non-invasive glucose monitoring system using a single-wavelength Photoplethysmography (PPG) technique integrated with System-on-Chip (SoC) technology. The proposed system operates by transmitting light from an LED or laser source into the tissue and measuring the reflected signal using a photodiode. Variations in blood properties due to glucose concentration are captured as PPG signals. These signals are processed using an analog front-end circuit consisting of amplifiers and filters to remove noise and motion artifacts, followed by digitization using an Analog-to-Digital Converter (ADC). Feature extraction techniques are applied to obtain key parameters such as amplitude, pulse width, and frequency from the PPG signal. These features are then used as input to a Support Vector Regression (SVR) model to estimate glucose levels accurately. The integration of sensing, processing, and computation within a compact SoC ensures low power consumption and portability. The proposed system offers a painless, cost-effective, and convenient solution for continuous glucose monitoring. Future enhancements include integration with wireless communication modules for real-time data transmission to smartphones and cloud-based health monitoring systems.

Keywords: Non-invasive glucose monitoring, Photoplethysmography (PPG), Support Vector Regression (SVR), System-on-Chip (SoC), Machine Learning, Signal Processing

AI BASED SMART LPG GAS MONITORING SYSTEM

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Abstract

Liquefied Petroleum Gas (LPG) is widely used for domestic and industrial applications due to its efficiency and ease of use; however, gas leakage, fire accidents, and improper monitoring of LPG cylinders pose serious safety risks. This paper presents an AI-based Smart LPG Gas Monitoring System designed to improve safety, automation, and real-time monitoring of LPG cylinders using embedded systems and sensor technology. The proposed system utilizes an ESP32 microcontroller integrated with multiple sensors such as an MQ-6 gas sensor for gas leakage detection, a temperature sensor for environmental monitoring, a flame sensor for fire detection, and a PIR sensor for motion detection near the LPG cylinder. The system continuously monitors environmental conditions and gas leakage levels and processes sensor data using intelligent decision-making logic to detect abnormal conditions. When gas leakage or fire is detected, the system automatically activates safety mechanisms such as a buzzer alert, exhaust fan control using a relay module, and automatic gas valve control using a servo motor to prevent further gas leakage and reduce accident risks. The system also displays real-time status and warning messages on an LCD display for user monitoring. This system demonstrate that it can detect gas leakage and fire hazards quickly and respond automatically, improving safety and monitoring efficiency compared to traditional gas monitoring systems.

Keywords— LPG Monitoring, Gas Leakage Detection, ESP32, IoT, Smart Gas Safety System, Embedded Systems.

PREDICTIVE IRRIGATION SYSTEM USING IOT AND MACHINE LEARNING

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Abstract

Agriculture requires more water, manual power and frequent monitoring as well as time and critical problems initially dueto waterscarcity, cropdisease, inefficient decision making, nutrition deficiency, proper maintenance of crops and improper pesticide for crop. These problems should not be ignored because it plays major role in day-to-day life. Water management can be controlled by monitoring the environment in real time and by early predictive analysis. To achieve this goal, the proposed solution which is based on IoT and machine learning based predictive martirrigation system with environmental monitoring and crop recommendation by integrating hardware design and by applying various machine learning techniques. Using hardware components like microcontroller, camera, sensors and actuators. Machine learning classification and ensemble techniques on a dataset provide better result for predicting the climate as well as crop suggestion. In which the algorithms are Decision Tree(DL), Random Forest (RF), Convolutional Neural Networks and the accuracy is different for every model when compared to other models. The project which automated the irrigation, making decision and croprecommendations based on the environmental inputs and also recommends suitable pesticides based on the crop variety such as Brinjal, groundnut, Muskmelon. The proposed system reduces water wastage, manual efforts, increase cropyields and support sustainable smart farming practices.

SMART HOME AUTOMATION USING DIGITAL TWINING TECHNOLOGY

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Abstract

Modern smart homes increasingly depend on motor-driven appliances such as ceiling fans, air conditioners, and water pumps, where unexpected failures can significantly impact efficiency, safety, and energy consumption. Traditional home automation systems provide basic control functionalities but lack intelligent monitoring, fault diagnostics, and real-time visualization capabilities required for advanced smart environments. This paper presents an advanced Digital Twin-based Smart Home Automation System integrated with IoT, cloud computing, and solar energy support for comprehensive motor health monitoring and control. The proposed system deploys a network of IoT sensors to continuously capture essential operational parameters including temperature, voltage, current, vibration, and acoustic signals. These real-time data are processed and transmitted through an ESP32 microcontroller to a cloud platform, where adynamic digital twin model is created to replicate the real- world behaviour of the motor with high accuracy. A significant innovation of this system isthe Augmented Visualization (AV)-enabled digital twin interface, which allows users to scan and monitor appliances in real time using smart devices. The system represents motor health through intuitive color- coded indicators, green for normal operation, orange for warning states, and red for critical conditions enabling quick fault identification and decision-making without the need for physical inspection. Furthermore, the system incorporates data-driven fault detection and predictive maintenance techniques, utilizing threshold-based analysis and historical data trends to identify early signs of faults such as overheating, overcurrent, abnormal vibration, and unusual noise patterns. This proactive approach minimizes downtime, reduces maintenance costs, and extends the life span of appliances. The integration of solar energy support enhances the sustainability of the system by optimizing energy usage and enabling hybrid power operation. Additionally, the system supports remote monitoring and control via cloud connectivity, allowing users to access real-time data, receive alerts, and manage appliances from anywhere. The proposed framework is scalable, cost-effective, and adaptable, making it suitable for a wide range of residential applications. By combining Digital Twin technology with IoT, renewable energy integration, and immersive visualization, this system provides a next- generation smart home solution that improves reliability, energy efficiency, user interaction, and overall system intelligence.

SMART HEALTHCARE ASSIST ROBOT WITH MEDICINE DISPENSER FOR RURAL AREAS

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Abstract

The need for rapid and automated primary health care solutions has led to the development of intelligent systems capable of both diagnosis and immediate medical assistance. In this work, a diagnosable and dispensable Medibot is proposed, designed to monitor patient health conditions and provide timely response without continuous human supervision. The system is implemented using an ESP32 microcontroller interfaced with biomedical sensors to acquire vital parameters such as body temperature and heart rate in real time. A rule-based decision-making mechanism is employed to analyze the acquired physiological data and identify abnormal health conditions based on predefined thresholds. Upon detecting critical conditions, the system autonomously performs a sequence of actions, including generating alerts, initiating communication, and activating an automated pill dispensing unit to deliver appropriate medication. This ensures immediate primary care, particularly in situations where medical personnel may not be readily available. To enhance system functionality, real- time communication capabilities are integrated through a web-based interface, enabling direct interaction between the patient and healthcare provider. A video communication module facilitates remote consultation, while a bidirectional messaging system allows doctors to send instructions, which are displayed on an embedded LCD for patient guidance. The integration of sensing, decision-making, actuation, and communication modules results in a comprehensive and efficient healthcare solution. The proposed Medibot is cost-effective, scalable, and suitable for deployment in smart hospitals, rural healthcare environments, and home-based monitoring systems. By combining automated diagnosis with immediate drug dispensing and remote consultation, the system significantly improves response time and enhances the overall quality of healthcare delivery.

Keywords: IoT, ESP32, Health Monitoring, WebRTC, Telemedicine, Real-Time Systems, Blynk, Remote Patient Monitoring, Embedded Systems, Smart Healthcare

FULLY AUTONOMOUS INTELLIGENT SOLAR PANEL CLEANING SYSTEM

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ABSTRACT

Fully Autonomous Intelligent Solar Panel Cleaning system represents a significant shift from reactive maintenance to proactive, data-driven optimization. By operating entirely within a standalone 12V ecosystem, the system bypasses the complexities of grid-tied infrastructure, making it an ideal candidate for decentralized energy installations in arid or high-pollution corridors. Its core architectural strength lies in the Multi-Factor Scoring System, which effectively serves as a digital filter for environmental noise. Rather than relying on a solitary sensor—which could be misled by a passing cloud or a sudden spike in ambient temperature—the Arduino-based logic synthesizes inputs from the BH1750 irradiance sensor and INA219 power monitor to establish a "Clean Efficiency Baseline." This baseline is not static; it evolves during an initial three-day heuristic learning phase, allowing the robot to adapt to the specific solar trajectory and shading profile of its unique location. Mechanically, the hardware selection emphasizes longevity and torque over simple speed. The utilization of a 120 RPM Johnson Geared Motor ensures that the cleaning brush exerts sufficient friction to dislodge "cemented" dust—layers that have been hardened by morning dew—while the L298N driver dual-channel configuration allows for simultaneous control of the propulsion and the fluidic pump system. This eliminates the need for mechanical relays, thereby reducing the risk of electromagnetic interference and extending the mean time between failures (MTBF). Furthermore, the integration of IoT telemetry via the ESP-01 transforms the device from a simple tool into a smart node in the "Internet of Energy." By delivering real-time diagnostics and status updates directly to a user's smartphone, it provides a transparent view of system health, including critical safety overrides such as thermal postponement and rain-based cancellation, ultimately ensuring that every Milliliters of water and every watt of battery power is utilized with maximum precision.

Keywords: IoT, Autonomous Cleaning Robot, Solar Panel Efficiency Optimization, BH1750 Sensor, INA219 Power Monitoring, Multi-Factor Decision System, Adaptive Learning Algorithm, Embedded Control System, ESP01 Communication, Smart Energy Systems.

IOT-BASED SMART ENVIRONMENT AUTOMATION SYSTEM USING AI-DRIVEN DECISION MAKING

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Abstract

The proposed project presents an IoT-enabled Smart Environment Automation System using AI-driven decision-making. The system is designed to monitor indoor environmental conditions in real time and automatically control electrical appliances to improve energy efficiency, enhance safety, and reduce manual intervention. The system integrates multiple sensors, including a PIR sensor for occupancy detection, a DHT22 sensor for temperature and humidity measurement, an MQ-2 sensor for gas leakage detection, and an MQ-135 sensor for air quality monitoring. Based on predefined conditions, the system automatically controls appliances such as lights, fans, and a buzzer through a relay module. Lighting is controlled based on occupancy, fan operation is based on temperature, and safety alerts are triggered during gas leakage or poor air quality conditions. To improve functionality, the system includes Smart Mode for automatic operation and Manual Mode for user control. A priority-based mechanism ensures that critical conditions over ride other operations, while delay- based logic enhances system stability and energy efficiency. The system also provides real-time feedback through an LCD display. Additionally, the ESP32's Wi-Fi capability enables IoT-based monitoring and control through a mobile application. Overall, the system combines sensing, intelligent decision-making, and automation to provide an efficient and reliable smart environment solution.

Keywords: IoT, Smart Automation, ESP32, Sensor-Based System, Rule- Based AI, Environmental Monitoring, Relay Control, Smart Home.

SECURE VOTING SYSTEM FROM NEAREST AUTHORISED CENTRES

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Abstract

Electronic voting systems play a crucial role in modern democracies by enabling efficient, accurate, and secure election processes. This paper presents the design and implementation of a fast, low-cost, and secure electronic voting system that allows citizens to cast their votes from the nearest authorized voting centre, eliminating the need to travel to their native constituency. The proposed system incorporates a location-based filtering mechanism, where users first select their State, District, and Constituency through a user-friendly interface. This approach enables the system to load only the relevant voter database, significantly reducing fingerprint matching time and improving authentication speed. A biometric fingerprint sensor is employed to ensure secure and reliable voter identification. Upon successful authentication, the system verifies voter eligibility and displays the candidate list corresponding to the selected constituency on a touchscreen interface. The voter can then cast their vote, which is securely recorded with mechanisms to prevent duplicate voting. The proposed system emphasizes simplicity, scalability, and cost-effectiveness while maintaining high accuracy and security standards. Biometric Authentication, Electronic Voting System, Fingerprint Recognition, Secure Voting, ESP32, Voter Verification, Constituency- Based Filtering, Data Security, Embedded Systems.

WOMEN SAFETY DEVICE WITH AI VOICE AND GESTURE DETECTION

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Abstract:

This project focuses on developing an advanced and intelligent women safety system using the combined power of Artificial Intelligence (AI) and Internet of Things (IoT) technology. The primary goal of this system is to provide immediate, reliable, and automated assistance during emergency situations, especially when a woman is in danger or unable to seek help manually. In today's world, women safety has become a major concern, particularly in public places, isolated areas, and during travel. To address this issue, this system is designed to continuously monitor the user's surroundings in real-time using multiple sensors and smart technologies. These sensors help in identifying abnormal or suspicious situations such as sudden jerks or movements, unusual physical activity, or distress signals like shouting, crying, or panic voice detection. The Artificial Intelligence component plays a key role in analyzing the collected data intelligently. It distinguishes between normal and abnormal behavior patterns, ensuring that false alerts are minimized. Once a potential threat or emergency situation is detected, the system immediately triggers a series of safety actions without requiring manual intervention. One of the major features of this system is the automatic alert mechanism. When danger is detected, an alert message is instantly sent to pre-registered emergency contacts such as family members, friends, or authorities. This message includes the user's real-time live location using GPS technology, enabling quick tracking and faster response. This feature ensures that help can reach the user as soon as possible. Additionally, the system activates a buzzer or loud alarm to attract the attention of nearby people. This can help in discouraging attackers and increasing the chances of immediate assistance from people around. The combination of alert messaging and local alarm significantly improves the safety level. The entire system is built around the ESP32 WROOM microcontroller, which acts as the central processing unit. It connects all the components such as sensors, GPS module, communication modules, and alarm system. The ESP32 processes all incoming data efficiently and performs real-time decision-making, making the system fast and reliable. This project is designed to be cost-effective, compact, and easy to use, making it accessible for everyday use. It can be implemented in wearable devices like bands, bags, or mobile-based systems, allowing women to carry it comfortably wherever they go. Overall, this AI-based women safety system provides asmart, efficient, and proactive solution to enhance personal security. It not only ensures faster emergency response but also increases confidence and independence among women. By leveraging modern technology, this project aims to reduce crime risks and create a safer environment for women in society.

AI ENABLED AUTONOMOUS RAILWAY TRACK CRACK DETECTION WITH GPS AND GSM MONITORING

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Abstract:

Railway transportation is one of the most widely used modes of travel, making the safety and reliability of railway tracks a critical concern. Track defects such as cracks and fractures are major contributors to railway accidents, including derailments and infrastructure damage. Even minor cracks, if not detected data nearly stage, can propagate overtime and lead tos evere consequences, resulting in loss of life and significant economic impact. Therefore, continuous monitoring and early detection of railway track defects are essential for ensuring safe railway operations. Conventional inspection methods, including manual patrolling and periodic monitoring, are inefficient, time-consuming, and prone to human error. These approaches do not support real-time monitoring and often fail to identify small or early-stage cracks. As a result, there is a need for an automated and intelligent system that can provide accurate, continuous, and reliable track inspection with minimal human intervention. This project proposes an AI-enabled autonomous railway track crack detection and risk prediction robot integrated with GPS and GSM technologies. The system utilizes a combination of infrared sensors, ultrasonic sensors, and a camera module to detect and validate cracks with high precision. Infrared sensors are used to identify surface-level defects, while ultrasonic sensors help detect internal structural flaws. The camera module captures real-time images of the detected cracks, enabling visual verification and improved reliability. The collected sensor data is processed using an AI-based decision algorithm that classifies defects into different severity levels such as low, medium, and highrisk. This multi-senso data fusion approach reduces false detections and enhances overall system accuracy. In addition, the predictive capability of the system helps in identifying potential risks before they develop into critical failures. Upon detecting a high-severity defect, the system automatically retrieves the exact location of the fault using GPS and transmits an alert message to the control center through GSM communication. This ensures immediate notification and enables quick maintenance response, thereby reducing the chances of accidents and operational delays. The proposed system offers a cost-effective, reliable, and efficient solution for modern railway track monitoring. By reducing dependency on manual inspection and enabling real-time defect detection and reporting, the system significantly improves railway safety and operational efficiency. This project contributes to the development of a smart railway infrastructure by integrating sensing, artificial intelligence, and communication technologies for proactive maintenance and enhanced safety.

SMART COMAPATIENT MONITORING SYSTEM

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Abstract

Coma patients need continuous monitoring as they cannot communicate any discomfort or sudden changes. Traditional manual methods often cause delaysin detecting critical conditions. This project develops a low-cost Smart Coma Patient Monitoring System using the ESP32 micro controller. The system monitors heart rate, body temperature, liquid quantity in the drip bottle using an ultrasonic sensor, and drop flow using an IR sensor. Body movements are detected in real-time via a webcam with OpenCV. A 6V motor pump automatically delivers liquid food during scheduled meal times. Real-time data is shown on an I2C LCD, and abnormal conditions trigger a buzzer alert. All parameters are uploaded to the Thing Speak cloud platform for remote monitoring and analysis. The prototype successfully demonstrates continuous multi-parameter monitoring, automated feeding, and early alerts.

Keywords: ESP32 Microcontroller, Healthcare IoT, Heart Rate Sensor, Body Temperature Monitoring, Ultrasonic Sensor, IR Sensor, OpenCV Motion Detection, Automated Feeding System, ThingSpeak Cloud, Real-Time Monitoring

Li-Fi TECHNOLOGY

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Abstract

Li-Fi Technology (Light Fidelity) is an emerging wireless communication technology that uses visible light to transmit data at very high speeds. It works by using light from LED bulbs to send information through rapid changes in light intensity, which are detected by a photodetector at the receiving end. Unlike traditional wireless communication systems such as Wi-Fi, Li-Fi uses the visible light spectrum instead of radio waves, making it faster, more secure, and less prone to interference.

The main advantage of Li-Fi technology is its ability to provide high-speed data transmission, potentially reaching speeds of several gigabits per second. It can be used in environments where radio frequency communication is restricted, such as hospitals, aircraft, and underwater communication systems. Since LED lights are already widely used for illumination, Li-Fi can easily be integrated into existing lighting infrastructure, making it energy efficient and cost effective.

This paper discusses the basic concept, working principle, components, advantages, and applications of Li-Fi technology. It also highlights how Li-Fi can help overcome the limitations of current wireless communication systems and contribute to the future development of high-speed data networks.

REAL-TIME EDGE-BASED ANOMALY DETECTION USING TINYML AND MULTI-SENSOR FUSION

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Abstract
This paper presents a real-time anomaly detection system using a Bidirectional Long Short-Term Memory (BiLSTM) model deployed on an ESP32 microcontroller. The system utilizes multivariate sensor data, including temperature, vibration, and pressure, to classify equipment conditions into No Fault, Bearing Fault, and Overheating. The model is trained and evaluated on the Industrial Equipment Monitoring Dataset with 7,672 sequences, achieving a fault recall of 90.1% and a weighted accuracy of 0.76. The system operates in real time using DHT22, MPU6050, and BMP280 sensors, displaying results on an I2C LCD and streaming data to a web dashboard. This approach enables efficient, low-latency fault detection directly on edge devices without cloud dependency.

MULTI-PURPOSE SOLAR POWERED DRYER FOR AGRICULTURAL AND MARINE PRODUCTS

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Abstract
The inefficiency of dryness in the crops during the post-harvest stage is a major challenge for our farmers in the agricultural sector and particularly in rural areas where farmers only depends upon the traditional open sun drying method, This conventional technique that exposes the crops to dust, pests and fluctuating weather conditions which reduces the product quality and increases the spoilage. This project presents a smart solar powered crop drying system to provide controlled and efficient drying using hybrid approach. The system utilizes a microcontroller-based setup to monitor temperature and humidity through sensors and regulates the drying process automatically. It incorporates solar power with battery storage for the off grid operation and enables dual monitoring through the internet and Bluetooth. The proposed solution aims to be energy efficient, reliable and farmers friendly making it suitable for rural applications. It promotes sustainable agriculture and supports the adoption of the smart technologies in the rural environments.
Keywords: Agricultural Drying; IoT-Based Smart Dryer; ESP32; Temperature and Humidity Monitoring; Forced Convection; Energy-Efficient System.

REAL-TIME ENERGY CONSUMPTION TRACKER USING IOT WITH THE LOAD PROTECTION SYSTEM

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Abstract
This report explains how a smart meter monitoring and load protection can be implemented and designed using the Internet of Things concept to achieve optimal and safe energy use. The system will entail a continuous monitoring of current and voltage parameters using potential transformers and current transformers. These two transformers will communicate with the embedded controller where the data on the energy will be wirelessly transferred to a cloud server where the energy use will then be effectively monitored remotely and through any web or mobile interface. The smart load protection system has also been added to allow protection of abnormal load like overcurrent and overload by automatically de-energizing such faulty circuits. Integration of smart and automatic load protection system into the design will reduce damages that will be incurred on the system and the environment it will be situated in.
Index Terms- Energy, Internet of Things; load protection; smart meter

FOREST SURVEILLANCE & THEFT DETECTION MONITORING SYSTEM

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Abstract
The Forest Surveillance and Theft Detection Monitoring System is designed to safeguard forest resources by integrating advanced sensing technologies, real-time monitoring, and intelligent alert mechanisms. Forests are often vulnerable to illegal logging, poaching, and unauthorized access leading to ecological imbalance and resource depletion. This system employs a network of IoT enabled sensors, surveillance cameras, and machine learning algorithms to detect suspicious activities such as unauthorized human movement, vehicle entry, or tree cutting. Data collected is transmitted to a centralized control unit where anomalies are analyzed, and immediate alerts are sent to forest authorities for rapid response. The system aims to minimize human intervention, enhance efficiency in forest protection, and ensure sustainable conservation practices. By combining automation, real-time communication, and intelligent detection, the solution provides a proactive approach to forest security and resource management.

AI-DRIVEN SMART WATER QUALITY ASSESSMENT AND DYNAMIC ADSORPTION-BASED PURIFICATION SYSTEM USING IOT AND PREDICTIVE ANALYTICS

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Abstract

Water quality monitoring and purification are critical challenges in ensuring safe and sustainable water resources for domestic, industrial, and environmental applications. This project proposes an AI-Driven Smart Water Quality Assessment and Adaptive Adsorption-Based Purification System using IoT and Predictive Analytics, designed to provide real-time monitoring, intelligent analysis, and automated purification of water. The system integrates multiple sensors to continuously measure key parameters such as pH, turbidity, Total Dissolved Solids (TDS), and temperature. These parameters are collected and processed by an ESP32-based embedded system and transmitted to a cloud platform through IoT connectivity for remote access and monitoring. A machine learning model is employed to analyse the acquired data and predict water quality levels using predictive analytics techniques. Based on classification results, the system dynamically controls an adsorption-based purification unit utilizing materials such as activated carbon or biochar to remove contaminants, including heavy metals, suspended particles, and organic pollutants. The adaptive nature of the system enables efficient decision-making, such as regulating water flow and identifying adsorbent saturation levels, thereby optimizing purification performance. The proposed system offers a cost-effective, energy-efficient, and scalable solution with minimal human intervention.

It ensures continuous water quality assessment, intelligent purification control, and remote monitoring through a user-friendly IoT interface. This approach enhances water safety, reduces operational costs, and supports sustainable water management practices, making it suitable for smart cities, rural water supply systems, and industrial wastewater treatment applications.

BIOMETRIC-BASED SMART INSTITUTIONAL SECURITY SYSTEM WITH AI-POWERED ANTI-SPOOFING

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Abstract:
In recent years, institutional security has become a major concern due to increasing cases of unauthorized access, identity impersonation, and proxy attendance. Traditional access control systems such as ID cards, PIN-based entry, and manual attendance registers are vulnerable to misuse, duplication, and human error. To address these challenges, this project proposes a Biometric-Based Smart Institutional Security System with AI-Powered Anti-Spoofing, designed to provide secure, automated, and intelligent access management within educational institutions. The proposed system integrates biometric authentication technologies such as face recognition and fingerprint verification with Artificial Intelligence-based liveness detection mechanisms, ensuring that fake biometric attempts using photographs, videos, or artificial fingerprints are detected and rejected. By combining secure door control with automated attendance logging, the system eliminates manual errors and effectively prevents proxy attendance. The framework utilizes embedded systems including microcontrollers, camera modules, and fingerprint sensors to capture real-time biometric data, while machine learning algorithms analyse facial features to detect spoofing patterns and ensure accurate identity verification. Upon successful authentication, the system activates an electromagnetic door lock and automatically updates the attendance database. Overall, this solution enhances institutional safety, improves monitoring efficiency, reduces administrative workload, and provides reliable identity validation, making it scalable, cost-effective, and adaptable to schools, colleges, laboratories, and other restricted-access environments.

Keywords: Biometric Authentication, AI-Powered Anti-Spoofing, Face Recognition, Fingerprint Verification, Automated Attendance System, Smart Access Control.

INFORMATION TECHNOLOGY

MACHINE LEARNING-BASED ANALYSIS OF MULTI-ORGAN IMPACT IN ADVANCED BLADDER CANCER

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Abstract

Bladder cancer is a progressive disease that can significantly impact multiple organs in its advanced stages, leading to severe complications and reduced survival rates. Understanding the relationship between bladder cancer progression and its effects on other organs is crucial for improving diagnosis, treatment planning, and patient outcomes. This project proposes a machine learning-based approach to analyze and predict the multi-organ impact of advanced bladder cancer using clinical and genomic data. Various machine learning algorithms such as Decision Trees, Clustering, and Association Rule Mining are employed to identify hidden patterns and relationships between cancer severity and organ involvement, including the kidneys, liver, lungs, and lymphatic system. The model processes large-scale datasets to detect correlations between disease progression and secondary organ damage, enabling early prediction of metastasis. By analyzing these patterns, the system aims to assist healthcare professionals in making informed decisions and developing personalized treatment strategies. Furthermore, the study highlights the importance of integrating data-driven techniques in cancer research to enhance accuracy and efficiency in medical diagnosis. The proposed approach not only improves the understanding of bladder cancer progression but also contributes to the development of intelligent healthcare systems for better patient management and prognosis.

Keywords: Machine Learning; Predictive Modeling; Genomic Data; Decision Trees; Metastasis Prediction; Healthcare Analytics

PREDICTIVE SUPPLY CHAIN RISK MANAGEMENT SYSTEM WITH DECISION SUPPORT FOR B2B

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Abstract

This paper presents a machine learning–based predictive supply chain risk management system for business-to-business wholesale and retail networks that integrates internal inventory data such as stock levels, lead time, safety stock, and reorder points with external risk indicators like weather and logistics disruptions to proactively identify potential risks, where a hybrid approach combining rule-based internal risk evaluation and a Random Forest–based external risk prediction model is used to classify and normalize risk levels, and a dynamic reliability score is calculated for each business using both current risk values and historical stability trends , enabling a decision support system to generate actionable insights such as inventory adjustments, safety stock optimization, and alternative sourcing strategies, while an interactive dashboard visualizes risk trends, inventory status, and reliability metrics for real-time monitoring, and a collaboration engine recommends suitable partners based on location, industry type, inventory surplus, and reliability scores to support efficient resource sharing, further enhanced by an integrated communication module that enables collaboration requests, acceptance or rejection workflows, and direct messaging between businesses, thereby improving coordination, reducing supply chain disruptions, minimizing stockouts and overstock situations, and supporting proactive, data-driven decision-making in dynamic and uncertain supply chain environments while maintaining historical data integrity to ensure accurate and consistent risk and reliability calculations.

Keywords: Supply Chain Risk Management; Machine Learning; Predictive Analytics; Decision Support System; Collaborative Supply Chain; Risk Prediction.

CROP GROWTH SIMULATION AND PREDICTION USING MACHINE LEARNING

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Abstract

Agriculture remains a vital sector for food security and economic stability, yet farmers frequently encounter challenges including improper crop selection, inefficient nutrient management, delayed disease detection, and excessive fertilizer usage, resulting in reduced productivity and environmental degradation. This paper presents a Crop Growth Simulation and Prediction System using Machine Learning to support data-driven agricultural decision-making. The system predicts suitable crops based on soil type, nutrient composition, pH level, and climatic conditions using trained machine learning models. An image-based disease prediction module identifies plant diseases from leaf images, enabling early intervention and reducing yield loss. A fertilizer recommendation module determines optimal fertilizer types and quantities based on soil deficiencies, promoting balanced nutrient management. Additionally, a crop growth simulation module visually represents cultivation stages from sowing to harvesting, aiding farmer training and planning. Experimental results demonstrate improved prediction accuracy, reduced disease impact, and optimized fertilizer usage compared to traditional practices, contributing to precision agriculture and sustainable resource utilization.

Keywords: Precision agriculture; Crop prediction; Machine learning; Disease detection; Fertilizer recommendation; Crop growth simulation

BLOCKCHAIN-BASED CERTIFICATE VERIFICATION SYSTEM

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Abstract

Traditional certificate verification systems face significant challenges, including certificate forgery, inefficient manual verification processes, a lack of transparency, and inherent data manipulation risks. This project proposes a blockchain-based solution, AcadChain, designed to ensure the secure, transparent, and immutable handling of academic and professional credentials. By decentralizing certificate records and enabling real-time verification, the system establishes a framework of trust among institutions, students, and employers. The platform leverages smart contracts developed and tested using Hardhat to facilitate automated issuance and verification. A key innovation of this approach is the introduction of a Soulbound Token (SBT) Framework, which converts certificates from static records into non-transferable digital assets that reside permanently within a student's digital wallet. To address the efficiency concerns typical of standard blockchain systems, the architecture implements a 1 MB Bloom Filter optimization layer capable of identifying "False" states in 0.02ms, thereby reducing search times for invalid certificates by up to 80%. While metadata is handled on-chain, the actual certificate documents are stored securely off-chain using Encrypted IPFS Storage (Pinata), with unique Content Identifiers (CID) pinned to the blockchain to guarantee total data integrity. Furthermore, the system incorporates a smart revocation layer that allows authorized institutes to "burn" or invalidate defective tokens in real-time, providing immediate visual and technical updates to the digital portfolio. This model delivers a scalable and reliable digital credentialing ecosystem that significantly improves operational efficiency while strengthening credential integrity.

Keywords: Blockchain; Soulbound Tokens (SBT); IPFS; Smart Contracts; Certificate Verification; Bloom Filter

ADAPTIVE MULTISENSORY LEARNING PLATFORM FOR DYSLEXIC CHILDREN USING REAL-TIME AI-POWERED CONTENT PERSONALIZATION

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Abstract

Dyslexia is a neurodevelopmental learning disorder that affects reading ability, phonetic decoding, memory retention, and word sequencing skills in children. Traditional identification methods rely on manual evaluation, which is time-consuming and lacks scalability. This paper presents an AI-Based Dyslexia Detection and Adaptive Learning System using game-based assessment and machine learning to enable early detection and personalized learning support. The system evaluates students through interactive tasks including visual confusion, phonics (audio-based), memory, and word sequencing exercises, each designed with multiple difficulty levels. During interaction, behavioral data such as accuracy, response time, retry count, and audio replay frequency is collected and transformed into structured features. An XGBoost classification model is trained on this data to categorize students into four levels: normal, mild, moderate, and severe dyslexia. Based on the predicted level, the system adapts learning content dynamically to improve engagement and comprehension. Experimental analysis shows improved accuracy in identifying learning difficulties and enables early intervention through personalized learning strategies. The proposed system contributes to inclusive education by providing an efficient, scalable, and intelligent solution

Keywords: Dyslexia detection; Adaptive learning; Machine learning; XGBoost; Game-based assessment; Phonics analysis

WEBSAGE CONTEXT AWARE CHATBOT FOR INTELLIGENT WEBSITE ASSISTANCE

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Abstract

Websites today contain a large amount of information, making it difficult for users to quickly locate the content they need. Many existing website chatbots rely on rule-based systems or frequently asked question responses. These systems do not understand the actual context of the webpage and often provide repetitive or unrelated answers. Because of this limitation, users must manually navigate through multiple pages to find the required information.This work proposes WebSage, a context-aware chatbot that assists users by understanding the content of the current webpage. The system uses natural language processing techniques to analyze webpage information and respond to user queries. Webpage content is extracted in real time using Document Object Model parsing methods. The extracted text is processed and converted into semantic representations that capture the meaning of the content.These representations are stored in a vector database that allows efficient similarity-based retrieval. When a user submits a question, the system compares the query with stored webpage information and retrieves the most relevant content. The retrieved information is then used to generate a meaningful and context-aware response for the user. The proposed system improves website usability by reducing search time and providing quick access to relevant information.

Keywords: Chatbot; Natural Language Processing; Vector Database; Semantic Search; Artificial Intelligence

AI BASED NAVIGATION SYSTEM FOR VISUALLY IMPAIRED USING AR

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Abstract

This study proposes an intelligent indoor navigation system that leverages Artificial Intelligence and Augmented Reality to assist visually impaired individuals. The system utilizes a mobile device camera to capture real-time indoor scenes and employs a deep learning model for detecting obstacles such as furniture, walls, doors, and moving individuals. Based on the spatial position and proximity of detected objects, a navigation module generates safe and efficient movement paths within indoor environments. To enhance user interaction, Augmented Reality is used to provide visual cues for partially sighted users, while an integrated Text-to-Speech module delivers clear and continuous audio instructions for navigation. The system is implemented as a mobile application developed using Android Studio, incorporating modern programming frameworks for real-time processing and user-friendly operation. The proposed solution improves situational awareness in complex indoor settings such as buildings and corridors. Experimental evaluation demonstrates that the system reduces navigation difficulty and enhances user independence, safety, and confidence. This approach provides a cost-effective and accessible assistive technology for indoor mobility support.

Keywords: Augmented Reality; Object Detection; Assistive Navigation; Path Planning; Visual Impairment; Mobile-Based System.

AN INTELLIGENT ONLINE PAYMENT FRAUD DETECTION SYSTEM

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Abstract

The rapid growth of digital payment systems and online financial transactions has significantly increased the risk of fraud in the banking and fintech sectors. Fraudulent activities such as unauthorized transactions, phishing attacks, and fake payment requests have become more advanced, making traditional detection methods less effective. This project proposes an intelligent fraud detection system that combines machine learning techniques with rule-based analysis to identify suspicious transactions in real time. A synthetically generated dataset is used to simulate realistic financial transactions, including both legitimate and fraudulent patterns. Key features such as transaction time, amount, user details, bank information, and geographical location are analyzed. Advanced feature engineering techniques are applied to detect unusual behaviors like high transaction values, abnormal timing, and foreign locations. The system uses a supervised machine learning model, specifically XGBoost, to classify transactions as normal or fraudulent. To improve accuracy and reduce false positives, a hybrid approach combining machine learning predictions with rule-based scoring and behavioral analysis is implemented. The system is deployed using FastAPI for real-time prediction, along with a web dashboard for visualization. An OCR-based module is also included to detect phishing messages from images. The proposed system demonstrates high accuracy, efficiency, and scalability, making it suitable for real-world financial applications.

Keywords: Fraud Detection; Online Payment; XGBoost; UI and Dashboard

APPLICATION FOR EVENT MANAGEMENT WITH DIGITAL TICKET FEATURE

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Abstract

The rapid advancement of digital platforms has significantly transformed the way events are organized, managed, and attended. Traditional event management processes, which rely on manual registration, paper-based ticketing, and offline coordination, are increasingly insufficient for meeting the demands of modern large-scale events. This project proposes a web-based Event Management Application with a Digital Ticket Feature, developed using React and modern backend web technologies. The system offers a centralized platform enabling organizers to create, schedule, and manage events online, while allowing participants to register, make secure payments, and receive digital tickets instantly. Each digital ticket is embedded with a unique QR code that facilitates fast, secure, and reliable attendee verification at the event entry point, thereby reducing manual intervention and minimizing the risk of ticket duplication or forgery. The application supports real-time updates on event schedules, registrations, and attendee information, providing organizers with comprehensive dashboards for efficient oversight. A responsive and intuitive user interface ensures seamless accessibility across both desktop and mobile devices. Key features include online event registration, digital ticket generation, QR code-based verification, transport and food facility management, event notifications, and optional payment integration. The system architecture is designed for scalability and security, utilizing RESTful APIs and token-based authentication. The results demonstrate that the proposed system significantly reduces operational overhead, improves user experience for both organizers and participants, and provides a reliable, eco-friendly, and paperless approach to event management. This application is well-suited for college events, corporate programs, and public gatherings in the digital era.

Keywords: Event Management; Digital Ticketin; QR Code Verification; Online Registration, Real-Time Updates

NOVEL AI-DRIVEN REAL-TIME MULTIMODAL FAKE NEWS DETECTION SYSTEM LEVERAGING OFFICIAL SOURCE INTELLIGENCE

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Abstract

The rapid growth of social media platforms has led to a significant increase in the spread of misinformation, fake news, and fraudulent job postings in the form of text, images, and videos. Users often rely on unverified content, resulting in financial loss, social panic, and reputational damage. Existing verification systems are primarily text based and lack the ability to efficiently process multimedia content in real time. This paper proposes an AI driven real time multimodal verification system designed to detect fake news and job scams. The system integrates Natural Language Processing for text analysis and Optical Character Recognition for extracting text from images along with basic video analysis. It identifies key claims from user inputs and verifies them using trusted official sources such as government portals, authenticated job platforms, and reliable news agencies. A similarity based matching approach is used to evaluate the authenticity of the extracted information and generate an accuracy score. Based on this analysis the system classifies content as Real or Fake and provides instant verification results through a user friendly mobile interface. The proposed solution improves verification speed, accuracy, and usability compared to traditional methods making it suitable for real world deployment. This work contributes to reducing misinformation and enhancing digital trust and online safety.

Keywords: Fake News Detection; Job Scam Detection; Multimodal Verification; Artificial Intelligence,; Natural Language Processing; Optical Character Recognition; Real Time Systems

PHISHING MAIL DETECTION SYSTEM USING MACHINE LEARNING

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Abstract

The phishing attacks are still a major concern for the security of organizational emails, which rely on exploiting the psychology of humans and the techniques used for communication to gain unauthorized access to critical information. Since emails are one of the major mediums of corporate communication, there is an increased use of sophisticated spoofing techniques, malicious emails, and phishing content to bypass traditional filters. The traditional filters rely heavily on signatures and blacklists to detect malicious emails, which makes them ineffective against new phishing attacks and zero-day attacks. Keeping this issue in view, this project proposes an intelligent hybrid phishing detection system named PhishGuard. The system utilizes a multi-layer email analysis process, which includes analysis of the sender metadata, header consistency, URLs, HTML, and text features. The rule-first architecture provides a safe decision-making process, which utilizes a set of predefined phishing indicators and a supervised machine learning model. The LightGBM classifier utilizes a feature vector and predicts the probability of a phishing email with a confidence score. The combination of the rule-first and machine learning approaches minimizes false positives while maximizing detection accuracy. The system also utilizes a database logging layer and a Security Operations Center (SOC) dashboard for feedback. The architecture is scalable, interpretable, and applicable for use in an enterprise email environment. PhishGuard is designed to provide accurate, interpretable, and adaptable phishing detection for current cybersecurity challenges.

Keywords: Phishing Email; Light GBM; Machine Learning URLs; PhishGuard

SECURE ONLINE ELECTION SYSTEM USING FACE AUTHENTICATION AND INTELLIGENT PROCTORING

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Abstract

Conventional election systems, including paper-based and basic online platforms, face significant challenges such as voter impersonation, duplicate voting, delayed result processing, and weak identity verification. Existing digital solutions relying on passwords or OTP-based authentication provide only initial access control and fail to ensure that the authenticated user remains the legitimate voter throughout the process. Hardware-based biometric systems, while more secure, are costly and unsuitable for scalable web deployment. This paper presents a Secure Online Election System with Face Authentication and Intelligent Proctoring, designed to address these limitations using artificial intelligence and computer vision. The system generates unique facial encodings during registration and performs real-time identity verification using live webcam input during voting. Additionally, intelligent monitoring detects anomalies such as multiple faces and camera tampering. The proposed approach ensures secure, continuous authentication and enforces one-person–one-vote without specialized hardware, providing a scalable and cost-effective solution for digital elections.

Keywords: Face authentication,; online voting; biometric verification; intelligent proctoring; election security; computer vision;

AN AI DRIVEN ABUSIVE COMMENTS DETECTION AND PREVENTION SYSTEM IN ONLINE PLATFORMS

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Abstract

With the rapid growth of social media and online communication platforms, the spread of toxic and abusive comments has become a major concern, negatively impacting users' mental well-being and online safety. Existing moderation systems rely on manual monitoring or rule-based filtering, which are inefficient and fail to understand context, sarcasm, and disguised abusive language. To address these challenges, this paper proposes SafeChat, an AI-powered moderation system designed for real-time, context aware detection of abusive comments. The system uses a hybrid approach combining rule-based preprocessing with a fine-tuned transformer-based model. User input is first cleaned and normalized, then processed by a custom RoBERTa-based model trained on over 0.5 million labeled comments to classify text into categories such as safe, profanity, hate speech, and harassment. The model effectively captures semantic meaning and contextual relationships, enabling accurate detection even when abusive words are modified or presented in slang form. The system achieves an accuracy of 94.3% with strong precision, recall, and F1-score values. In addition, SafeChat generates polite alternative suggestions to promote respectful communication. The proposed system provides a scalable and efficient solution for modern moderation systems, contributing to a safer and more inclusive digital environment.

Keywords: AI Content Moderation; Abusive Comments Detection; Transformer Model; Natural Language Processing; Abusive Comment Detection

TUBERCULOSIS INFECTION DETECTION USING DEEP LEARNING

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Abstract

Tuberculosis (TB) is a major global health threat, especially in developing countries. This project proposes an automated TB detection system using Deep Learning and Convolutional Neural Networks (CNNs) applied to chest X-ray (CXR) images. The system classifies X-rays as TB positive or negative using datasets such as the NIH Chest X-ray and Montgomery County TB datasets. Preprocessing techniques—normalization, resizing, and augmentation—enhance model performance. The CNN model, implemented in Python, TensorFlow, and Keras, automatically extracts features for accurate classification. Experimental results show high accuracy, precision, and sensitivity, outperforming traditional diagnostic methods. Grad-CAM visualization highlights key regions influencing predictions, improving interpretability. The proposed system offers a fast, cost-effective, and reliable diagnostic tool for TB screening in resource-limited settings, supporting early detection and global TB control.

Keywords: Tuberculosis; Deep Learning; CNN; Chest X-ray; Image Classification; Medical Imaging;

DESIGN AND IMPLEMENTATION OF AN AI-BASED STUDENT SUPPORT CHATBOT

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Abstract

Educational institutions often face challenges in managing a large number of student queries, leading to delayed responses, inefficient communication, and increased workload on administrative staff. This paper presents the design and implementation of an AI-based student support chatbot to provide automated and real-time assistance to students. The system utilizes Natural Language Processing (NLP) techniques to understand user queries and classify intent using rule-based and lightweight machine learning approaches. It retrieves relevant information from a structured database to generate accurate responses for queries related to attendance, examinations, fees, and academic procedures. The chatbot is developed using a Flask-based web framework, ensuring efficient backend processing and seamless frontend interaction. The proposed system offers 24/7 availability, reduces manual effort and improves response efficiency. Experimental evaluation demonstrates improved response time, enhanced user satisfaction, and reduced dependency on manual support systems, contributing to smarter and more efficient educational services.

Keywords: Artificial Intelligence (AI); Chatbot; Student Support System; Conversational Agent; Natural Language Processing (NLP)

PHYSIO-MOBILENETV3: AN EDGE-DEPLOYABLE FRAMEWORK FOR LIGHTWEIGHT DEEPFAKE DETECTION THROUGH A COMPARATIVE ARCHITECTURAL STUDY

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Abstract

The line between real and synthetic media has grown thin enough that it's becoming a practical problem, not just a theoretical one. Deepfake generation tools are widely available now, and the detection methods built to counter them are struggling to keep up — partly because the visual artifacts they rely on are getting harder to find, and partly because heavy social media compression erases many of them before a detector ever gets a look. This paper puts forward a dual-stream detection framework built to run in real time on the kind of hardware people actually own. The backbone is MobileNetV3-Small, chosen for its efficiency, but the more distinctive element is a second stream that pulls on principles from remote photoplethysmography — looking for the faint biological signals present in real skin that synthetic faces consistently lack. We also bring in a Convolutional Block Attention Module (CBAM) to help the network concentrate on the spatial and channel features most relevant to manipulation, rather than spreading attention evenly across everything. On Face Forensics++ (CRF 23), the model reaches 90.40% accuracy and an AUC of 0.9231. It fits in 6.13 MB and processes images in 12.11 ms on CPU — roughly four times faster than EfficientNet-B0. We also tested it without retraining on heavily compressed footage (CRF 40) and on Celeb-DF v2, a dataset built with generation methods the model had never seen. Those results support the broader argument: anchoring detection in biological cues produces something more transferable than systems trained to spot texture artifacts that keep disappearing.

Keywords: Deepfake Detection; MobileNetV3; Physiological Features; CBAM;Edge Computing; Real-time Security

AUTOMATED MARK DIGITIZATION AND CO-BASED MAPPING USING DEEP LEARNING

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Abstract

The manual evaluation and digitization of marksheets is a time-consuming and error-prone process, particularly in large-scale academic environments where a large volume of answer sheets must be processed within limited time. This paper presents an automated system for extracting handwritten marks from answer sheet images and performing Course Outcome (CO)-based mapping using deep learning techniques. The proposed system supports multiple input modes, including scanned images, bulk image uploads, and real-time capture through a mobile application, making it suitable for practical academic usage. A YOLOv8-based object detection model is trained on domain-specific datasets to accurately localize key regions such as student name, register number (RRN), and marks tables, even under varying image conditions. The detected regions are normalized using perspective transformation to correct distortions, followed by deterministic cell extraction to ensure consistent segmentation of tabular data. A hybrid Optical Character Recognition (OCR) pipeline, combining PaddleOCR with EMNIST-based enhancement, is employed to improve the accuracy of handwritten digit and text recognition. The system further incorporates preprocessing techniques and a dual-stream recognition approach to reduce errors in both numeric and alphanumeric extraction. To ensure data reliability, a rule-based validation engine is integrated to verify mark ranges and total calculations, along with a human-in-the-loop interface for manual correction when required. Additionally, the system performs automated CO-based mapping and generates a structured Excel report for further academic analysis. Experimental results demonstrate that the proposed system significantly reduces processing time while maintaining high accuracy and robustness, making it a scalable and efficient solution for automated academic evaluation and performance analysis

Keywords: YOLOv8; optical character recognition; deep learning, marksheet analysis; CO mapping

BIG DATA VISUALIZATION AND PREDICTION USING HYBRID MODEL OF AI ASSISTANCE AND PYTHON ALGORITHMS

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Abstract

Modern analytics systems are increasingly expected to support data preprocessing, visualization, forecasting, and monitoring within a unified environment. However, many conventional visualization tools separate these functions across multiple platforms, thereby increasing workflow fragmentation and user effort. This paper presents the design and evaluation of an AI-assisted data visualization platform that integrates static dataset analysis, interactive cleaning, chart generation, forecasting support, and data monitoring in a single web-based application. The system is implemented using Python and Streamlit, with Pandas and NumPy for processing, Plotly for visualization, Apache Kafka for message streaming, and MongoDB for data source integration. A key feature of the platform is its AI-assisted decision-support layer, which provides dataset summaries, context-aware recommendations, natural-language-style query handling, chart suggestions, cleaning guidance, and anomaly-oriented support for data streams. Unlike fully autonomous analytics systems, the proposed platform is designed as a human-in-the-loop environment in which AI features guide user decisions while preserving transparency and control. The platform also supports data ingestion by bridging MongoDB change events to Kafka topics and consuming them within the analytics interface. The paper describes the system architecture, implementation methodology, and experimental workflow used to evaluate responsiveness, usability, and integration capability. Results indicate that the platform successfully unifies multiple stages of analytics in a single interactive environment while improving accessibility for users who require both static and streaming data analysis. The work demonstrates a practical and extensible approach for combining AI-assisted analytics with visualization in a lightweight prototype platform.

Keywords: AI-assisted analytics; real-time analytics; data visualization; Streamlit, Apache Kafka; MongoDB; forecasting; interactive dashboards

MEDISYNC: A SECURE CENTRALIZED CLINICAL DATA MANAGEMENT FRAMEWORK WITH MACHINE LEARNING BASED DISEASE RISK PREDICTION

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Abstract

The rapid growth of AI (Artificial Intelligence) is providing new ways to enhance the healthcare system through intelligent data analysis and decision support. This paper describes an AI-based disease prediction and healthcare management system called MEDISYNC, which predicts diseases while enhancing efficiency and providing accurate diagnoses. MEDISYNC incorporates various types of health-related information, such as medical history, current symptoms, and clinical data (such as those needed to create an accurate diagnosis). In addition, the OCR (Optical Character Recognition) module reads through unstructured documents like a patient's report and prepares this information for use with machine learning prediction models, such as Decision Tree and Random Forest. The OCR module allows users to enter or upload their own patient data, as well as view predictions of possible diseases and receive confidence scores for each predicted disease. In addition to predictions, every disease will have a severity score to assist with clinical decision-making. Both patients and healthcare providers can communicate easily with the MEDISYNC interface. The centralized database allows all records to be kept securely, access to records to be easy, and for records to be tracked continuously over time. The results from the experiments would indicate that MEDISYNC improves prediction accuracy, decreases the amount of time required to complete prediction task manually, and increases the overall efficiency of healthcare systems. This work provides evidence of the potential impact of using AI-based solutions on converting traditional healthcare systems into more intelligent and data-based systems.

Keywords: Artificial Intelligence; Disease Prediction; Machine Learning; Electronic Health Records (EHR); Optical Character Recognition (OCR); Healthcare System; Random Forest; Decision Tree; Medical DataAnalysis; Clinical Decision Support

FEMORA: A SMART MULTILINGUAL SYSTEM FOR GYNECOLOGICAL DISEASE DETECTION

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Abstract

Women's health, particularly gynecological conditions such as Polycystic Ovary Syndrome (PCOS), often suffers from delayed diagnosis due to lack of awareness, social stigma, and limited access to healthcare services. This paper presents Femora, a smart multilingual system designed to assist in the early detection of gynecological diseases using Artificial Intelligence techniques. The proposed system collects user health data through an interactive form that supports multiple languages, enabling accessibility for users from diverse linguistic backgrounds. Natural Language Processing (NLP) is utilized to interpret and standardize multilingual inputs, ensuring accurate understanding of user symptoms. The system processes parameters such as menstrual irregularities, lifestyle habits, hormonal symptoms, and medical history, converting them into structured numerical data. A rule-based scoring mechanism is employed to evaluate the risk level of disease, categorizing users into low, moderate, or high-risk groups. Based on the prediction, the system provides personalized health recommendations, including lifestyle modifications and medical consultation advice. The integration of multilingual support with intelligent prediction enhances usability, accessibility, and effectiveness of healthcare assistance. The proposed system demonstrates a cost-effective, user-friendly, and scalable solution for early disease detection, particularly beneficial in rural and underserved areas. Femora contribute to improving women's healthcare by promoting awareness, enabling early intervention, and bridging the gap between technology and medical services.

Keywords: Gynecological Disease Detection; Polycystic Ovary Syndrome (PCOS); Artificial Intelligence; Machine Learning; Natural Language Processing (NLP)

STEGANOGRAPHIC METHODS FOR RESOURCE-CONSTRAINED IOT DEVICES: A COMPREHENSIVE SURVEY

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Abstract

The growth of the Internet of Things (IoT) has created major security challenges, especially in achieving secure data transfer among devices with limited resources. Although conventional encryption methods provide strong protection, they are often computationally expensive and easily detectable, making them less practical for IoT systems. Steganography provides an effective alternative by hiding confidential information within normal-looking data, reducing the chance of detection by unauthorized users. This study presents a comprehensive review of steganographic techniques for IoT, covering methods such as spatial, frequency-domain, hybrid, and quantum-based approaches applied to images, videos, audio, text, and network traffic. These techniques are evaluated using important metrics such as imperceptibility, robustness, and embedding capacity, while also considering IoT-specific requirements like low computational cost, real-time processing, and energy efficiency. The survey also discusses the combination of steganography and cryptography, along with emerging developments in ML, DL, and quantum technologies. Finally, it highlights future research opportunities and stresses the need for secure, efficient, and scalable steganographic methods for IoT applications.

Key words : Internet of Things (IoT); steganography; covert communication; secure data transfer; resource-constrained devices

DESIGN AND ANALYSIS OF SIERPINSKI FRACTAL ANTENNA FOR SATELLITE COMMUNICATION APPLICATIONS

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Abstract

This paper presents the design and analysis of a fractal antenna based on the Sierpinski geometry for satellite communication (SatCom) applications. The Sierpinski fractal structure is utilized to achieve multiband operation and size reduction while maintaining efficient radiation characteristics. By incorporating self-similar patterns, the antenna is capable of operating at multiple frequency bands required for reliable satellite communication systems. The proposed antenna is designed and analyzed using simulation tools to evaluate key performance parameters such as return loss, voltage standing wave ratio (VSWR), gain, and radiation pattern. The results indicate that the Sierpinski fractal design provides improved bandwidth, good impedance matching, and stable radiation performance across the desired frequency ranges. This makes it a suitable candidate for compact and efficient SatCom applications. The study demonstrates that fractal-based antenna designs offer significant advantages in terms of miniaturization and multiband functionality for modern communication systems.

ADAPTIVE MULTIMODAL AI SYSTEM FOR AUTISM INTERVENTION

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Abstract

Children with Autism Spectrum Disorder (ASD) exhibit diverse cognitive and behavioral profiles that make one-size-fits-all educational tools largely ineffective. Traditional learning systems fail to account for real-time emotional and attentional states, limiting their therapeutic and pedagogical value. This paper presents an Adaptive Multimodal AI System for Autism Intervention a game-based learning platform that integrates facial expression recognition, speech emotion analysis, attention tracking, and response-time analysis to deliver dynamically personalized learning experiences for children with ASD. The proposed system continuously monitors key behavioral signals through two emotion modalities facial expressions and vocal tone — alongside engagement level and task performance. These multimodal inputs drive an adaptive engine that adjusts game difficulty and task type in real time, ensuring the child remains within an optimal learning zone. Unlike static game-based tools or simple rule-based systems, the proposed architecture responds to the learner's live behavioral context, enabling a closed-loop intervention model that is both responsive and non-intrusive. Comparative evaluation against static and rule-based approaches demonstrates that the fusion of facial and speech-based emotion recognition yields superior engagement tracking and learning efficiency, confirming the advantage of multimodal sensing over unimodal methods for ASD intervention. The system contributes a scalable, non-invasive framework for AI-assisted autism intervention, with implications for personalized special education, behavioral analytics, and human-computer interaction research.

Keywords: Autism Spectrum Disorder; Multimodal Emotion Recognition; Facial Expression; Speech Emotion Analysis; Adaptive Learning; Game-Based Intervention

IMPROVED ENSEMBLE-BASED CREDIT RISK PREDICTION USING CNN–LSTM

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Abstract

Credit risk prediction plays a significant role in decision-making in banking and financial organizations since it allows them to predict the probability of the loan being returned by customers. However, it might be complicated due to such factors as class imbalance, complexity of feature relationships, and variations in behavior over time. In order to overcome those limitations, the paper suggests developing an advanced credit risk prediction technique which uses Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM). In data preprocessing, various resampling methods are applied to address the class imbalance issue and improve the learning process of minority class samples. The CNN model is responsible for detecting nonlinear and complex relations between features, whereas the LSTM model is concerned with capturing long-term dependencies between sequences of credit transactions. The use of these approaches in combination provides opportunities to make the best use of each of them to improve the prediction performance. The results of the experiment prove that the suggested approach outperforms machine learning techniques and single deep learning algorithms in such metrics as accuracy, precision, recall, and AUC.

Keywords: Credit Risk Prediction; CNN–LSTM Ensemble; Class Imbalance; Data Resampling; Financial Risk Assessment

AI-BASED DRIVER DROWSINESS DETECTION SYSTEM USING IOT

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Abstract

Drowsy driving is a significant cause of road accident globally. In addition to the dangerous driving caused by a fatigued driver, fatigue lowers the driver's alertness and reaction time. The Driver Drowsiness Detection System using computer vision and deep learning approach is proposed to keep an eye on the driver's facial features in the live mode and eye detection method is used to fatigue. It captures the driver's face using a camera and monitors eye closure, blinking rate, and facial motion. A deep learning architecture such as MobileNetV2 or Convolutional Neural Network (CNN) is applied to categorize the driver as alert or drowsy. On detection of the drowsiness, the system activates an alarming mechanism to alert the driver and avoid accidents. The proposed system can be installed in vehicles to enhance road safety w.r.t driver fatigue.

Keywords: Driver Drowsiness Detection; Deep Learning; Convolutional Neural Network (CNN); MobileNetV; Computer Vision; Image Processing; Real-Time Monitoring; Driver Safet; Fatigue detection; Image processing

SAVORING INDIA: DEEP LEARNING-ENHANCED CUISINE IDENTIFICATION AND NUTRITIONAL INSIGHTS FOR TRAVELERS

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Abstract

Indian cuisine gives a good flavour of foods and dishes, from spicy curries to Sweetsmelling biryanis. Some foods may lack proper hygiene standards. Finding the nutrients present in the food can be a challenging task. This paper focusses on an advanced system for automated food identification and nutrient analysis using Deep learning algorithm. Utilizing a dataset with 20 diverse food classes, each containing hundreds of images, the model leverages state-of-theart Convolutional Neural Network architectures – MobileNet, DenseNet121 and InceptionV3 - to accurately recognize and classify food images. Achieving an impressive accuracy rate, DenseNet121 emerges as the superior model. Additionally, the system incorporates a unique feature, it identifies the geographical origin of the recognized food, providing insights into the regional culinary landscape of India. Furthermore, the system offers practical utility by integrating web scraping techniques to retrieve nutritional information from food blogging websites. This information, combined with the identified food item, enables users, particularly fitness enthusiasts, to make informed dietary choices by understanding the macro nutrient composition of the foods they consume. Overall, this paper not only advances the field of automatic food recognition but also offers a valuable tool for dietary management and nutritional awareness. The main aim of this paper is to guide the tourist people to get awareness about the food details and nutrient level.

Keywords-:Deep Learning; MobileNet; DenseNet121 and InceptionV3, Tourist.

AN APPROACH FOR CROP PREDICTION IN AGRICULTURE: INTEGRATING GENETIC ALGORITHMS AND MACHINE LEARNING

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Abstract

The agricultural sector in many South Asian countries, including Bangladesh and India, plays a pivotal role in the economy, with a significant portion of the population dependent on it for livelihood. However, farmers often encounter challenges such as unpredictable weather conditions, soil variability, and natural disasters like floods and erosion, leading to substantial crop losses and financial strain. Despite government subsidies, many farmers struggle to sustain their livelihoods, resulting in a decline in interest in agriculture. Our focus lies on predicting the classification of various crops, including rice, jute, maize, and others, based on a combination of soil and weather features. Soil features, including Nitrogen, Phosphorus, Potassium, and pH levels, along with weather variables such as Temperature, Humidity, and Rainfall, are utilized as inputs for the predictive model. Methods: In this study, we address the critical issue of crop prediction by leveraging advanced machine-learning techniques and integrating genetic algorithms into the predictive model. Our proposed approach employs a hybrid methodology, where a Genetic Algorithm is utilized to optimize the hyperparameters of the model, enhancing its performance and robustness. Specifically, we employ a Random Forest classifier, a powerful ensemble learning technique, to classify the class labels associated with 22 different types of crops. Findings: The model's accuracy is evaluated extensively, demonstrating a remarkable accuracy rate of 99.3%. Additionally, we utilized Local Interpretable Model-agnostic Explaination(LIME) and SHapley Additive exPlanations(SHAP) Explainable AI (XAI) methods to interpret and validate the model's predictions. Novelty: The study presents a unique method for crop prediction that combines machine learning (ML) with genetic algorithms (GAs). The goal of this integration is to improve crop forecast models' interpretability and accuracy. Due to the nature of local approximation LIME may yield contradictory answers. On the other hand, for sophisticated models and extensive datasets, SHAP can be computationally costly. By improving feature selection and model parameters, the integration of GAs with ML models overcomes these drawbacks and produces predictions that are more reliable and accurate. The high accuracy achieved by our system underscores its potential to mitigate crop losses and enhance agricultural productivity, thereby contributing to the sustainability and prosperity of the agricultural sector in any country.

Key Words: predictive model; Random Forest classifier; genetic algorithms (GAs); machine learning; enhance agricultural productivity;

AI-BASED POTHOLE DETECTION USING YOLOV7 WITH UAV IMAGES

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Abstract

This project addresses the critical challenge of pothole detection for road maintenance and safety, as these hazards cause significant accidents and vehicle damage globally. Traditional inspection methods rely on expensive sensors or time-consuming manual surveys that remain impractical for large-scale infrastructure management. Our innovative approach leverages unmanned aerial vehicles to efficiently capture high-quality road surface images while applying the state-of-the-art YOLOv7 deep learning model for automated pothole detection. YOLOv7 delivers exceptional inference speed and accuracy, making it an ideal choice for real-time monitoring applications. The system further incorporates advanced super-resolution techniques to enhance low-resolution imagery, which significantly improves overall detection performance in diverse field conditions. Trained on extensive datasets encompassing varied pothole shapes, sizes, and road conditions, the model demonstrates superior detection speed and accuracy when compared to existing detection methods. This cost-effective, scalable solution directly supports proactive road maintenance strategies and meaningfully enhances long-term driver safety across public roadways. Future enhancements will integrate robust real-time alert systems and automated repair scheduling tools to streamline infrastructure management operations. Our results confirm that the integration of drone-based imagery with deep learning architectures offers a transformative path forward for modern civil engineering. By automating the identification process, municipalities can reduce overhead costs while prioritizing repairs based on accurate, real-time data analysis of the road network. Ultimately, this research provides a comprehensive framework for sustainable, high-efficiency road maintenance that leverages modern computer vision technology. We provide a detailed analysis of performance metrics and architectural design choices that ensure the system remains both lightweight and highly effective for deployment. This framework stands as a foundational advancement for autonomous road monitoring systems in complex urban and rural environments alike.

Keywords: real-time data analysis; YOLOv7 deep learning model; automated pothole detection; real-time alert systems; automated repair scheduling tool

IOT-BASED SMART AIR QUALITY MONITORING & HEALTH ALERT SYSTEM

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Abstract

The Smart Air Quality Monitoring and Health Alert System is an IoT-based solution designed to monitor environmental conditions in real time and protect public health. The system uses sensors to measure key air quality parameters such as carbon dioxide, harmful gases, temperature, and humidity. The collected data is processed through a microcontroller and transmitted to a cloud platform using wireless communication. Based on predefined thresholds, the system analyzes air quality levels and generates instant alerts when pollution exceeds safe limits. Users can access live data through a mobile application or web dashboard, enabling informed decisions about outdoor activities. The system also provides health recommendations to reduce exposure risks. This solution is cost-effective, scalable, and suitable for smart cities, industries, and residential areas. By promoting awareness and early warning, the project contributes to improving environmental monitoring and enhancing overall public health safety.

Keywords: Internet of Things (IoT); Air Quality Monitoring,Environmental Sensors; Real-Time Data; Health Alert System; Smart Cities; Pollution Detection; Cloud Computing; Wireless Communication Public Health

FAKE PRODUCT IDENTIFICATION USING BLOCK CHAIN

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Abstract

Counterfeit products continue to pose serious risks to consumers and businesses, leading to financial loss, safety issues, and damaged reputations. This paper presents a blockchain-based solution for authenticating products using a secure, transparent, and decentralized verification platform.Each product is assigned a unique digital identity at the point of manufacture, with essential details such as origin, production data, and supply chain history recorded on the blockchain. This immutable ledger ensures data integrity and prevents tampering. As products move through the supply chain, updates are made in real-time and stored on the blockchain.

THIRALCONNECT - REPRESENTS A CENTRAL PLACE FOR JOB OPPORTUNITIES AND ACTIVITIES FOR DISABLED INDIVIDUALS

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Abstract

ThiralConnect (from the Tamil word 'thiral' / திறல், meaning ability and skill) is an AI-powered mobile application designed to bridge the empowerment gap faced by persons with disabilities (PWDs) in India. With 26.8 million registered PWDs in India (Census 2011) and an employment rate of approximately 36% among this population—compared to 76% for the general population—digital-first interventions are urgently needed. ThiralConnect integrates four core modules: accessible job opportunities, community peer support, informative content on rights and benefits, and cognitive mind games, augmented by three AI features powered by the Claude large language model: an intelligent job-matching engine, a conversational rights-and-benefits assistant, and an accessible AI resume builder. A prototype was evaluated with 15 participants across varied disability types, achieving a System Usability Scale (SUS) score of 82.4, placing it in the Excellent usability band. The platform adheres to WCAG 2.1 AA accessibility standards and is aligned with India's RPWD Act, 2016. ThiralConnect represents a culturally grounded, technically novel approach to disability inclusion in the Indian digital ecosystem.

DEPOTEYE: AUTOMATED BUS MONITORING SYSTEM

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Abstract

The Bus Entry and Exit Registration System for a depot is a comprehensive solution developed to automate and streamline the monitoring of bus movements within depot premises. In traditional systems, bus entry and exit details are manually recorded in logbooks, which often leads to inaccuracies, data loss, and inefficiencies in tracking vehicle movement. To overcome these challenges, this system introduces a digital platform that ensures accurate, reliable, and real-time data management. The proposed system captures essential information such as bus identification number, driver details, route information, entry time, exit time, and purpose of movement. It utilizes a centralized database to store and manage records, enabling easy retrieval and analysis of data. The system can be integrated with technologies such as RFID, barcode scanning, or biometric authentication to enhance automation and reduce human intervention. Furthermore, the system provides role-based access control to ensure data security and integrity. Depot administrators can monitor bus availability, track delays, and identify operational bottlenecks through analytical reports and dashboards. The system also supports automated report generation for daily, weekly, and monthly operations, assisting in maintenance scheduling and resource planning. By minimizing manual errors, reducing paperwork, and improving operational visibility, the Bus Entry and Exit Registration System enhances overall depot efficiency and accountability. It contributes to better fleet utilization, improved time management, and increased security within the depot environment. This system serves as a scalable and adaptable solution for modern transport management needs.

Keywords: Bus system; Depot management; RFID; Automation; Transport system

UNIVERSAL FLIGHT COTROLLER WITH SAFETY PROTOCOL

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Abstract

The Universal Flight Controller with Safety Protocol is developed to create a flexibleandsecurecontrolsystemforvarioustypesofUnmannedAerialVehicles (UAVs). Unlike traditional controllers designed for specific models, this system uses a unified architecture adaptable to fixed-wing, rotary, and hybrid UAVs. It integrates sensor fusion, PID-based stabilization and real-time data acquisition to ensure precise control and stable flight performance. A built-in safety protocol manages critical situations like signal loss, power failure or communication disruption, enabling automatic safe landing or return-to-home actions. With redundant communication links and secure data handling, the controller enhances both reliability and operational safety. Additionally, the system supports modular hardware and open-source firmware, allowing customization for experimental and industrial applications. The inclusion of diagnostic monitoring ensures early detection of anomalies, reducing the risk of mission failure. Overall, this project aims to provide a versatile, intelligent and robust solution for modern UAV systems, contributing to advancements in autonomous flight control and aerial mission safety.

Keywords: UAV; Flight Controller; Sensor Fusion; PID Control; Safety Protocol

AI-POWERED MULTILINGUAL VOICE AND IMAGE ASSISTANT FOR FARMERS IN SMART AGRICULTURAL DECISION MAKING

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Abstract

This innovation introduces an AI-powered multilingual voice assistant that enables farmers to access intelligent agricultural decision support through natural speech in their regional language. Unlike existing agricultural applications that rely on text-based interaction or limited language support, the proposed system allows end-to-end voice communication, making advanced advisory services accessible to farmers regardless of literacy level. The system combines multilingual speech understanding, crop image analysis, and real-time weather intelligence with a farmer interaction memory to deliver adaptive, context-aware recommendations. A key innovative aspect is its ability to learn from past voice interactions and adjust future guidance based on crop stage, environmental conditions, and farmer behaviour. Implemented as a mobile application, the proposed solution transforms conventional advisory platforms into an inclusive, personalized, and intelligent agricultural assistants.

Keywords: Multilingual; Voice assistant; Regional language; Voice communication; Crop image analysis;

AI-DRIVEN CARBON-AWARE AND ENERGY-EFFICIENT WORKLOAD SCHEDULING FOR CLOUD DATA CENTERS

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Abstract

The exponential growth of cloud computing has intensified energy consumption and carbon emission challenges in large-scale data centers, where traditional scheduling methods focus only on performance and cost while ignoring environmental impact. To address this, a Carbon-Aware Adaptive Workload Scheduler (CAWS) is proposed, combining real-time carbon sensing, deadline-aware decision modeling, and adaptive GPU resource management into a practical scheduling framework. Workloads are classified into latency-sensitive and deferrable categories, where critical tasks are routed immediately to the nearest available region while flexible tasks are scheduled using the Deadline-Aware Carbon-Optimal Assignment Algorithm (DACOA), which selects low carbon-intensity regions based on live grid data from ElectricityMap and WattTime. A lightweight LSTM model within the Carbon Intensity Prediction Module (CIPM) forecasts near-term carbon values across regions, enabling smarter proactive scheduling rather than simple reactive assignment. The system follows a three-layer architecture covering workload classification, carbon intelligence, and resource orchestration, with dynamic GPU time-slicing applied to balance real-time inference and background training jobs during peak load. Simulation results using synthetic cloud workload traces show measurable reductions in carbon emissions and energy usage compared to Round-Robin, First-Fit, and Energy-Proportional baselines, while keeping deadline violations within acceptable limits. The findings confirm that carbon-aware scheduling can be integrated into existing cloud systems without disrupting real-time services or adding significant overhead. This work provides a reproducible and scalable foundation for building greener cloud infrastructures, with future scope for reinforcement learning-based dynamic optimization and broader multi-region deployment.

Keywords: Carbon-Aware Scheduling; Cloud Computing; Energy Efficiency; Carbon Emission Reduction; Workload Scheduling; Deadline-Aware Scheduling; LSTM Prediction

GRAPH NEURAL NETWORKS FOR FINANCIAL FRAUD DETECTION IN DIGITAL TRANSACTIONS

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Abstract

The growth of payments has changed financial services a lot making transactions faster and more convenient. It has also given fraudsters new ways to find and exploit weak spots between users and accounts. Old detection systems usually look at transactions one by one checking things like amount, time or location. This approach is helpful. It misses complex fraud patterns that are hidden when looking at transactions alone.This project looks into using Graph Neural Networks for detecting fraud in transaction networks. By turning users accounts and transactions into a network Graph Neural Networks can spot patterns like strange money movements, repeated transactions and groups working together to commit fraud. Our approach combines information about nodes, relationships between them and time changes to improve detection and reduce alerts.Tests on real transaction data show that Graph Neural Network models work better than machine learning methods. They offer accuracy can handle large amounts of data and are more reliable in finding complex fraud. By giving a picture of transaction networks graph-based deep learning can make financial security stronger improve trust, in digital payments and create safer digital economies.

Keywords: Graph Neural Networks; Financial Fraud Detection; Digital Transactions; Machine Learning; Graph-Based Learning; Anomaly Detection; Financial Security

AI-POWERED STOCK MARKET CRASH PREDICTION AND PORTFOLIO OPTIMIZATION SYSTEM USING MACHINE LEARNING

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Abstract

The stock market is highly volatile and influenced by economic, political, and behavioral factors, making accurate prediction challenging. Sudden market crashes result in significant losses, especially for small investors who depend on fragmented information sources. Existing systems provide isolated insights such as price trends and news updates but fail to offer integrated decision-making support. This paper proposes an AI-powered system for stock market crash prediction and portfolio optimization using machine learning techniques. The system analyzes real-time and historical data, including stock prices, indices, sector performance, and sentiment indicators. Machine learning models such as Random Forest, Logistic Regression, and Long Short-Term Memory (LSTM) are used to predict crash probabilities. The proposed system also provides sector-wise analysis and portfolio recommendations based on risk levels. Experimental results demonstrate that the ensemble model achieves 94.7% accuracy, 93.2% precision, 92.6% recall, and 92.9% F1-score — outperforming individual classical baselines. This system enhances financial analytics by integrating predictive intelligence with real-time insights.

Keywords: Machine Learning; Stock Market Prediction; Crash Detection; Portfolio Optimization; LSTM,; Random Forest; Artificial Intelligence; Financial Analytics

MULITIPLE NOISE DETECTOR FOR LIVE MAP

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Abstract

The development of a mobile application for real-time noise monitoring and live map visualization is presented as an effective solution for managing environmental noise pollution, collecting noise level data from multiple sources such as IoT-based sound sensors and smartphone microphones, and displaying it on an interactive map interface while processing the data through a cloud-based backend and categorizing noise levels using color-coded indicators like green for low noise, yellow for moderate noise, and red for high noise, along with providing additional features including location tracking, historical data analysis, and alert notifications when noise levels exceed permissible limits, thereby enabling both users and authorities to efficiently monitor environmental noise, identify highrisk zones, and take necessary actions while supporting smart city initiatives by enhancing public awareness, encouraging community participation, and offering a scalable solution for noise pollution monitoring and management.

Keywords: Mobile application; Noise monitoring; Live map; IoT; Smart city; Pollution control

SMART SIGN LANGUAGE GLOVE FOR REAL-TIME COMMUNICATION

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Abstract

The IoT-Enhanced Sign Language Glove is an innovative wearable device designed to bridge the communication gap between hearing and hearing-impaired individuals. Communication is essential in daily life, and people with hearing impairments often face challenges in expressing themselves or understanding others. This glove provides a real-time solution by translating hand gestures into text and speech, enabling seamless two-way interaction. It is equipped with flex sensors to monitor finger movements and an inertial measurement unit (IMU) to track hand orientation. These sensors send data to a microcontroller, which processes the information and converts gestures into corresponding textual and audible outputs. In addition to translating gestures into speech and text, the system supports reverse communication, where spoken words from hearing individuals are converted into text for the user. This feature ensures efficient two-way communication, allowing hearing-impaired users to participate fully in conversations, educational activities, healthcare consultations, and daily interactions. The integration of IoT and Artificial Intelligence (AI) enhances the accuracy and adaptability of gesture recognition. AI algorithms identify patterns in hand movements, while ML enables the system to learn and improve over time, reducing recognition errors and adapting to individual user styles. Designed as a standalone, portable, and low-cost device, the glove does not rely on smartphones or continuous internet access, making it practical for everyday use in various environments. Its portability and ease of use allow it to be worn comfortably for extended periods. The device has significant applications in education, healthcare, workplaces, and public services, promoting accessibility. By enabling real-time, two-way communication, the IoT-Enhanced Sign Language Glove empowers hearing-impaired individuals, reduces communication barriers, and demonstrates the potential of technology to improve social interaction and enhance quality of life.

Keywords: IoT; Gesture Recognition; Sign Language; Artificial Intelligence; Assistive Technology; Speech-to-Text; Text-to-Speech

AN INTELLIGENT APPROACH TO SOFTWARE DEFECT PREDICTION USING MACHINE LEARNING

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Abstract

Software engineering research increasingly focuses on defect prediction, as successful software development depends on effective collaboration between data mining and software engineering disciplines. Software defect prediction is a pre-testing technique used to estimate the locations in code where defects are likely to occur. The primary objective of defect prediction research is to identify potentially faulty software modules before the testing phase, thereby enabling more efficient allocation of testing time and resources to error-prone components. However, only a limited number of defect prediction algorithms have been specifically developed for mobile applications. Commonly, defect prediction techniques are employed to analyze the impact domain in software using approaches such as clustering, neural networks, statistical methods, and machine learning models. This study aims to examine and compare various machine learning (ML) algorithms for software bug prediction. Despite the wide availability of defect prediction techniques, no single method is universally suitable for all datasets. In this research, several ML algorithms—including Support Vector Machine, Random Forest, Naïve Bayes, Logistic Regression, and Artificial Neural Networks (ANN)—are applied to identify the maximum possible subset of software defects. Five benchmark datasets (JM1, KC1, KC2, PC1, and DS1) are used for experimental evaluation. The results demonstrate that ANN outperforms the other methods, achieving the highest prediction accuracy of 93.8%

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CIVIC RESOLVE: DISTRICT GRIEVANCE MANAGEMENT WITH REAL-TIME LOCATION AND E-SIGNATURE

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Abstract

Efficient grievance redressal is a challenging issue in public administration, and the problem is further complicated by delays, a lack of transparency, and the absence of verification processes. This paper proposes a mobile-based grievance management system, where the integration of real-time location tracking and electronic signature verification is incorporated to ensure effective accountability and service delivery. This system enables citizens to raise and track the status of their complaints, and government officials can update the status and share their location in real time during the course of work. This location based verification process ensures the actual location where the complaint is resolved, minimizing the chances of false updates. Moreover, the digital signature verification is incorporated to ensure the authenticity and integrity of the completed work. This proposed system is based on a modular structure, where multiple administrative roles are incorporated, and the entire process is coordinated in a structured manner. This ensures transparency, reduces the time taken to resolve complaints, and builds trust between citizens and government authorities.

Keywords: Grievance Management System; Real-Time Lo cation Tracking;Digital Signature; E-Governance; Geospatial Verification;Public Service Transparency

AI-ENHANCED PREDICTIVE MODELS FOR OPTIMIZING CROP YIELDS AND DATA-DRIVEN CROP RECOMMENDATIONS

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Abstract

The crop yield prediction is an essential step for the betterment of agriculture. The crop yield estimation techniques used today are based on observation and experience. These techniques are not sufficient to achieve precise results due to changing environmental conditions. This paper presents an artificial intelligence-based crop yield prediction system using machine learning techniques to improve the accuracy of crop yield prediction for better crop productivity. This is a proposed system to predict crop yield based on various agricultural parameters like nutrients present in the soil, weather conditions, water supply status, crop type, etc. Data Preprocessing and Feature Selection. The system is designed to execute machine learning algorithms like Multi-Layer Perceptron (MLP), Bagging Classifier, Linear Regression, etc., to predict crop types and crop yield. The results of the experiment showed that the ensemble learning algorithms like Random Forest and Bagging Classifier have better accuracy compared to other algorithms.

SECUREBRIDGE: ENCRYPTED COMMUNICATION AND COMPLAINT RESOLUTION PLATFORM AGGREGATES AES, ASCON AND CHACHA20 ALGORITHMS

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Abstract

The proposed system is a Java-based project management web application designed to streamline task delegation, communication, and file handling across different roles within an organization. The system consists of five key modules: Employee, Team Lead (TL), Team Management, Manager, and Admin. Employees can register and log in to view assigned projects, request necessary files, upload completed work, and receive feedback. Managers can log in directly to create and manage teams under the Team Management module, assign projects to specific Team Leads, and oversee project progress. Team Leads, upon receiving a project from the Manager, can assign tasks to relevant Employees within their team. When an Employee needs access to specific files, a request is sent to the Team Lead, who, along with the Team Management module, can approve or reject the request. Once approved, the Employee gains access to download the file. After completing the task, the Employee reuploads the updated file to the system, which the Team Lead can then review. If changes are required, the Team Lead can communicate directly with the Employee for modifications. Furthermore, Employees can review the project summary and provide feedback. All Employees can also view the team structure, while Managers can review feedback and reply accordingly. The Admin module allows direct login to monitor all user activities across the modules, ensuring centralized control and transparency. This system enhances collaboration, improves task visibility, ensures secure file sharing, and provides an organized workflow for efficient project delivery.

ACCIDENT DETECTION FOR ROAD SAFETY USING SMART HELMET

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Abstract

This project introduces Accident Detection for Road Safety Using Smart Helmet, an intelligent, real-time safety system designed to provide immediate emergency response for motorcyclists. By addressing the critical delay in post-accident medical assistance—often referred to as the "Golden Hour"—the system autonomously detects high-impact collisions and falls, notifying emergency contacts without requiring the victim's intervention. Developed using a Python-based Flask architecture, the system creates a seamless bridge between embedded sensor data and advanced cloud-based artificial intelligence to enhance rider survival rates in developing nations like India.The core hardware integration utilizes an MPU-6050 sensor, which combines a 3-axis accelerometer and a 3-axis gyroscope to monitor G-force thresholds and helmet orientation in real-time. Additionally, a MAX30102 heart rate and blood oxygen sensor, along with a DS18B20 temperature sensor, provide continuous monitoring of the rider's physiological state. A dual-trigger algorithm is employed to analyze instantaneous acceleration (>3.0G) and tilt angles (>45 degrees) to accurately differentiate between normal riding maneuvers and genuine accident events. Upon a confirmed accident, a NEO-6M GPS module captures the precise geographical coordinates, which are then dispatched via an automated emergency alert service.A distinguishing feature of this project is the integration of the Groq AI inference platform and Large Language Models (LLMs). These models perform sophisticated tasks such as real-time risk assessment, trauma classification, and the generation of concise, location-aware emergency SMS notifications. The user interface is implemented as a high-performance web dashboard using HTML5, CSS3, and JavaScript, utilizing Server-Sent Events (SSE) to push live sensor telemetry with sub-100ms latency. This eliminates the need for manual polling, ensuring that life-saving information is transmitted instantly to a centralized monitoring station or emergency contacts.Experimental results indicate that the system successfully identifies impact events within 40 milliseconds and generates location-aware emergency notifications within 6 seconds. The system also features a hardware-free simulation mode to test various riding scenarios, such as highway cruising and rural road vibrations, ensuring the algorithm's robustness. By integrating cost-effective hardware with cutting-edge AI, this project demonstrates a scalable and portable solution for reducing motorcycle fatalities and reimagining road safety through automated, intelligent intervention.

Keywords: Road Safety; Accident Detection; Smart Helmet, Sensor Fusion; Groq AI; Large Language Models (LLMs); Flask; Real-Time Monitoring; GPS Tracking; Embedded Systems

INTELLIGENT SYSTEM FOR CYBERBULLYING DETECTION USING NLP AND ML

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Abstract

NeuroShield AI is an advanced cyberbullying detection system developed as a final year engineering project that leverages both traditional machine learning and deep learning approaches to identify harmful content across English and Tanglish languages on social media platforms. The system implements a dual-model architecture consisting of an enhanced Naive Bayes classifier with TF-IDF vectorization, n-gram features, and sentiment analysis, alongside a fine-tuned BERT (Bidirectional Encoder Representations from Transformers) model for contextual understanding. The application features a sophisticated preprocessing pipeline specifically designed to handle Tanglish—a hybrid language combining Tamil linguistic patterns with English script—through extensive language mapping, custom stopword removal, and advanced text normalization techniques. The system is built using Streamlit for an interactive web interface, incorporating real-time detection capabilities, comprehensive data visualization through Plotly and Matplotlib, and a user-friendly dashboard that allows users to explore datasets, train models, compare performance metrics, and test live inputs with confidence scores. The model is trained on a carefully curated dataset of over 300 samples spanning six categories including safe content, age-based bullying, gender-based harassment, religious discrimination, ethnicity-based attacks, and other forms of cyberbullying. The Naive Bayes model achieves 78-82% accuracy with 5-fold cross-validation, while the BERT model attains 80-85% accuracy through transfer learning with optimized training parameters. Key features include a multilingual preprocessing engine, interactive confusion matrices, classification reports with precision-recall metrics, detection history tracking, a sample gallery for educational purposes, and real-time analysis with confidence visualization. The system demonstrates the effectiveness of combining traditional machine learning efficiency with deep learning contextual understanding for social media safety applications, particularly in multilingual South Asian contexts where code-switching and informal language patterns present unique challenges. The application serves both as a practical tool for cyberbullying detection and an educational platform for understanding online harassment patterns, with potential for extension to additional languages, integration with social media APIs, and deployment as browser extensions for real-time protection. Through its intuitive interface and robust performance, NeuroShield AI represents a significant contribution to creating safer digital spaces by providing accessible, accurate, and culturally-aware content moderation capabilities.

REAL TIME THEFT DETECTION USING AI

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Abstract

In this project we presents an advanced, real-time AI-based theft detection system designed to enhance surveillance in retail environments. The system architecture is engineered for high performance, moving beyond simple motion tracking by implementing a sophisticated, multi threaded pipeline. This pipeline combines deep learning for content analysis, computer vision for motion analysis, and an ensemble of machine learning models to accurately identify and flag suspicious activities. The real-time capability is achieved using a dedicated detection_worker thread that processes frames asynchronously from a queue.Queue, ensuring the main camera feed never stutters.The core of the system is a novel, hybrid feature engineering approach. A pre-trained ResNet-18 Convolutional Neural Network (CNN) is loaded using PyTorch, where its final classification layer is removed (model.fc = nn.Identity()). This transforms it into a powerful deep feature extractor, converting each video frame into a rich 512-dimension content vector. Simultaneously, a MotionAnalyzer module uses OpenCV to perform a parallel analysis. This module generates 8 distinct motion features by combining two separate techniques: cv2.createBackgroundSubtractorMOG2 for robust foreground object detection and cv2.absdiff for analyzing simple frame-to-frame changes. The resulting motion features include metrics like motion density, the mean value of pixel changes, and the area of the largest moving contour.These 512 content features and 8 motion features are then concatenated into a single 520-dimension vector. This vector is normalized using StandardScaler and used to train an Ensemble Voting Classifier. This ensemble is explicitly defined in the Model Manager and combines the predictive power of four distinct models: a Random Forest Classifier, a Gradient Boosting Classifier, a Multi-layer Perceptron (MLP Classifier), and an XGB Classifier. The ensemble is configured with voting='soft', meaning it averages the probability estimates from all four models, leading to a more nuanced and accurate final decision. To combat the inherent class imbalance of surveillance data (where "theft" frames are rare), the SMOTE (Synthetic Minority Over-sampling Technique) is applied during the preprocessing stage to balance the dataset before training.Upon detecting a suspicious event, the system's alert logic is designed to be robust against false positives. An alert is only triggered if multiple consecutive frames (e.g., 3 out of 5) are flagged as "theft" and the average confidence exceeds a configurable threshold. This logic respects an alert_cooldown period to prevent alert spam. Once triggered, an instant Telegram alert is dispatched to security personnel. The entire application is supported by a Flask-based Web Dashboard (web_dashboard.py), which provides a live, browser-based interface. This dashboard features API endpoints to monitor detection statistics (/api/stats), view recent log entries (/api/logs), and list all available trained models (/api/models). This multi-layered approach, managed by a central config.yaml file, results in a robust, accurate, and scalable solution for automated theft detection.

SMART SIGN LANGUAGE GLOVE FOR REAL-TIME COMMUNICATION

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Abstract

The IoT-Enhanced Sign Language Glove is an innovative wearable device designed to bridge the communication gap between hearing and hearing-impaired individuals. Communication is essential in daily life, and people with hearing impairments often face challenges in expressing themselves or understanding others. This glove provides a real-time solution by translating hand gestures into text and speech, enabling seamless two-way interaction. It is equipped with flex sensors to monitor finger movements and an inertial measurement unit (IMU) to track hand orientation. These sensors send data to a microcontroller, which processes the information and converts gestures into corresponding textual and audible outputs. In addition to translating gestures into speech and text, the system supports reverse communication, where spoken words from hearing individuals are converted into text for the user. This feature ensures efficient two-way communication, allowing hearing-impaired users to participate fully in conversations, educational activities, healthcare consultations, and daily interactions. The integration of IoT and Artificial Intelligence (AI) enhances the accuracy and adaptability of gesture recognition. AI algorithms identify patterns in hand movements, while ML enables the system to learn and improve over time, reducing recognition errors and adapting to individual user styles. Designed as a standalone, portable, and low-cost device, the glove does not rely on smartphones or continuous internet access, making it practical for everyday use in various environments. Its portability and ease of use allow it to be worn comfortably for extended periods. The device has significant applications in education, healthcare, workplaces, and public services, promoting accessibility. By enabling real-time, two-way communication, the IoT-Enhanced Sign Language Glove empowers hearing-impaired individuals, reduces communication barriers, and demonstrates the potential of technology to improve social interaction and enhance quality of life.

Keywords: IoT; Gesture Recognition; Sign Language; Artificial Intelligence; Assistive Technology; Speech-to-Text; Text-to-Speech

VOICE BIOMARKER-BASED PARKINSON'S DISEASE DETECTION USING SUPERVISED MACHINE LEARNING

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Abstract

Parkinson's Disease (PD) is a neurologic condition that continually gets increasingly severe and causes impairments in speech and movement. Early detection of the disease is important to ensure that the treatment and disease management is effective. The recent studies have indicated that, speech issues, including the anomaly of frequency vibrations in the vocal folds, and unstable speech can be employed as possible early indicators of Parkinson Disease. Voice analysis has proven to be a viable method of detecting the Parkinson disease through machine learning with ease due to the inexpensive recording of voices, which is readily availed and does not involve invasive techniques. The database on which the paper relied on was a standard Parkinson voice database which included paramount biomedical voice parameters like jitter, shimmer, noise-harmonics ratio and nonlinear dynamic parameters. In comparison of the performance of the different methods of supervised learning, which include the Logistic Regression, Support Vector Machine, Random Forest, and Gradient Boosting, we employ an unified platform of preprocessing and experimentation. We evaluate the model in conventional evaluation metrics including accuracy, precision, recall, F1-score, and ROC-AUC. The outcomes of the experiment give a clue of the most effective model to use with voice based Parkinson classification and the strengths and weakness of each method. The findings indicate that machine learning and acoustic voice variables can be used to produce accurate, non-invasive, and scalable detection tools of the early diagnosis of Parkinson's Disease.

SMART IOT-ENABLED EEG-BASED MENTAL WELLNESS DETECTION USING LIGHTWEIGHT 1D CNN MODELS

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Abstract

Mental health disorders including stress, anxiety, and cognitive fatigue have emerged as significant public health challenges worldwide. Early detection and continuous monitoring of mental wellness states can facilitate timely intervention and improved patient outcomes. Electroencephalography (EEG) provides a non-invasive, cost-effective method for capturing brain electrical activity that reflects underlying cognitive and emotional states. The integration of Internet of Things (IoT) technologies with EEG acquisition enables remote, continuous, and real-time mental wellness monitoring outside clinical settings.This project presents the design, implementation, and comprehensive evaluation of a Smart IoT-Enabled EEG-Based Mental Wellness Detection System that leverages lightweight one-dimensional Convolutional Neural Network (1D CNN) models for automated classification of mental states. The proposed system integrates IoT-based EEG data acquisition using consumer-grade EEG headbands (NeuroSky/OpenBCI) with edge computing gateways (Raspberry Pi/ESP32) for signal preprocessing, followed by deep learning-based classification of five mental wellness states: Relaxed, Stressed, Anxious, Focused, and Drowsy.

The proposed lightweight 1D CNN model employs two convolutional layers with batch normalization for stable training, max-pooling layers for dimensionality reduction, dropout regularization to prevent overfitting, and fully connected dense layers for multi-class classification. The architecture is specifically designed to be lightweight with approximately 150,000 trainable parameters, enabling deployment on resource-constrained IoT edge devices while maintaining high classification accuracy.A comprehensive comparative analysis evaluates the proposed 1D CNN model against five established machine learning and deep learning classifiers: Support Vector Machine (SVM), Random Forest, Long Short-Term Memory (LSTM) networks, Multi-Layer Perceptron (MLP), and k-Nearest Neighbours (k-NN). Evaluation employs six metrics: accuracy, precision, recall, F1-score, model size (parameter count), and detection speed (milliseconds per sample). All results are visualized using professionally formatted comparative bar charts generated through a reusable matplotlib visualization function (plot_bar_with_tips).The experimental results demonstrate that the proposed 1D CNN model achieves superior classification performance with accuracy of 79%, precision of 0.80, recall of 0.79, and F1-score of 0.79, outperforming all baseline models. The model achieves a detection speed of 12 ms/sample, making it suitable for real-time IoT deployment. The LSTM model attains 77% accuracy but with 300,000 parameters and 35 ms/sample speed, making it less suitable for edge deployment.

Keywords:EEG; Mental Wellness Detection; IoT; 1D CNN; Deep Learning; Brain-Computer Interface; Edge Computing; Lightweight Neural Network; Comparative Analysis

INDUSMIND – AI-BASED INDUSTRIAL MACHINE MONITORING AND PREDICTIVE MAINTENANCE SYSTEM

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Abstract

Industrial equipment failures cause significant production losses, increased maintenance costs, and operational downtime in manufacturing industries. Traditional machine monitoring systems rely on manual inspection or threshold-based alerts, which are inefficient and incapable of predicting failures in advance. Although machine learning-based monitoring systems improve prediction accuracy, many existing solutions lack real-time monitoring and integrated visualization for industrial environments.This paper presents IndusMind, a web-based intelligent industrial machine monitoring and predictive maintenance system designed to detect anomalies and predict potential machine failures. The proposed system monitors machine parameters such as temperature, vibration, load, and power consumption using simulated industrial machine datasets. The system employs machine learning algorithms including Random Forest and Isolation Forest for predictive analytics and anomaly detection. A web-based dashboard is developed to visualize machine health status, alerts, and performance analytics.Experimental results demonstrate that the proposed system can effectively detect abnormal machine behavior and provide early warning alerts for potential failures. The system improves maintenance planning, reduces unexpected downtime, and increases operational efficiency. The dashboard provides clear visualization and alert notifications, enabling industries to make data-driven maintenance decisions.Future work will focus on implementing deep learning models such as LSTM for time-series forecasting, deploying the system on cloud platforms for multi-factory monitoring, and developing a mobile application for remote monitoring and alerts.

Keywords: Predictive Maintenance; Industrial Monitoring; Machine Learning; Anomaly Detection; Random Forest;Isolation Forest; Smart Manufacturing;Industry 4.0

EYES OF TECHNOLOGY: WEB EDITION
A SMART VISUAL AID FOR THE VISUALLY IMPAIRED

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Abstract

Visual impairment affects approximately 2.2 billion people globally, severely limiting their ability to navigate physical spaces, read printed text, identify objects, and recognize individuals. This project presents "Eyes of Technology: Web Edition," a comprehensive, web-based computer vision application designed to serve as a smart visual aid for visually impaired individuals.The proposed system leverages a standard webcam and employs multiple AI models to provide four distinct detection modes: object detection using YOLOv3-tiny (80 COCO classes); text recognition through Tesseract OCR with Otsu's binarization; face detection via Haar Cascade classifiers; and scene description using MobileNetV2 with HSV color analysis fallback.The system architecture follows a multi-threaded design pattern with three concurrent processing units: a frame grabber thread, a detection engine thread, and the Flask web server thread. Inter-thread communication uses thread-safe queue data structures. For each detected entity, the system computes spatial information including horizontal position and distance estimation, translated into natural language descriptions.

The web interface utilizes MJPEG streaming for real-time video and JavaScript polling for asynchronous result retrieval. The system demonstrates the feasibility of providing accessible, real-time environmental awareness through commodity hardware and open-source software.

Keywords: Computer Vision; Visual Impairment;Object Detection; YOLO;OCR;Face Detection; Haar Cascade;Scene Description; Flask;OpenCV;MobileNetV2; Assistive Technology

DESIGN AND TECHNOLOGY OPTIMIZATION OF AN INCLUSIVE WEB PLATFORM FOR EMPLOYMENT, COMMUNITY BUILDING, AND EVENT ORGANIZATION FOR DIFFERENTLY-ABLED INDIVIDUALS (INCLUSION HUB)

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Abstract

Differently-abled individuals often face significant challenges in securing employment, forming social connections, and actively participating in community events due to physical, sensory, and cognitive barriers. Although digital platforms exist for job searching and social networking, most lack accessibility-centered design and intelligent personalization required to support users with disabilities effectively. This paper proposes a design and technology optimized web-based platform that enables differently-abled individuals to find suitable job opportunities, form supportive communities, and organize inclusive events. The proposed system integrates accessibility-driven interface design with advanced technology optimization techniques, including artificial intelligence-based job matching, smart community clustering, and optimized event scheduling. Design optimization focuses on reducing cognitive load, enhancing usability, and improving navigation efficiency, while technology optimization ensures high performance, scalability, reliability, and security. The platform aims to empower differently-abled individuals, promote social inclusion, and provide equal opportunities in employment and community engagement. Experimental analysis demonstrates significant improvements in usability, job matching accuracy, and user participation.

Keywords: Design Optimization;Technology Optimization;Accessibility; Differently-Abled;Employment Platform;Community Formation; Event Management; Inclusive Web System

AI POWERED QUICK INSTALL PLATFORM

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Abstract

Software environment setup is often a complex and time-consuming process that requires manual installation and configuration of multiple tools across different operating systems. Traditional approaches lead to inconsistencies, increased setup time, and potential errors. This paper presents an AI-Powered Quick Install Platform, a web-based system designed to automate the generation of customized installation scripts based on user requirements.The proposed system utilizes artificial intelligence and natural language processing to interpret user intent through a feature called Magic Search, which recommends suitable software bundles for various domains such as Full Stack Development, Data Science, and DevOps. The platform supports cross-platform script generation for Windows, macOS, and Linux using native package managers including winget, Homebrew, and apt. Additionally, a security auditing module is integrated to analyze generated scripts and identify potential vulnerabilities before execution.Experimental evaluation shows that the system significantly reduces setup time, minimizes manual errors, and improves overall developer productivity by providing automated, secure, and consistent environment configuration. The system architecture, based on a React frontend and modular data-driven design, ensures scalability and efficient performance. Future work includes cloud synchronization, Docker integration, and enhancement of AI models for more accurate recommendations.

Keywords: AI, Automation; Software Installation; Natural Language Processing; Cross-Platform Systems; Security Auditing; DevOps.

HYBRID-HD: ADVANCED MACHINE LEARNING FOR PRECISION CARDIOLOGY

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Abstract

Heart disease remains one of the leading causes of mortality worldwide, necessitating the development of accurate and early prediction systems to improve patient outcomes. With the rapid advancement of artificial intelligence, deep learning and ensemble-based machine learning techniques have shown significant potential in healthcare analytics. In this study, an advanced heart disease prediction system is proposed using hybrid deep learning and boosting algorithms, including Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM) networks and Extreme Gradient Boosting (XGBoost). The dataset comprises diverse clinical and physiological parameters such as age, blood pressure, cholesterol levels, and other relevant medical attributes. The proposed model leverages CNN for feature extraction, LSTM for capturing temporal dependencies in patient data, and XGBoost for robust classification and improved predictive performance. Data preprocessing techniques such as normalization, missing value handling and feature selection are applied to enhance model efficiency. Experimental results demonstrate that the hybrid model significantly out performs traditional machine learning approaches, achieving higher accuracy, precision, recall, and F1-score. The integration of deep learning and boosting techniques enables better generalization and reliability in prediction. The proposed hybrid CNN-LSTM-XGBoost model achieves an accuracy of 95.6%, with a precision of 0.94, recall of 0.96, and an F1-score of 0.95, indicating strong performance in heart disease prediction. This system provides an efficient and scalable solution for early detection of heart disease, assisting healthcare professionals in clinical decision-making and enabling timely preventive interventions.

Keywords: Heart Disease Prediction; Deep Learning; CNN;LSTM; XGBoost; Predictive Modeling

A BLOCKCHAIN BASED SYSTEM FOR PREVENTING ORGAN FRAUD

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Abstract

The system also enforces role-based access control, ensuring that donors, recipients, hospitals, and administrators can perform only authorized actions. Smart validation rules verify donor consent, medical compatibility, and hospital approval sequences before any organ allocation is finalized. Each block contains a timestamp, previous hash, and transaction summary, forming a verifiable audit trail that supports regulatory compliance.To enhance transparency, the platform includes real-time monitoring dashboards for authorities, allowing them to trace organ allocation history from donor registration to transplantation. Any inconsistency in hashes immediately flags potential tampering, triggering automated alerts. The modular Python architecture allows future integration with smart contracts, biometric verification, or national health systems.Overall, the proposed blockchain-based organ donation system improves security, traceability, and ethical governance, offering a reliable alternative to centralized databases while ensuring fairness and public trust in life-critical medical workflows.The platform supports end-to-end traceability, where every action is cryptographically linked, eliminating single-point failures common in centralized systems. By separating on chain integrity data and off-chain medical records, the system achieves both scalability and privacy compliance. Data anonymization techniques ensure sensitive patient information is never exposed on the blockchain. matching engine evaluates donor–recipient compatibility using medical parameters such as blood group, urgency level, and geographic proximity, improving allocation efficiency while maintaining fairness. The reporting module generates immutable logs and compliance reports, useful for audits and legal verification.The prototype is designed to be fault-tolerant and extensible, supporting future upgrades like distributed node deployment, interoperability with hospital information systems, and AI-based prediction of organ demand. This approach demonstrates how blockchain and cryptographic hashing can be practically applied to safeguard humanitarian healthcare systems where trust and accountability are critical .The system significantly **improves security, traceability, and ethical governance**in organ donation processes. By leveraging blockchain technology, it eliminates the vulnerabilities associated with centralized databases, such as single points of failure and susceptibility to cyberattacks. In a centralized system, a breach in the main server can compromise all stored data. However, in the proposed decentralized system, data is distributed across multiple nodes, making it highly resistant to attacks and failures. This ensures continuous system availability and data protection.Another important feature of the system is its support **for end-to-end traceability.** Every action performed within the system is cryptographically linked to previous actions, creating a complete and unbroken chain of records. This allows stakeholders to track every step of the process, from donor registration to organ transplantation. Such traceability is essential in healthcare systems, where accountability and transparency are critical. It ensures that all processes are conducted ethically and in accordance with established guidelines.To balance scalability and privacy, the system adopts a hybrid approach by separating **on-chain and off-**

chain data storage. Critical integrity data, such as hash values and transaction summaries, are stored on the blockchain, while detailedmedica**l** records are stored off-chain in secure databases. This approach reduces the storage burden on the blockchain while maintaining high levels of security. It also ensures compliance with privacy regulations by limiting the exposure of sensitive patient information.

Keywords: Organdonation; Organ transplantation,;using blockchain;Technology Secure Data Donor recipient

INDUSTRIAL SAFETY MONITORING SYSTEM USING XGBOOST MACHINE LEARNING ALGORITHM

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Abstract

Industrial accidents pose a serious risk to worker safety and organizational productivity. Early prediction of accident risk can help in taking preventive safety measures. This project presents a machine learning-based Industrial Safety Monitoring System using the XGBoost (Extreme Gradient Boosting) algorithm for predicting accident occurrence. The system uses structured data including worker information, environmental conditions, equipment status, and work-related factors. Data preprocessing techniques such as label encoding and cleaning are applied to prepare the dataset. The model performs binary classification of accident versus non-accident cases and is evaluated using metrics like accuracy, precision, recall, F1-score, and ROC-AUC. The proposed system identifies high-risk workers and provides probability-based risk levels, enabling proactive decision-making. The results show that machine learning can effectively improve industrial safety and reduce accident risks.

Keywords: Industrial Safety, Accident Prediction, Machine Learning, XGBoost, Classification, Risk Analysis, Workplace Safety, Predictive Modeling, Data Preprocessing, Supervised Learning

A HYBRID BERT AND MULTI-SCALE CNN FRAMEWORK WITH FRAUD-AWARE METADATA FUSION FOR FAKE JOB POSTING DETECTION

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Abstract

Fraudulent postings on online job boards represent a big danger to job seekers and put them at risk of losing their money and identity theft. Current detection systems are mainly based on single-modality text detectors that are unable to identify the multi-layered deception patterns within fraudulent listings such as structural anomalies such as missing salary data, missing company features, and language constructs. The current paper suggests a hybridized deep learning model that combines Bidirectional Encoder Representations with Transformers (BERT) with Multi-Scale Convolutional Neural Network (MS-CNN) and Fraud-Aware Metadata Fusion system. Critical limitations of the previous work are met by the proposed method focusing the language understanding on a contextual and structural signals of fraud and the balanced representation of classes. Running on the EMSCAD dataset with 17,880 job postings, the system will be found to be 98% accurate and F1-score of approximately 0.94, drastically outperforming baseline models of both fine-tuned BERT and traditional machine learning models. Explainability of real-time prediction is made available through LIME, allowing human-understandable logic of fraud to non-technical users.

Keywords : fake job detection; BERT; multi-scale CNN; fraud-aware metadata; explainable AI; Borderline-SMOTE; threshold optimization; NLP

MECHANICAL ENGINEERING

TAGUCHI OPTIMIZATION OF ELECTROCHEMICAL MICRO-MACHINING PARAMETERS FOR SS304 BASED ON 3D SURFACE TOPOGRAPHY OF HOLE PERIPHERY

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Abstract:

Electrochemical Micro-Machining (ECMM) is an Effective non-Traditional Machining Process for Producing Precise Micro-Holes in Difficult-to-Machine Materials Like SS304. This Study Focuses on Optimizing ECMM Process Parameters Using the Taguchi Method, Based on the 3D Surface Topography of the Hole Periphery.Key Parameters Such as Applied Voltage, Electrolyte Concentration, Inter-Electrode Gap, and Pulse Frequency Were Selected and Arranged Using a Suitable Taguchi Orthogonal Array. The Machining Performance was Evaluated in Terms of Surface Roughness, Overcut, and Geometric Accuracy. 3D Surface Topography Analysis was Used to Assess the Quality and Morphology of the Machined Hole Edges.The Optimized Parameters Resulted in Improved Surface Finish and Reduced Overcut. This Study Demonstrates that the Taguchi Method is an Efficient Approach for Enhancing ECMM Performance and Achieving High-Quality Micro-Machining of SS304 Components

DESIGN OF THERMOELECTRIC COOLER FOR BATTERY THERMAL MANAGEMENT SYSTEM IN ELECTRIC VEHICLE

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Abstract:

Thermoelectric Cooling Technology, based on the Peltier Effect, offers a Compact, Environmentally Friendly, and Reliable Cooling Solution Without the Need for Refrigerants or Moving Mechanical Components. The Proposed System integrates TEC Modules with Heat Sinks, Cooling fans, and Temperature Sensors to Maintain the Battery pack Within an Optimal Temperature Range. The Design Emphasizes Efficient Heat Dissipation, Energy Consumption Optimization, and Uniform Temperature Distribution Across the Battery Cells The System Performance is Evaluated Through Thermal Analysis, Experimental Testing, and Simulation Studies to Determine Cooling Efficiency and Temperature Control Capability Under Different Operating Conditions. The Results Demonstrate that the Thermoelectric - based BTMS Effectively Regulates Battery Temperature, Improves Battery Safety, and Enhances Overall System Reliability. This Approach Provides a Promising Alternative to Conventional Cooling Methods and Supports the Development of Advanced Thermal Management Solutions for Next-Generation Electric Vehicles.

OPTIMAZATION OF CNC WIRE EDM PARAMETERS FORIMPROVED 3D SURFACE ROUGHNESS

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Abstract

Wire Electrical Discharge Machining (Wire EDM) is a widely used non-traditional machining process for producing complex and precise components, especially in hard materials, but achieving improved 3D surface roughness remains a major challenge. This study focuses on optimizing key CNC Wire EDM parameters such as pulse ON time (Ton), pulse OFF time (Toff), peak current, voltage, and wire feed rate to enhance surface quality. The Taguchi method is employed for systematic experimental design, while signal-to-noise (S/N) ratio and analysis of variance (ANOVA) are used to evaluate the significance of each parameter. The results show that pulse ON time and peak current significantly influence surface roughness, where higher values increase material removal rate but lead to a rougher surface finish. By identifying the optimal combination of parameters, a considerable improvement in 3D surface finish and machining performance is achieved. This study provides an effective approach for parameter selection in CNC Wire EDM to obtain better surface quality in industrial applications.

Keywords: CNC Wire EDM; Surface Roughness (Ra); 3D Surface Topography; Process Parameter Optimization; Taguchi Method; Pulse ON Time (Ton); Pulse OFF Time (Toff); Peak Current; Wire Feed Rate; Material Removal Rate (MRR); Signal-to-Noise Ratio (S/N); ANOVA

STUDIES OF CRYOGENIC TREATMENT ON MECHANICAL BEHAVIOUR OF CRYOGENICALLY TREATED LASER WELDED ALUMINUM ALLOYS

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Abstract

Marine structures and components are continuously exposed to aggressive corrosive environments, leading to severe degradation of mechanical properties and reduced service life. Aluminum alloys are widely used in marine and aerospace applications due to their high strength to weight ratio and corrosion resistance; however, welding—especially laser welding can significantly alter their microstructure and performance. This project focuses on the study of the mechanical behaviour and corrosion resistance of cryogenically treated laser- welded aluminum alloys. Cryogenic treatment involves subjecting the welded specimens to extremely low temperatures to refine grain structure, relieve residual stresses, and enhance material properties. Laser welding is employed due to its high precision, deep penetration, and minimal heat-affected zone. Mechanical testing and salt fog testing are conducted to evaluate strength and corrosion behaviour under simulated marine conditions

Keywords*:* Cryogenic Treatment; Laser Welding; Aluminum Alloys; Mechanical Properties; Corrosion Resistance; Marine Application.

ASSESSMENT OFRCCI ENGINE PERFORMANCE AND EMISSIONS USING HYDROGEN AND WASTE COOKING OIL DERIVED BIODIESEL

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Abstract:
This project focuses on the performance, combustion, and emission analysis of a Reactivity Controlled Compression Ignition (RCCI) engine using hydrogen as a low-reactivity fuel (LRF) and waste cooking oil (WCO) derived biodiesel as a high-reactivity fuel (HRF). The study aims to address the drawbacks of conventional diesel engines, such as higher combustion noise, uncontrolled heterogeneous combustion, and elevated emissions of nitrogen oxides (NOx) and particulates. In RCCI mode, hydrogen is inducted through the intake manifold to form a homogeneous air–fuel mixture, while WCO biodiesel (BD20) is directly injected into the combustion chamber using a common rail direct injection (CRDI) system with a split injection strategy. The variation in fuel reactivity allows better control over ignition timing, combustion phasing, and heat release rate, resulting in smoother and quieter engine operation. Experimental investigations are carried out under full load conditions by analyzing key parameters such as in-cylinder pressure, heat release rate (HRR), relative air–fuel ratio (λ), cycle-to-cycle variations, and combustion noise. Performance parameters including Brake Thermal Efficiency (BTE), Brake Specific Fuel Consumption (BSFC), and Exhaust Gas Temperature (EGT) are also evaluated along with emission characteristics such as CO, HC, and NOx. The results indicate that RCCI operation with hydrogen and WCO biodiesel improves combustion efficiency and significantly reduces emissions. Optimal combustion is achieved at specific energy share conditions, where higher hydrogen substitution leads to lower CO emissions and controlled heat release, while maintaining acceptable in-cylinder pressure limits. However, slight increases in HC emissions are observed at certain operating conditions due to incomplete combustion of the premixed charge. Overall, the hydrogen–WCO biodiesel RCCI strategy demonstrates a promising approach for achieving cleaner combustion, reduced emissions, and improved engine performance, making it a viable alternative for sustainable future engine applications

Keywords: Reactivity Controlled Compression Ignition (RCCI); Hydrogen Fuel; Waste Cooking Oil Biodiesel; Dual-Fuel Combustion; Low-Temperature Combustion; Brake Thermal Efficiency; Nitrogen Oxides Emissions; Smoke Emissions; Sustainable Alternative Fuels; Internal Combustion Engine

SALT FOG CORROSION TESTING APPARATUS

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Abstract

The present study describes the design and development of a simplified salt fog corrosion testing rig intended for controlled laboratory evaluation of material performance under accelerated corrosive conditions. Salt fog testing is widely used to simulate prolonged environmental exposure, particularly for metallic substrates and protective coatings. The proposed system incorporates a sealed exposure chamber, a saline atomization mechanism, and a regulated air supply to ensure uniform fog distribution. Key operational parameters, including solution concentration, temperature stability, and exposure duration, are maintained in accordance with established testing practices to ensure consistency and reliability of results.Experimental evaluation demonstrates that the rig is capable of producing a stable and uniform corrosive environment suitable for comparative material analysis. Its straightforward construction enables ease of assembly, operation, and maintenance, making it well suited for academic laboratories and small-scale research applications. Furthermore, the modular nature of the design allows for future refinement and adaptation. Overall, the system offers a practical and economical alternative to complex commercial equipment while maintaining acceptable standards of performance and reproducibility.

***Keywords*:** Salt fog testing; corrosion evaluation; accelerated environmental exposure; laboratory testing rig; material durability.

DESIGN AND FABRICATION OF MOTORCYCLE SHAFTDRIVE TRANSMISSION WITH INTEGRATED GEAR SHIFTING SYSTEM

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Abstract

This project focuses on the design and fabrication of a motorcycle shaftdrive transmission system with an integrated gear shifting mechanism. Conventional two-wheelers commonly use chain and sprocket systems, which require frequent maintenance, lubrication, and replacement due to exposure to dust, dirt, and corrosion. To overcome these limitations, the proposed system replaces the traditional chain drive with a shaft-driven Mechanism using bevel gear for power transmission.

In this design, the conventional gear box is eliminated, and the gear shifting mechanism is directly integrated into the transmission shaft. Bevel gears are arranged to transmit power at a 90-degree angle, while a propeller shaft ensures smooth torque transfer to the rear wheel. The gear shifting is achieved through a combination of a dog clutch, camdrum, and a specially designed elbow mechanism, enabling efficient and compact operation. The system offers advantages such as reduced maintenance, improved durability, cleaner operation, and consistent efficiency compared to chain drives. The fabrication process includes machining operations such as lathe work, welding, and grinding. Experimental results indicate that the shaft drive mechanism provides reliable power transmission and serves as a feasible alternative for low-power vehicles such as bicycles and motorcycles.

Keywords: Shaft Drive; Bevel Gear; Gear Shifting Mechanism; Dog Clutch; Power Transmission; Chainless Bicycle

SMART HELMET FOR REAL-TIME ACCIDENT DETECTION AND EMERGENCY ALERT SYSTEM

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Abstract

Two-wheeler riders are highly vulnerable to road accidents, often resulting in severe injuries or fatalities. A major challenge in such incidents is the delay in detecting accidents and informing emergency services, especially when the rider is unable to communicate. This paper addresses the issue by proposing a **Smart Helmet based Accident Detection and Emergency Alert System**. The system integrates impact detection sensors, a microcontroller, GPS module, and a mobile application to automatically detect accidents and send emergency alerts with real-time location information. Sensor data is continuously monitored to identify abnormal movements or sudden impacts, which are processed to detect potential accidents. Once detected, the system retrieves the rider's location and transmits an alert message to predefined contacts. A prototype was developed and tested under simulated conditions, successfully detecting impact events and triggering emergency alerts. The results demonstrate that the proposed system can significantly reduce response time and improve rider safety. This solution provides a cost-effective and practical approach to enhancing road safety using wearable smart technology.

Keywords: Smart Helmet; Accident Detection; GPS Tracking; IoT; Road Safety; Emergency Alert System

DESIGN OF AN AI-REINFORCED SMART DUSTBIN FOR INTELLIGENT WASTE MONITORING AND USER INTERACTION

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Abstract

In the era of smart cities and intelligent infrastructure, efficient waste management remains a critical challenge. This project presents an AI-reinforced smart dustbin system designed to enhance waste monitoring, optimize collection processes, and improve overall sanitation management. The proposed system integrates multiple sensing mechanisms, including ultrasonic sensors for fill-level detection, weight sensors for load monitoring, and moisture sensors for waste condition analysis. These sensors continuously collect real-time data, which is processed locally using a microcontroller and transmitted through an internet module. The collected data is stored and analyzed in a cloud environment, where a reinforcement learning model is applied to identify usage patterns, predict fill levels, and optimize waste collection schedules. Unlike traditional systems, the proposed model focuses on intelligent monitoring and decision-making rather than basic automation. A user interface, consisting of a municipal dashboard and mobile application, provides real-time updates, alerts, and system control to both administrators and users. This system aims to reduce overflow incidents, improve operational efficiency, and support data-driven decision-making in urban waste management. By integrating sensing, edge processing, cloud intelligence, and user interaction, the proposed solution contributes to the development of sustainable and smart waste management systems.

Keywords—Smart dustbin; AI reinforcement; waste monitoring; IoT; smart city; predictive analytics; cloud computing.

MECHANICAL CHARACTERIZATION OF STEEL WIRE EMBEDDED GFRP COMPOSITES

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Abstract

Glass Fiber Reinforced polymer (GFRP) structures are chiefly manufactured using the hand lay up or carpet sweeper infusion techniques, which are efficient for the gist of able bodied sailor vessels and aviation industry.The scope of this study is to assess the tensile strength, flexural strength and Izod impact strength analysis on a bidirectional Glass Fiber Reinforced Polymer (GFRP) 0.3mm diameter steel wire embedded laminates. Laminates fabricated with lay up of steel wire placedat ¼ $_{th}$& thick with 3, 5 and 7 mm pitch intervals have been fabricated. The tensile strength, flexural strength and total energy absorbed by the specimens were evaluated for both GFRP and steel wire embedded glass fiber reinforced polymer (SWGFRP) sample. From the results, it was evaluating the tensile strength, flexural strength and the impact resistance were enhanced due to the influence of steel wire in the samples at a range of thicknesses.

Keywords: Mechanical Behaviour, Steel Wire, Glass Fiber Reinforced Polymer.

ANALYSIS OF MECHANICAL PROPERTIES ONAA5083 AND AA7075 ALLOYS USING FRICTION STIR WELDING PROCESS

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Abstract

Aluminium alloy is widely used in various sector due to their good mechanical properties, better corrosion resistance and low melting point as compare to others. The most important property of these materials is relatively light weight and having low manufacturing cost which make them attractive for different applications from technological point of view. This project work is to understand the material result various tests like hardness test, tensile test is carried out on these samples to understand the mechanical behaviour which are produced by friction stir welding. Further it is concluded that as the weight percentage of reinforcement goes on increasing the mechanical properties such as hardness and tensile increases.

Keywords—FSW welding; AA5083 alloy; AA7075 alloy; mechanical properties.

DESIGN AND DEVELOPMENT OF A PORTABLE RFID-BASED AUTOMATED CHECKOUT SYSTEM WITH LIVE BILLING

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Abstract

This paper presents the design and implementation of a portable RFID-based automated checkout system aimed at improving billing efficiency and reducing manual intervention in retail environments. The proposed system integrates an EM-18 RFID reader with an ESP8266 microcontroller to enable contactless product identification and real-time billing. A user-friendly interface consisting of an LCD display, push-button controls, and audio-visual indicators ensures operational transparency and ease of use. To enhance monitoring and digital recordkeeping, the system incorporates IoT-based web connectivity for real-time transaction updates and automated email notifications. A rechargeable lithium-ion battery pack enables portable and independent operation without reliance on fixed infrastructure. Experimental evaluation demonstrated reliable product detection with an accuracy of 99.2% and an average response time of 1.8 seconds per item. Compared to conventional barcode-based checkout systems, the proposed solution significantly reduces billing time while maintaining simplicity and cost-effectiveness. The compact architecture and scalable design make the system suitable for diverse retail and inventory applications.

Index Terms: RFID, Automated Checkout System, ESP8266, Contactless Billing, Retail Automation, Embedded Systems, Industry 4.0.

SCIENCE AND HUMANITIES

INNOVATING ENGLISH LANGUAGE TEACHING FOR THE DIGITAL GENERATION

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Abstract

The way Generation Z learns and engages with language has evolved due to the rapid adoption of digital technologies in daily communication. Traditional English language teaching (ELT) approaches, which rely on rote memorization and textbook-driven instruction, often fail to engage this tech-savvy generation. To meet their evolving needs, educators must adopt innovative strategies that leverage digital technologies, interactive learning, and real-world applications. This study explores novel approaches to ELT, emphasizing the use of social media, gamification, and artificial intelligence (AI) as powerful learning tools. AI-driven chatbots, virtual reality (VR), and microlearning strategies cater to Gen-Z's preference for immediate, interactive, and visually engaging content. Task-based learning and practical communication exercises enhance language retention and critical thinking skills. However, these advancements also present challenges, including screen fatigue, reduced face-to-face interaction, and the need for educators to continuously adapt to emerging technologies. Striking a balance between formal academic learning and informal digital experiences requires a student-centered approach that fosters creativity, collaboration, and cultural awareness. By rethinking ELT methodologies, educators can design effective, relevant, and engaging learning experiences that align with the needs of the digital generation. This study advocates for a flexible, technology-enhanced approach that not only strengthens language proficiency but also prepares students for global communication in the 21st century.

ENHANCING VOCABULARY ACQUISITION: INTEGRATING ONLINE TOOLS AND MIND MAPPING FOR EFFECTIVE LANGUAGE LEARNING

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Abstract

This paper explores the use of online tools and mind mapping techniques to enhance vocabulary learning. As language acquisition becomes increasingly digital, leveraging technology has proven to be an effective way to improve vocabulary retention and comprehension. Online platforms, such as vocabulary-building apps, interactive games, and digital flashcards, offer learners a dynamic and engaging environment. Additionally, mind mapping—a cognitive strategy that visually organizes information—helps learners connect new words with related concepts, facilitating deeper understanding and recall. By integrating these tools, learners can engage in active learning, encouraging both independent study and collaborative practice. This study examines the benefits of combining online tools with mind mapping to foster vocabulary development, increase retention rates, and offer a more personalized approach to language learning. Results suggest that this combination significantly enhances vocabulary acquisition, making the learning process more efficient and enjoyable. The integration of online tools and mind mapping also promotes long-term vocabulary retention by encouraging learners to visualize the relationships between words, their meanings, synonyms, antonyms, and contextual usage. Mind mapping allows for a non-linear approach, helping learners organize their thoughts creatively and intuitively. Online tools, such as spaced repetition systems and vocabulary quizzes, further reinforce this process by providing regular opportunities for review and reinforcement.Moreover, the collaborative aspect of online tools allows learners to share and compare their mind maps with peers, creating an interactive learning community that fosters both individual growth and group learning. This social aspect encourages learners to discuss word meanings, usage, and nuances in various contexts, promoting deeper engagement with the vocabulary.The combination of these strategies creates a holistic learning experience that addresses multiple learning styles. Visual learners benefit from the mind maps, while auditory and kinaesthetic learners engage with interactive features of online tools. This approach not only improves vocabulary but also promotes overall language proficiency by encouraging learners to practice using new words in context and strengthening their ability to recall and apply vocabulary in real-world situations.In conclusion, the use of online tools and mind mapping offers a comprehensive, flexible, and engaging method for vocabulary acquisition. This combination supports personalized learning, caters to diverse learner needs, and provides a solid foundation for effective language development. Future research could further explore the long-term effects of this approach and its potential applications in different educational settings.

ZINC OXIDE NANOPARTICLES WITH CURCUMIN EMBEDDED IN PMMA-CHITOSAN AS A DRUGS CARRIER FOR ANTIARTHRITIC THERAPY

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Abstract

A promising drug delivery method for a number of illnesses, including autoimmune inflammatory diseases like rheumatoid arthritis, is polymer-based nanoparticles. Nanomaterials' antiarthritic qualities are influenced by their large surface area, oxygen vacancies, and reactive oxygen species (ROS) production. This study created a biocompatible nanocomposite (Cur-PMMA-CS-ZnO) by synthesizing and functionalizing chitosan-coated zinc oxide (ZnO) nanoparticles with Cur-PEG by a hydrothermal procedure. X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), UV-visible spectroscopy (UV-Vis), transmission electron microscopy (TEM), and in vitro drug release investigations were used to evaluate the produced nanoparticles. These analyses validated the created nanocomposite's-controlled drug loading and release capabilities, nanoscale particle size, and structural formation. Additionally, in vitro tests showed that Cur-PMMA-CS-ZnO efficiently controls the generation of auto-antigens and inhibits protein denaturation, which plays a crucial role in inflammation. The findings highlight the potential of this novel nanocomposite in targeted drug delivery for rheumatoid arthritis treatment, ensuring enhanced therapeutic efficacy and reduced systemic toxicity.

Keywords Polymer-based nanoparticles, rheumatoid arthritis, chitosan-coated ZnO, controlled drug release, nanocomposite, anti-inflammatory therapy.

APPLICATION OF POWER DOMINATION NUMBER OF GRAPHS IN PMU PLACEMENT IN ELECTRIC POWER NETWORKS

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Abstract

The problem of monitoring an electric powernetwork by placing as few measurement devices in the system as possible is closelyrelated to the well-known domination problem in graphs.Electrical powernetwork must be continuously monitored. Such monitoring can beefficiently accomplished by placing phase measurement units (PMUs) at selected networklocations. Due to the high cost of the PMUs, their number must be minimized. The powerdomination problem consists of finding the minimum number of PMUs needed to monitor agiven electric powernetwork. The power domination number identifies the number of PMUs to be placed. The proposed concept of power domination number gives not only the minimum number of PMUs but also identifies the optimal locations for PMU placement in an electric power network.

Keywords: Phasor measurement unit, Optimization, Domination, Power domination,Electric power network.

DETERMINATION OF THERMOLUMINESCENCE KINETIC PARAMETERS OF TERBIUM DOPED LITHIUM MAGNESIUM BORATE

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Abstract

In this paper we reported the kinetic parameters of rare earth doped lithium magnesium borate (LMB) phosphor using different methods. Irradiated LMB:Tb phosphor has only one glow peak at 520 K. The kinetic parameters such as activation energy (E), frequency factor (s) and order of kinetics (b) of this phosphor were determined using various heating rate (VHR), initial rise (IR) and peak shape (PS) methods. The calculated trap depth and frequency factor of phosphor using VHR and IR methods are in good agreement with one another. The order of kinetics, trap depth and frequencyfactor are determined for LMB:Tb phosphor using peak shape method.

Keywords Lithium magnesium borate, Kinetic parameters, Thermoluminescence

THERMAL SPREADING: A FACILE METHOD TO PREPARE 2D-G-C_3N_4/M_XO_Y

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Abstract

A facile thermal spreading technique has been developed to fabricate 2D/3Dg-C_3N_4/$M_xO_y$heterojunction photocatalysts. Concurrent exfoliation and deposition of g-C_3N_4 on the surface of M_xO_y occurs in a single-step process. Adjusting the carbon nitride loadings in this technique enables controlled coating of carbon nitride onto the rough surfaces of randomly distributed 3D metal oxide particles. The catalytic performance depends strongly on the carbon nitride loading and reaches a maximum at certain percent loading. Carbon nitride loadings lower and higher than the critical loading results in inferior performance. This method offers an easy, scalable and efficient method to obtain carbon nitride metal oxide composites with tunable optical and catalytic properties.

Keywords Clioquinol, Chlorpyriphos, photodegradation, carbon nitride, Manganese tungstate, S-scheme heterojunction.

ECO-FRIENDLY NATURAL DYEING OF COTTON AND SILK USING COCCINIA INDICA LEAF EXTRACT: EFFECT OF MORDANTING TECHNIQUES AND FASTNESS PROPERTIES

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Abstract

In recent years, increasing environmental concerns have led to a growing interest in eco-friendly and sustainable alternatives to synthetic dyes. In this study, a natural dye was extracted from the leaves of Coccinia indica using ethanol extraction and applied for dyeing cotton and silk fabrics. The dyeing process was carried out using different mordanting techniques, namely pre-mordanting, simultaneous mordanting, and post-mordanting, with various metal salts such as ferrous sulphate, copper sulphate, potassium permanganate, and others. The influence of process parameters including pH, temperature, and exhausting agent concentration on dye uptake was also investigated. The results revealed that the dye extract exhibited good affinity towards both cotton and silk fabrics, producing a range of shades depending on the mordant used. Simultaneous mordanting showed superior performance for cotton, while post-mordanting was more effective for silk. Fastness properties, including washing and light fastness, were found to be satisfactory for all dyed samples. SEM analysis indicated a uniform distribution of dye particles on the fabric surface. Overall, the study demonstrates that Coccinia indica leaf extract can serve as an effective, non-toxic, and environmentally friendly natural dye for textile applications.

Keywords Coccinia indica, Natural dye, Cotton and silk fabrics , Mordanting techniques , Fastness properties ,Eco-friendly dyeing

DEGRADATION OF POLYETHYLENE USING WAX MOTH LARVAE OF GALLERIA MELLONELLA

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Abstract

Aim: Plastics are synthetic polymers derived from fossil oil and largely resistant to biodegradation. Degradation of Polyethylene can be processed through environmental factors and microbial degradation.This study disintegrated the polyethylene using bee wax worms (Galleria mellonella) in simple and natural way.

Methodology : The present study tried to degrade the low density polyethelene with both live and dead worms. Only one live larva of Galleria mellonella is introduced into the HDPE bag which involved in degradation of the plastic bag by secreting the enzyme. Disintegration of the polyethylene bag was observed in both live and dead worms. Through FTIR analysis the extent or rate of degradation is ensured which indicating an alteration in the distinctive peaks of C−H and H−C−Bonds.

Results: After 40 minutes contact period of wax worm with high density polyethylene it was observed that weight loss of approximately 10mg with one live worm and in the FTIR analysis the carbon bond breakage in polyethylene chemical bond (CH 2 -CH 2) n which is very high resistance to degradation and this molecular bond is broken down by the formation of acidic group.

Interpretation: FTIR graph for the analysis of breaking of bonds in the high density polyethylene obtain a new peak over a range of 1900 representing formation of acid group so it is proven that the wax worm can degrade the plastics significantly. since plastic bags is the huge component in the Municipal solid waste this study recommends for the source segregation of plastic bags and it can be treated with wax worms will considerably reduce the volume of plastics, in future it can be implemented in landfill.

POWER DOMINATION NUMBER IN STANDARD GRAPHS APPLIED ELECTRICAL POWER NETWORKS

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Abstract

Electric power networks must be continuously monitored. Such monitoring can be efficiently accomplished by placing phase measurement units (PMUs) at selected network locations. Due to the high cost of the PMUs, their number must be minimized. The power domination number $\gamma_P(G)$ is the minimum cardinality of a power dominating set of G. The power domination problem consists of finding the minimum number of PMUs needed to monitor a given electric power system. In this work we obtain the power domination number for some standard graphs.

KeywordsDomination, Power domination, Electric power monitoring

GENETIC POLYMORPHISM AND FREQUENCY STUDY AT 15 SHORT TANDEM REPEAT LOCI IN THE INDIAN POPULATIONS FOR USE IN PERSONAL IDENTIFICATIONS AND APPLICATIONS IN INDIA

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Abstract

Allele frequency is a most important factor in estimating the evidence for an individual involvement in any DNA sample. To determine the allele and genotype frequency in Indian Population 15 Short tandem repeats (STRs) were used, including Penta E, CSF1PO, D18S51, D7S820, D21S11, TH01,D3S1358, Vwa, FGA, TPOX, D8S1179, D16S539, D13S317, Penta D, and D5S818. The study involved 1000 randomly selected individual's samples were selected and analyzed using the powerplex 16 system kit. Various statistical parameters of forensic significance were calculated using Forensic Statistic Analysis Toolbox (FORSTAT) software, including the typical paternity index (TPI), power of exclusion(PE), matching probability (MP), power of discrimination (PD), polymorphism information content(PIC), and observed (Hobs) and expected heterozygosities(Hexp). The following nine loci (D3S1358, D21S11, D18S51, penta E, D7S820, D16S539, penta D, TPOX and FGA) had the minimum allele frequency on 0.0005 which showed those alleles in STRs present rarely among the Indian population. The Highest frequency of 0.4655 in allele 8 at TPOX locus indicated that the allele 8 is more prevalent among the Indian population. FGA was found to be the most polymorphic loci among the 15 loci analyzed in the Indian populations. Furthermore, no divergence from the Hardy-Weingberg equilibrium (HWE) was observed. The results serve as a valuable source of information for establishing a DNA database for Indian populations, providing essential information for population genetics studies and forensic casework in India.

Keywords Hardy-Weinberg equilibrium; PowerPlex 16; STR; WoE.

MATHEMATICAL MODELS USING ORDINARY DIFFERENTIAL EQUATIONS

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Abstract

This paper explores various mathematical models utilizing ordinary differential equations. Introductory in nature, it provides basic definitions regarding equilibrium, stability and phase plane. Furthermore, it examines mathematical models for the spread of infections and the flu virus within a population. The study also discusses the modeling of diabetes progression and analyzes predator-prey dynamics, specifically focusing on the Lotka-Volterra model and its equilibrium states.

Keywords ODE; Mathematical models; predator-prey dynamics; Lotka-Volterra model; Equilibrium and stability; Phase plane analysis; Epidemiological modeling; Diabetes progression modeling.

SWITCHING INVARIANCE OF MODULAR MULTIPLICATIVE DIVISOR LABELING

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Abstract

This paper introduces a new graph obtained through vertex switching on the one-point union of $C_4$and $K_{1,n}$, and investigates its behavior under Modular Multiplicative Divisor (MMD) labeling. A graph $G(V,E)$with $|V|=n$admits MMD labeling if there exists a bijection $f:V(G)\to\{1,2,\dots,n\}$ such that $f^*(uv)\equiv f(u)f(v)(modn)$. It is proved that the constructed graph admits MMD labeling, and the induced edge labels retain modular consistency. Further, the sum of all edge labels is derived and shown to satisfy the required modular property. The results emphasize the stability of MMD labeling under structural transformation and extend its applicability to newly derived graph classes.

Keywords One point union of cycle graph and Star graph; Graph labeling and Modular Multiplicative Divisor Labeling

STRONG GEODETIC NUMBER OF MYCIELSKIAN OF GRAPHS

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Abstract

The strong geodetic number of a graph is a variation of the classic geodetic number problem and it aims to cover every vertex of a graph G, using a minimum number of vertices and the geodesics connecting them, while ensuring that one geodesic is fixed between each pair of these vertices. The strong geodetic number is widely applied in transportation networks and communication networks. Mycielski graphs are triangle free graphs and in this paper, the strong geodetic number of the mycielskian graph of path Pn is investigated.

Keywords Strong geodetic number; geodesic; Mycielski graphs

δgr -MAPPING ASSOCIATED WITH δ -GENERALISED REGULAR CLOSED SETS

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Abstract

Every αg -closed set is a generalised pre closed set. A set A to be regular generalised closed if $cl\,A \subset V$ whenever $A \subset V$ and V is regular open and a pre regular $T_{1/2}$ spaces as the spaces in which every generalised pre regular closed set is pre closed. A subset B of (X, τ) is said to be regular open if $B = int\left(cl\ B\right)$,semi open $B \subset cl\,(\mathrm{int}\,B)$ and semi closed if $\mathrm{int}(cl\,B) \subset B$ .The collection of all regular open is denoted by $\mathrm{RO}(\mathrm{X}, \tau)$ .B is defined as the $\alpha -$sets in (X, τ) if $B \subset \mathrm{int}(cl\,(\mathrm{int}\,B))$.

Keywords δ -generalized regular closed sets, α -generalised closed sets

A STUDY ON DIGITAL MARKETING STRATEGIES ADOPTED BY EDUCATIONAL INSTITUTIONS TO ATTRACT STUDENTS

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Abstract

The present study aims to analyse the digital marketing strategies adopted by educational institutions and examine their effectiveness in attracting students. The study is based on primary data collected through a structured questionnaire administered to students of selected educational institutions. Secondary data has been collected from journals, books, websites, and published reports to support the study.

The research focuses on understanding student awareness, preferences, and perceptions towards various digital marketing strategies such as social media marketing, online advertisements, institutional websites, email marketing, and influencer promotions. The findings of the study are expected to help educational institutions understand student expectations and improve their digital marketing practices to attract more students and gain a competitive advantage.

Key words Digital marketing; Educational institutions; Student attraction; Social media marketing; Online advertising.

GREEN SYNTHESIZED POLYCRYSTALLINE ZR/FE3O4 DECORATED RGO NANOCOMPOSITES: CHARACTERIZATION AND ITS PHOTOCATALYTIC ACTIVITY

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Abstract

For many years, research scientists have aided communities in their tremendous efforts towards environmental remediation. Due to their high physical and chemical stability, metal oxide nanoparticles (NPs) have been used as metal catalysts to remedy this issue. Natural extracts provide a great alternative to harsh chemical, efficient synthesis techniques and cost effective. Here, Zr/Fe_3O_4 modified rGO nanocomposites were synthesized via Kappaphycusalvarezii plant extract green method with efficient hot plate combustion method. The synthesized nanomaterials characterized by X-ray diffraction (XRD), energy dispersive X ray analysis (EDX), Fourier transform infrared (FTIR) spectroscopy. The shape and exceptional size of synthesized Zr/Fe_3O_4 modified rGO nanocomposites demonstrated using high resolution scanning electron microscopy (HRSEM) and transmission electron microscopy (HRTEM). UV–vis and Cyclic voltammetry confirmed the growth and band gap energies of Zr/Fe_3O_4 modified rGO nanocomposites were found to be excellent photocatalysts for the degradation of hazardous cationic textile dye waste (CTDW) collected from dyeing industry. Furthermore, antibacterial activity against Gram positive (Staphylococcus aureus) and Gram-negative (Escherichia coli) bacteria and also, evaluate the impedance analysis. The results explained that the synthesis of Zr/Fe_3O_4 modified rGO nanocomposites were economically cheap when compared with conventional methods and the nanoparticles showed a high efficiency in the removal of hazardous textile dyes, in an eco-friendly manner. Thus we have projected a diverse approach for the green synthesis of Zr/Fe_3O_4 modified rGO nanocomposites, which is economical and that is extremely important in the present times for the removal of hazardous chemicals.

A COMPARATIVE DEEP LEARNING FRAMEWORK FOR MULTI-CLASS SOLAR PANELFAULT DETECTION

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Abstract

The Solar PV systems are one of the major contributors to renewable energy. However, efficiency is impacted by factors like dust accumulation, bird droppings, snow, as well as physical and electrical failures. This paper proposes an automated fault detection system based on deep learning techniques along with an ensemble approach. Pre-trained models like VGG16, EfficientNet-B3, and MobileNetV2 are employed for multi-class classification of faults in solar panels. A stacking ensemble approach, where Logistic Regression acts as a meta-learner, is employed to improve accuracy, along with a soft voting mechanism. The model categorizes panel conditions into six classes: Bird-Drop, Clean, Dusty, Electrical-Damage, Physical-Damage, and Snow-Covered. There is also a website where people can upload images and receive predictions along with confidence values and actions. Experiments demonstrate that the proposed model achieves good and reliable performance, making it suitable for real-time solar panel monitoring.

KeywordsDeep Learning, Solar Photovoltaic Systems, Fault Detection, CNN, VGG16, EfficientNet-B3, MobileNetV2, Ensemble Learning, Logistic Regression, Flask Web Application

FLEXIBLE SEMICONDUCTOR-BASED WEARABLE ELECTRONICS FOR BIOMEDICAL APPLICATIONS

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Abstract

Wearable electronics based on semiconductor devices have revolutionized personalized healthcare and smart sensing technologies by enabling continuous, real-time monitoring in flexible and lightweight formats. This study presents the design, fabrication, and characterization of a flexible wearable electronic device using a hybrid semiconductor system composed of zinc oxide (ZnO) thin films integrated with graphene as a conductive network on a polyimide substrate. Comprehensive characterization techniques including X-ray diffraction (XRD), scanning electron microscopy (SEM), atomic force microscopy (AFM), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, and electrical measurements were employed to evaluate structural, morphological, chemical, and electrical properties. The fabricated device demonstrated high sensitivity (gauge factor ~32), excellent conductivity (1.8×10^3 S/m), and stable performance under repeated mechanical deformation (over 5000 bending cycles with <5% degradation). The results indicate significant improvements over conventional rigid electronics in terms of flexibility, durability, and energy efficiency.

KeywordsWearable electronics; Semiconductor devices; Flexible sensors; ZnO thin films; Graphene; Characterization techniques; Nanoelectronics

SOLE CLASSOF MULTIFOLD WEIGHTTHREEFOLD LINEAR CODES

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Abstract

The weight distributions of three different classes of three fold linear codes two-weight, three- weight, and four-weight over (ℚ) are presented and established in this study. The optimal codes in these codes are extracted from the irreducible cyclic codes.They also have optimum codes in their duals.

Keywords Cyclotomic Classes; Gaussian Periods; Linear Codes; Trace Function; Irreducible Cyclic Codes

GENERALIZED NEUTROSOPHIC SET FRAMEWORK FOR ENHANCED MULTI-CRITERIA DECISION MAKING UNDER UNCERTAINTY

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Abstract

This paper presents a novel generalization of neutrosophic sets aimed at improving decision-making performance in environments characterized by uncertainty and inconsistency. The proposed framework refines the representation of membership, indeterminacy, and nonmembership functions, thereby enhancing flexibility and adaptability in handling complex information. A comprehensive comparative study is carried out against conventional neutrosophic models across multiple domains, including business analytics, clinical decision systems, supply chain management, and risk assessment scenarios. Performance evaluation is conducted using key metrics such as decision accuracy, computational complexity, and algorithmic stability, based on both simulated and real-world datasets. The results demonstrate that the proposed approach achieves an average improvement of approximately 15% in decision accuracy, along with increased robustness and reliability. Although the method incurs a marginal increase in computational cost, its superior adaptability highlights its effectiveness for multi-criteria decision-making applications. Future work will focus on optimizing the computational efficiency of the proposed model.

Keywords Neutrosophic sets; Decision-Making Systems ;Generalization Techniques; Traditional Methods; Uncertainty; Decision Accuracy and Robustness

PERFORMANCE ANALYSIS OF A MULTI-STATE WI-FI MESH NETWORK IN A CORRIDOR USINGSUMUDU TRANSFORM

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Abstract

This research evaluates the performance of a multi-state Wi-Fi mesh network installed along a 100 meter linear corridor, conceptualised as a linear consecutive 3-out-of-5:G reliability system, where the network remains operational if at least one block of three consecutive APs functions, guaranteeing at least 75 m of continuous coverage and enabling seamless roaming across at least one corridor segment. The network comprises five access points (APs) spaced evenly at 25-meter intervals, each offering a coverage radius of approximately 30 m. Common-cause mechanisms include power outages, switch failures, construction vibrations, electromagnetic interference, HVAC extremes, and water leaks. Positive dependence among repair processes is captured via a Gumbel–Hougaard copula and the Supplementary Variable Technique combined with the Sumudu transform applied to derive analytical expressions for subsystem reliability, availability and Sensitivity. An economic evaluation based on the expected profit assesses the cost-effectiveness of the design. The proposed modeling framework offers a mathematically rigorous and practically relevant tool for assessing the performance of corridor-based wireless mesh networks in environments where continuous connectivity is crucial, such as smart buildings, hospital hallways, hotel corridors, and airport terminals. The model also aids engineering decisions related to access point placement, redundancy planning, maintenance scheduling, and cost-benefit optimization of wireless infrastructure deployments.

Keywords Wi-Fi mesh network, Gumbel-Hougaard copula, Supplementary variable technique, Sumudu transform, Availability, Reliability.

HEATTRANSFER CHARACTERISTICS OF VISCOPLASTIC NANOFLUID FLOW PAST AN IMPULSIVELY STARTED PERMEABLE VERTICAL SURFACE

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Abstract

The non-Newtonian aspect of electrically conducting ferrofluid is illustrated analytically over a moving semi-infinite permeable vertical plate. The transport equations are solved by employing suitable transform technique together with MATLAB programming. In contrast with the magnetic nanoparticles (CoFe2O4, Fe3O4), the flow properties of non magnetic nanoparticles (Al2O3, TiO2) are demonstrated. The influence of Prandtl number on temperature and Nusselt number are elucidated graphically. The effects of flow parameters such as Prandtl number, Grashof number, permeability, Casson parameter and magnetic parameter on velocity and skin friction coefficient are also depicted. Increasing the volume fractioncoefficient exhibits an elevation in the temperature and velocity distribution. A comparison study has been made with the already existing result which shows an excellent agreement of solutions.

Keywords Ferrofluid; Non-Newtonian fluid; Casson parameter; Magnetohydrodynamics (MHD); Nanoparticles; Heat transfer; Permeable vertical plate; Analytical solution.

THE STABILITY AND THE EXISTENCEON NONLINEAR DELAY INTEGRO-DIFFERENTIAL EQUATIONS WITH SOME CONSTRAINS

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Abstract

In this paper, the existence, uniqueness, stability via continuous dependence and Ulam stabilities of nonlinear integro-differential equations with random impulses are studied under necessary condition. The results are obtained by using Leray-Schauder alternative fixed-point theorem and Banach contraction principle.

NITROGEN-DOPED CARBON MATERIALS FOR SUPERCAPACITOR ELECTRODES

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Abstract

Carbon-based materials have emerged as indispensable electrode candidates for high-performance supercapacitors due to their excellent electrical conductivity, large specific surface area, chemical stability, and tunable pore architecture. Conventional carbon materials such as activated carbon, carbon nanotubes, and graphene primarily store charge through electrostatic ion adsorption, governed by the principle of Electric Double Layer Capacitance, which ensures high power density and long cycle life. However, their relatively low energy density limits broader applications. To overcome this limitation, nitrogen-doped carbon materials have gained significant attention as advanced electrode systems. Nitrogen incorporation into the carbon framework modifies the electronic structure, enhances wettability, and introduces additional active sites, thereby enabling faradaic reactions alongside double-layer capacitance. This synergistic effect improves overall capacitance through Pseudocapacitance. Different nitrogen functionalities—such as pyridinic, pyrrolic, and graphitic nitrogen—play distinct roles in enhancing conductivity and electrochemical activity. Furthermore, N-doped carbon materials exhibit improved ion transport kinetics and structural stability, making them suitable for next-generation flexible and high-energy-density supercapacitors. Recent advancements in synthesis strategies, including biomass-derived carbons and template-assisted methods, have enabled precise control over pore size distribution and heteroatom doping levels. Overall, the integration of nitrogen doping into carbon materials presents a promising pathway to bridge the gap between high power and high energy storage, thereby advancing the development of efficient, sustainable, and scalable supercapacitor technologies.

SYNTHESIS AND CHARACTERISATION OF ZINC DOPED IRON NICKEL NANOMATERIAL

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Abstract

Zinc (Zn) doped nickel (Ni) and iron (Fe) nanomaterials were synthesized successfully by the chemical co-precipitation method, enabling controlled incorporation of Zn ions into the host lattices. Structural characterization by X-ray diffraction (XRD) confirmed the formation of crystalline phases without secondary impurities, with Zn doping influencing lattice parameters and crystallite sizes. Specifically, the doped Ni and Fe nanostructures retained their characteristic crystal structures while exhibiting variations in crystallite size due to Zn substitution. Morphological analyses using scanning electron microscopy (SEM) and transmission electron microscopy (TEM) revealed uniform nanoscale particle distributions with doping-induced size modulation. Optical properties assessed by ultraviolet-visible (UV-Vis) spectroscopy and photoluminescence (PL) indicated that Zn doping caused shifts in the absorption edges and modification of band gaps, which can be attributed to defect states and electronic structure changes induced by dopant incorporation. Furthermore, Fourier-transform infrared spectroscopy (FTIR) and energy-dispersive X-ray (EDX) spectroscopy confirmed the successful doping of Zn and the absence of unwanted contaminants. The Zn-doped Ni and Fe nanomaterials demonstrated enhanced functionalities such as improved optical absorption and potential magnetic behavior, suggesting their suitability for applications in catalysis, sensing, and environmental remediation. This work illustrates that the chemical co-precipitation method is an effective approach for producing Zn-doped nickel and iron nanomaterials with tunable structural and optical properties for multifunctional nanotechnology applications.

Keywords Zinc, Iron, Nickel, doping, Nanomaterial

TIO_2 PHOTOANODE DOPED WITH MO FOR PEROVSKITE SOLAR CELLS: SYNTHESIS AND CHARACTERIZATION

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Abstract

With the increase in population and the following technological advancements, the energy demand has been exponentially increasing in the present world. The climate change induced by conventional energy production methods is wreaking havoc throughout the world. Sustainable methods of energy production which could meet the increased energy requirement are thus in demand. Extensive research in the field of material science is being put in place to address these challenges. Photovoltaic cell-based technologies are one promising and efficient energy production technology. Perovskite nanostructures solar cells have been certified with an exemplary power conversion efficiency near to 28%. Photoanodes play a significant role in the energy conversion process in any kind of photovoltaic cells and in storage devices. Keeping this in mind, we are intending to fabricate cost effective, non-toxic photoanodes with remarkably high charge diffusion length for perovskite based solar cells. TiO_2 came to limelight as an electron transport layer due to its high UV stability and mesoporous layer formation.

In this paper we reported synthesization of Mo doped TiO_2 based photoanode material by sol-gel method. Also, we studied the crystal formation of photoanode using X-ray diffraction spectrometer (XRD). Molybdenum dopants are infused into pure TiO_2 in concentration of 0.5%, 1.5%, 2%, 2.5%, and 3% and analyzed various characterization studies in detail.

MULTIFUNCTIONAL TI-DOPED $CACO_3$ NANOCOMPOSITES FOR EFFICIENT DYE DEGRADATION AND ANTIBACTERIAL APPLICATIONS

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Abstract

A novel technique of biomimetic method has been used for the synthesis of Ti-doped calcium carbonate nanocomposites (TCNs) for photocatalytic and antibacterial activities. The prepared various concentrations (0.02, 0.04, 0.06, 0.08, and 0.1 M) of TCNs, Ti-doped calcium carbonate nanocomposites, were subjected to the different spectroscopic techniques. The absorption and emission properties were analyzed through UV-DRS and PL analysis. From the results, 0.06 M of TCNs exhibits higher absorption (268 nm) and emission values (465), and 0.1 M of TCNs shows lower absorption (260 nm) and emission (457 nm) values compared with other concentrations. The functional and structural analyses of the products were characterized via FTIR and XRD analysis. From this, the successful incorporation of titanium in the $CaCO_3$ host was confirmed by the presence of metal oxide peaks in the range of around 450 cm^{-1}. The rhombohedral structure of $CaCO_3$ was confirmed through XRD analysis, and the calculated crystallite size was in the range of 25-35 nm, respectively. The spherical morphology of the prepared TCNs was obtained through FE-SEM analysis. From the EDX and mapping, it shows the confirmation of dopant ions (Ti^{2+}/Ti^{4+}) in the $CaCO_3$host. The optimized samples were subjected to the photocatalytic and antibacterial activities. From the photocatalytic activity, 0.06 M of TCNs exhibits good degradation efficiency (95%) against malachite green dye during 110 min under UV irradiation. The antibacterial performance of 0.1 M of TCNs against different bacteria such as S. aureus, S. pyogenes, K. pneumoniae, and E. coli was analyzed. From the results, it shows a higher zone of inhibition for both gram-positive and gram-negative bacteria at a dose concentration of 1000µg/ml. These results show that Ti-doped $CaCO_3$ nanocomposites are appropriate for biological applications and a promising sustained photocatalyst.

Keywords Titanium; Calcium carbonate; Biomimetic synthesis; Photocatalysis; Antibacterial activity

GREEN SYNTHESIS AND CHARACTERIZATION OF CARBON DOTS DERIVED FROM WASTE BIOMASS

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Abstract

Carbon quantum dots (CQDs) are also known as carbogenic nanodots because they have higher oxygen content. Carbon-based products are traditionally made from sources like coal and petroleum coke. However, rising demand and dwindling non-renewable resources need the production of carbon-based products from renewable raw materials. Biomass waste (agricultural residues, municipal solid trash, and food waste) is a renewable resource with a high carbon content that can be exploited to produce high-value carbon products (45%-55%). This study aims to investigate the synthesis of carbon dots from sugarcane biomass source, focusing on their understanding of the relationship between biomass source, synthesis conditions, and CD properties, and also to evaluate the potential of biomass-derived CQDs as sensors for various applications, including environmental monitoring, food safety, detecting pollutants in water and air, biosensing, and biomedical applications.

BRIDGING THE DUAL-FUNCTIONAL AU@TIO_2 NANOCOMPOSITE FOR SERS DETECTION AND DEGRADATION OF ATRAZINE IN AGRI-FOOD MATRICES

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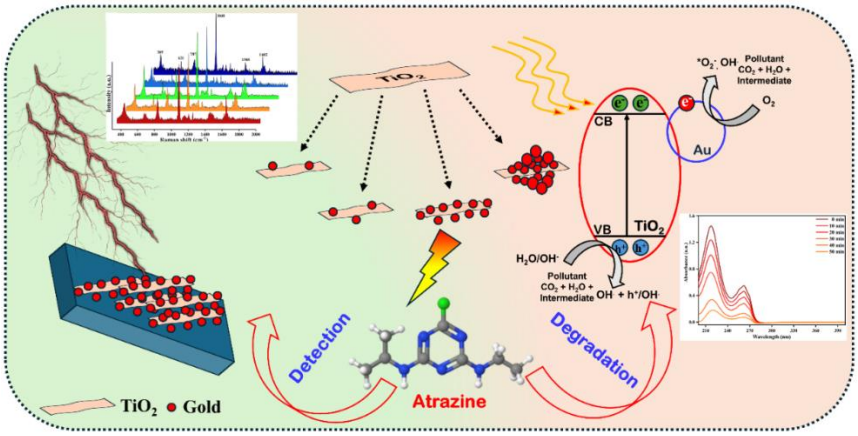
Abstract

Atrazine (ATZ), a widely used triazine herbicide that persists in the environment and its frequently detected in water and agri-food related matrices, raising concerns due to its mobility and endocrine-disrupting toxicity. Herein, we report a gold nanoparticle-decorated titanium dioxide nanocomposite (Au@TiO_2) as a dual functional platform for ultrasensitive surface-enhanced Raman scattering (SERS) detection and visible-light driven photodegradation of ATZ. Au nano particles were deposited on TiO_2 by a simple in situ method with tunable loadings (2, 4, 6, and 8 wt%). Rietvield-refine XRD confirms high crystallinity and phase purity of anatase TiO_2 after Au decoration. Among the series, 6%Au@TiO_2 exhibits optimal Au dispersion, a reduced optical band gap, and suppressed charge-carrier recombination, as supported by DRS and PL analyses. The optimized substrate achieves an ATZ detection limit 10^{-6} M with good signal reproducibility in complex matrices (corn, soil, fish-scale extracts) and enables rabid photocatalytic removal of ATZ (~98 % within 50 min) under visible light, retaining activity over five consecutive cycles. This recyclable sensing-remediation nanoplatform provides a practical route for on-site monitoring and solar-assisted mitigation of atrazine contamination.



MECHANICAL BEHAVIOUR AND DURABILITY EVALUATION OF CONCRETE MADE WITH RECYCLED FINE AGGREGATE

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Abstract

The excessive extraction of natural river sand and the large generation of construction and demolition waste (C&DW) have created serious environmental concerns in the construction industry. Recycled Fine Aggregate (RFA) obtained from C&DW offers a sustainable alternative to natural fine aggregate in concrete. However, the presence of adhered mortar and higher porosity in untreated RFA adversely affect the strength and durability of concrete. The present study investigates the mechanical and durability performance of concrete incorporating untreated and treated RFA as partial replacement of natural fine aggregate. RFA obtained from demolished concrete structures was processed through acid, mechanical and thermal treatment methods to improve its physical properties. Concrete of M30 grade was prepared with 20%, 30% and 40% replacement of natural fine aggregate by untreated and treated RFA. Compressive strength, split tensile strength and flexural strength were evaluated at 7, 28, 56 and 90 days. Durability was assessed through hydrochloric acid exposure and Rapid Chloride Permeability Test (RCPT). The results showed that treated RFA significantly enhanced the performance of concrete compared to untreated RFA. Among the treatment methods, acid treatment exhibited the best performance. Concrete containing 40% acid-treated RFA achieved a compressive strength of 42.49 MPa at 90 days, which was higher than that of conventional concrete. Similarly, improved tensile and flexural strengths were observed. The RCPT values for acid-treated concrete decreased from 2866 coulombs at 28 days to 1698 coulombs at 90 days, indicating lower chloride penetration and improved durability. Acid-treated specimens also showed better resistance against hydrochloric acid attack. The study demonstrates that treated RFA, particularly acid-treated RFA, can be effectively used as a sustainable replacement for natural fine aggregate in structural concrete without compromising strength and durability.

Keywords: Acid resistance, Compressive strength, Construction and demolition waste, Durability, Flexural strength, Rapid chloride permeability test, Recycled fine aggregate, Split tensile strength.

ECO-FRIENDLY NATURAL DYE OBTAINED FROM BIXA ORELLANA SEEDS ON COTTON AND SILK: A STUDY

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Abstract

The growing environmental and health concerns associated with synthetic dyes have driven the investigation of sustainable and eco-friendly alternatives derived from natural resources. This study investigates the extraction and application of a natural dye obtained from Bixa orellana seeds on cotton and silk fabrics. The dye was extracted using an environmentally benign solvent extraction method and subsequently applied to pre-treated textile substrates. Mordanting agents, namely alum and iron, were employed to enhance dye fixation, improve color strength, and increase fastness properties. The dyeing process was optimized by systematically varying parameters such as pH, temperature, and dye concentration to achieve maximum dye uptake and uniform coloration. The dyed fabrics were evaluated for color strength, shade uniformity, and fastness properties, including resistance to washing, rubbing, and light exposure. The results indicate that silk exhibited higher dye affinity and produced brighter shades compared to cotton due to its proteinaceous structure, which facilitates stronger interactions with dye molecules. Furthermore, mordanting significantly enhanced both color depth and durability in both fabric types.The results indicate that dye extracted from Bixa orellana seeds represents a viable and sustainable alternative for textile applications, offering an eco-friendly, biodegradable, and non-toxic substitute to synthetic dyes. This approach contributes to the reduction of environmental pollution and promotes the utilization of renewable plant-based resources in sustainable textile processing.

Keywords Natural dye, Bixa Orellana, Cotton fabric, Silk fabric, Mordanting, Color fastness, Sustainable textiles, Plant-based dye, Dye extraction

THE IMMIGRANT FEMININE VOICE: DIASPORA AND WOMANHOOD IN THE NOVELS OF CHITRA BANERJEE DIVAKARUNI

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Abstract

Chitra Banerjee Divakaruni stands out as the central figure of Indian diaspora in the United States of America in the group of modern female authors. Her fictional work provides a literary expression of the psychological and cultural journey of South Asian women immigrants, their struggles between values of homeland and requirements of their new America. The essence of the issues of the diasporic literature is reflected in the works of Divakaruni, most of all in The Mistress of Spices (1997), Sister of My Heart (1999)., The Vine of Desire (2002). and Queen of Dreams (2004). Relying on the concepts of diaspora theory as discussed by William Safran and Homi Bhabha, the present paper makes an argument that the loss of home is not the only thing that Divakaruni dramatizes but rather she also develops a diasporic feminine matrix of consciousness that privileges memory, relationship, and the inner world. By examining the text closely, the article shows how her female characters who are caught between India and America slowly develop a sense of belonging that is neither in the past nor in the present.

Keywords diaspora, immigration, Indian women, Chitra Banerjee Divakaruni.

INDIVIDUATION AND SELF-ACTUALIZATION IN THE ALCHEMIST: A PSYCHOLOGICAL READING OF SANTIAGO'S JOURNEY

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Abstract

Paulo Coelho's The Alchemist (1988) narrates the spiritual and psychological odyssey of Santiago, a young Andalusian shepherd, whose pursuit of his "Personal Legend" unfolds as an allegory of human self-discovery. This paper explores Santiago's journey through the theoretical frameworks of Carl Jung's concept of individuation and Abraham Maslow's hierarchy of needs, illustrating how the novel's central themes reflect universal aspects of psychological growth and self-actualization. The analysis traces Santiago's transformation from material desire to spiritual enlightenment, interpreting the novel's symbols, omens, and events as stages of inner awakening. Jung's archetypal theory elucidates Santiago's confrontation with the self, the unconscious, and the collective human psyche, while Maslow's model highlights the progressive satisfaction of his physiological, emotional, and transcendental needs. Through this integrated psychological reading, the paper argues that Coelho's narrative depicts self-realization not as a linear pursuit but as an inward, dynamic process bridging consciousness and the unconscious. Ultimately, this study presents The Alchemist as a modern myth of personal transformation, affirming that when individual purpose aligns with a universal rhythm, life attains its fullest meaning. Thus, Coelho's work is examined as a philosophical narrative that transcends literature, psychology, and spirituality in articulating the timeless human search for meaning.

KeywordsCarl Jung, Individuation, Alchemist, Paulo Coelho, Spiritual, Psychological Journey.

EMPOWERING WOMEN THROUGH LITERATURE: A STUDY OF GENDER INEQUALITY AND RESILIENCE IN SUDHA MURTY'S WORKS

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Abstract

This article explores how Sudha Murty's works—Wise and Otherwise: A Salute to Life, and The Mother I Never Knew—address gender inequality and the resilience of women. Key gender issues like dowry killings, female infanticide, societal expectations, economic dependence, the challenges faced by single mothers, the struggles of elderly women, patriarchal constraints, and changing roles of women in modern India are explored in her stories. Murty highlights society's views on women, their aspirations for empowerment, education, independence, gender roles, and economic independence. She underscores the importance of empowering women through values such as honesty, empathy, and perseverance, often drawing from her personal experiences.The study aims to analyze how Murty's narratives promote gender equality and female empowerment while also highlighting the adversities and strength of women in a patriarchal society. A qualitative literary analysis using a gender perspective is employed to examine the themes, characters, and storytelling techniques in Murty's works. The research incorporates gender studies and feminist literary criticism to contextualize her portrayal of women's struggles and resilience. It shows that Sudha Murty's writing consistently focuses on the structural challenges faced by women, such as lack of education, societal expectations, and financial dependence, while also celebrating the determination and adaptability of female protagonists who challenge patriarchal norms and redefine their roles in society. This essay specifically examines how gender inequality and female resilience are portrayed in Murty's aforementioned works.

Keywords Education, Resilience, Female Empowerment, Patriarchy, Sudha Murty's Narratives and Gender Inequality

BUSINESS AND MANAGEMENT STUDIES

THE SOCIO-ECONOMIC IMPACT OF MICROCREDIT NON-REPAYMENT IN SRI LANKA

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This research has been prompted by recent Sri Lankan and international news reports about incidents of suicide and self-harm in Sri Lanka related to unpaid loans and microcredit repayment collections. However, it is not investigated in a systematic way. Thus, providing insights into the operations of the microfinance industry through academic research has the potential to make a major contribution to improve the design of future microfinance projects and Microfinance Institution's operations and help policy makers to formulate successful credit policies and programs that will again help in allocating financial resources effectively and efficiently. Apart from the challenges to reaching out to the poor in offering the microcredit loan, microfinance institutions also have challenges with loan repayments. High default rate has affected the sustainability of the micro-credit initiatives. The aim of the research is to find out the causes of loan default and the consequences of loan default on social and economic condition of the poor. This research underpinned credit default theory which determine the factors influencing non (repayment). This qualitative research collected data through the interviews conducted with 12 loan borrowers (Five repaid and six non-repaid the loan taken) with the secondary data analysis.The findings revealed that most borrowers did not spend the loan amount on the intended purpose. The research found out that loan repayment default was a result of inadequate returns to repay the loan and the findings further, indicate borrowing from many institutions at a same time (multiple borrowing) also as a reason for loan repayment default.

Keywords: Microcredit, multiple borrowing, non-repayment, socio-economicx

AI-DRIVEN HR ANALYTICS AND EMPLOYEE RETENTION: THE MODERATING ROLE OF DIGITAL MATURITY IN THE CHENNAI IT SECTOR

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Artificial intelligence is revolutionising the human resources functions like recruitment, performance tracking and employee engagement. However, the increase in operational efficiency through AI-driven analytics does not necessarily equate to an increase in employee retention. The existing literature does not pay attention to digital maturity, an organisation's ability to implement and scale AI, as a factor that decides if investments in analytics would lead to retention.

The study aims to investigate whether digital maturity acts as a moderator in the link between AI-driven HR analytics and employee retention. It challenges universalistic assumptions and attempts to explain under what circumstances these technologies are most effective.

Based on the Technology-Organisation-Environment (TOE) framework, this research paper is digitally mature to be a moderator instead of a static antecedent. The main data were obtained through a structured survey among 300 companies from various industries. Moderated regression analysis was applied to measure the interaction effect.

Firstly, it gives empirical evidence of digital maturity as a moderating mechanism in the transformation of AI-HR investments into retention effects; secondly, it adds to the TOE framework by viewing digital maturity as an important contextual factor; and thirdly, it settles the concerns on the "human element" in AI adoption by discovering the circumstances under which analytics in still trust and foster commitment in employees.

Test results show that the positive effect of AI analytics on employee retention depends on the existence of a certain minimum level of digital maturity. If digital maturity is below the minimum level, then operational problems and employee resistance can wipe out or even negate the expected positive effects.These findings should have an impact on business leaders by showing that technology investment should be accompanied by investments in digital infrastructure, leadership training, and workforce education. The wide implementation of AI-assisted human resources (HR) has put organisations in such critical stages that the present research may offer them a proactive guideline to harmonise the adoption of technology with the human-centred retention activities, which are, at the same time, the goals of the organisations.

Keywords: AI- driven HR analytics; Employee Retention; Digital maturity; TOE framework

FINTECH ADOPTION AMONG WOMEN OF CHENNAI CITY: AN EMPIRICAL STUDY WITH SPECIAL REFERENCE TO THE BANKING SECTOR IN INDIA

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In today's world, the emergence of technologically advanced financial institutions, such as banks and financial companies has harnessed technology to improve financial transactions commonly referred as financial technology (FinTech). Despite of these many advancements in technology, many individuals especially women, the illiterate, and the economically weaker do not utilize fintech effectively due to lack of awareness and social barriers. Economic growth is stimulated when these groups actively engage in financial inclusion. The purpose of the study is to assess the relationship between financial inclusion, fintech adoption and advancement toward sustainable development goals, as well as to determine the factors influencing FinTech adoption among female banking customers in Chennai. The TAM (Technology acceptance model) forms the basis of the research framework. The research offers guidance to educators, policy makers and financial technology providers to bridge gender gaps in financial management.

Keywords: Financial institutions, Financial transactions.

THE POWER OF TIMELY RESPONSE: DIGITAL PR STRATEGIES AND THEIR INFLUENCE ON CRISIS OUTCOMES

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This study investigates the paradox in which negative publicity, usually viewed as detrimental, instead helps the brand if efficiently managed by strategic digital public relations. The advanced digital landscape today demands effective and swift crisis management to turn potentially blemishing scandals into an opportunity for higher public engagement.This study explores the way brands respond to crises, particularly how the strategies and timing of digital PR could affect the flow and impact of negative publicity.

The study also investigates the timeliness in responsiveness with PR tools a sitrelates to the virality of negative publicity and the various techniques for management adopted such as apologizing, denial, transparency, and utilizing influencers.This research also studies the role social media platforms such as Twitter, Instagram, or Facebook may play in either scalating the negative sentiments or in containing them. To as certain the effects that these strategies produce, variables such as response timeliness of response, mode of communication used, and public sentiments before and after a brand responds will be studied.

For the purpose of data collection, a questionnaire will be administered among Indian consumers who are actively engaging and following a brand on social media. Participants will be selected using a convenience and snowball sampling survey methodology. The questionnaire would gather insights about what consumers think about the various crisis response strategies and the probability of them sharing content relating to brand scandals. Statistical methods like regression analysis would be used to measure the relationship between PR responses and the resultant level of social media engagement. The changes inpublic sentiment before and after the response to the crisis would be analyzed to appraise the effectiveness of the communication strategies undertaken.

The expected outcome of this study is that those brands which respond strategically and efficiently to crisissituations will have better control over the narrative and reduce the negative effects. The two best techniques expected to help in restoration of consumer trust and reduction of virality are transparency and genuine apologies.Additionally, influencer collaborations will also be very pivotal in determining and controlling the narrativeundercrisis. Social algorithms will, therefore, come into play and help amplify trending or controversy-ridden content. This makes response speed a key factor in managing any kind of crisis.

It can offer a working guide for brands as they look to navigate their way through crises in a fast-paced digital environment while keeping their eyes fixed on gaining consumertrust and perhaps reducing damageover time.

Keywords: Digital PR; Crisiscommunication; Timely response; Online reputation management

HR ANALYTICS ADOPTION IN SMES: INTEGRATING TOE AND INNOVATION DIFFUSION PERSPECTIVES

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Human Resource (HR) analytics has become an essential skill for facilitating data-informed decision-making and improving organizational effectiveness in the digital age. Nonetheless, despite its strategic promise, the use of HR analytics remains limited, especially within small and medium-sized enterprises (SMEs) that face specific structural and capability challenges. This research consolidates the current literature to examine the key factors, obstacles, and theoretical perspectives influencing the implementation of HR analytics in small and medium-sized enterprises.

The results suggest that the adoption of HR analytics is a complex phenomenon shaped by technological preparedness, organizational abilities, environmental influences, and individual skills. Although technological infrastructure and leadership backing serve as crucial facilitators, ongoing issues like inadequate analytical abilities, reluctance to adapt, and resource limitations still hinder successful execution. The research highlights a significant gap in the existing literature, marked by the disjointed use of theoretical frameworks, with minimal attempts to combine contextual and behavioural viewpoints.

To fill this gap, the research promotes a cohesive comprehension of HR analytics adoption by emphasizing the synergistic functions of the Technology–Organization–Environment (TOE) framework and Innovation Diffusion Theory (IDT). By linking these viewpoints, the research offers a more thorough understanding of adoption dynamics within SME environments. The results provide significant implications for researchers and practitioners by highlighting the necessity for capability enhancement, strategic alignment, and tailored adoption methods.

Keywords: HR Analytics; SMEs; Technology Adoption; Digital Transformation; Organizational Capability; Innovation Diffusion; TOE Framework

A STUDY ON EMPLOYEE WELFARE MEASURES IN SUNDRAM FASTENERS LIMITED CHENNAI

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Employee welfare is a vital factor in maintaining a productive and motivated workforce, particularly in the manufacturing sector. This study examines the effectiveness of both statutory and non-statutory welfare measures provided by Sundram Fasteners Limited (SFL), Chennai, and their impact on employee satisfaction.

The primary objectives are to evaluate the current welfare facilities including health, safety, and canteen services and to identify the relationship between these benefits and employee morale. Using a descriptive research design, primary data was collected from 200employees through a structured questionnaire. Data analysis was conducted using Percentage Analysis and Chi-Square tests.

The findings reveal that while the company maintains high standards in statutory compliance, there is room for enhancement in non-statutory areas such as recreational programs. The study concludes that robust welfare schemes are essential for reducing labor turnover and fostering a positive organizational culture within the competitive automotive industry.

Keywords: Employee Welfare measures, Statutory and Non-Statutory Measures, Job Satisfaction, descriptive research design, employee morale, Percentage Analysis, Chi-Square tests, labor turnover, welfare schemes, organizational culture.

A STUDY ON WORK-LIFE BALANCE OF NURSING STAFF AND ITS IMPACT ON JOB SATISFACTION IN TAGORE MEDICAL COLLEGE AND HOSPITAL

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Work-life balance has become an important issue in the healthcare sector, especially for nursing staff who face heavy workloads, long working hours, and shift duties. Maintaining a balance between professional responsibilities and personal life is essential for improving employee satisfaction and organisational efficiency. The main objective of this study is to analyse the work-life balance of nursing staff and its impact on job satisfaction in hospitals. The study is based on both primary and secondary data. Primary data were collected through a structured questionnaire distributed to nursing staff, while secondary data were collected from journals, books, and online resources. Percentage analysis and correlation analysis were used to interpret the data. The results of the study reveal that proper work-life balance significantly influences job satisfaction, productivity, and employee well-being. The study suggests that hospitals should implement flexible work schedules, supportive management practices, and stress management programs to improve the work-life balance of nursing staff.

Keywords: Work-Life Balance, Nursing Staff, Job Satisfaction, Hospital Management, Employee Well-being

A STUDY ON EMPLOYEE ENGAGEMENT PRACTICES IN TUBE PRODUCTS OF INDIA

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Employee engagement plays a crucial role in improving organisational performance and employee satisfaction. Engaged employees demonstrate commitment, enthusiasm, and a strong connection with their organisation. The objective of this study is to analyse the level of employee engagement and identify the factors influencing employee participation and satisfaction in the workplace. The study uses primary data collected through questionnaires and secondary data from reports and literature. Statistical tools such as percentage analysis, correlation, and chi-square analysis are used to interpret the data. The findings reveal that employee engagement activities positively influence job satisfaction, productivity, and organisational commitment. The study also provides suggestions to improve engagement practices within organisations.

Keywords: Employee Engagement, Job Satisfaction, Organisational Commitment, HR Practices.

A STUDY ON THE IMPACT OF SOCIAL MEDIA ON BUYING BEHAVIOR OF STUDENTS

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This study examines the impact of social media on consumer buying behavior in this digital environment. The rapid growth of social media platforms such as Instagram, Facebook, and YouTube's online content influence the consumers, including advertisements, influencer support, and user reviews.

The objective of this research is to analyze how social media influences consumer decision-making processes and buying habits. Descriptive research design is used and primary data is collected through questionnaires from a sample of 80 respondents, secondary data are collected through journals and articles.

The findings indicate that social media significantly increases product awareness, consumer perceptions, and influences purchase intentions. The factors like belief in reviews of product, influencer, and engaging content play a very important role in buying behavior of the product . The study concludes that social media is an important marketing tool that businesses must strategically utilize to influence consumer decisions and strengthen customer relationships.

Keyword : Social Media; Consumer Buying Behavior; Purchase Intention; Influencer Marketing; Online Review; Digital Marketing; Brand Awareness;

A STUDY ON CONSUMER PREFERENCE TOWARDS POOJA PRODUCTS WITH SPECIAL REFERENCE TO INCENSE STICKS AND BENZOIN RESIN IN CHINNASELAM

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This study examines consumer preferences towards pooja products, with special reference to incense sticks and benzoin resin in Chinnaselam. Pooja products play a significant role in the daily religious practices of consumers, especially in Indian households. The research focuses on understanding the factors that influence purchasing decisions, such as quality, fragrance, price, brand awareness, availability, and traditional beliefs.

Primary data was collected through a structured questionnaire from consumers in Chinnaselam. The study analyzes consumer behavior patterns, frequency of usage, and preference differences between incense sticks and benzoin resin. It also evaluates the impact of cultural values and spiritual beliefs on product selection.

The findings reveal that fragrance and quality are the most important factors influencing consumer choice, followed by price and brand reputation. Incense sticks are widely preferred due to their convenience and variety, while benzoin resin is valued for its traditional and long-lasting aroma. The study concludes that manufacturers should focus on product quality, natural ingredients, and effective branding to meet consumer expectations.

Keywords: Consumer Preference, Pooja Products, Incense Sticks, Benzoin Resin, Buying Behavior, Chinnaselam, Religious Practices, Brand Awareness, Fragrance, Traditional Products

AI-DRIVEN BIOLOGICAL DATA ANALYSIS FOR SPORTS PERFORMANCE AND STRATEGIC DECISION-MAKING

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This research focuses on the application of Automated Artificial Intelligence (AI) in analyzing biological data for enhancing sports performance and decision-making. In recent years, several incidents of "sudden deaths" during gym workouts and recreational sports such as badminton, Kabaddi and weightlifting have raised serious concerns about undetected health risks during physical activity. In modern sports, wearable devices and sensors are used to collect real-time physiological data such as heart rate, oxygen consumption (VO_2 max), and muscle activity. This study examines how biological data can be captured and transmitted through mobile applications for continuous monitoring. It highlights the role of smart devices like fitness trackers, heart rate monitors, and GPS systems in performance analysis. It explores how coaches and analysts can use this data to optimize training strategies and improve athlete performance. A key focus of this study is the prevention of critical health risks during physical activity. Incidents of Sudden "Cardiac Arrest" among athletes highlight the importance of real-time monitoring systems. AI-driven models can help in early detection of abnormal physiological patterns and prevent life-threatening situations. The study also examines how mobile-based applications enable easy data collection and accessibility. Furthermore, it discusses the role of predictive analytics in identifying fatigue, stress, and injury risks. The findings indicate that AI-based biological analysis enhances safety, performance, and strategic planning. This research bridges the gap between technology, health, and sports analytics.

Keywords – Human death risk analysis, AI, Biological Data Analysis, Sports Performance, Wearable Technology, Real-Time Monitoring, Predictive Analytics, Athlete Safe

AI-BASED MARKETING IN FASHION: TURNING PERSONALIZATION INTO LOYALTY

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This paper investigates the influence of AI-driven personalized marketing on consumer purchase decisions within the fashion industry. Using a qualitative research design grounded in systematic literature synthesis, the study examines how message relevance and brand loyalty mediate the effects of AI personalization on consumer behaviour, and how consumer trust in AI moderates those effects. Findings reveal two distinct mediation pathways, a relevance pathway operating in immediate consumer interactions, and a loyalty pathway that builds cumulatively through repeated positive brand experiences. Consumer trust emerges as a critical moderating condition, amplifying the impact of personalization when high and undermining it when low. Grounded in the Technology Acceptance Model (TAM) and the Resource-Based View (RBV), the study advances theoretical understanding and offers practical guidance for fashion brands seeking to leverage AI personalization for both short-term sales performance and long-term consumer engagement.

Keywords: AI-driven marketing, personalized marketing, consumer behaviour, brand loyalty, consumer trust, fashion industry

BEHAVIORAL DETERMINANTS OF FINANCIAL WELL-BEING: THE ROLE OF FINANCIAL KNOWLEDGE, ATTITUDE, AND BEHAVIOUR

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Financial well-being has become an important measure of a person's general economic stability and quality of life, especially as money matters get more complicated and uncertain. The purpose of this study is to look into how financial information, attitude, and behavior affect each other and how they affect financial well-being. The study is based on the behavioral finance and suggests a Conceptual model in which financial knowledge and attitude affect financial behavior, which in turn affects financial well-being.

The study uses a quantitative research design and gets its main data from a structured questionnaire sent to a group of people from different demographic groups. A Likert scale is used to measure important things like financial information, attitude, behavior, and how well someone thinks their finances are doing. To check how factors are related to each other, statistical tools like reliability analysis, correlation, and regression are used.

People who know more about money and have a good attitude, behave responsibly with their money by saving, budgeting, and making smart investments, according to the results. These actions make a big difference in your financial well-being by making you feel safer about your money, lowering your stress, and giving you more faith in your ability to plan for the future.

This study adds to what's already been written by looking at behavioral factors that affect financial well-being. It also has practical implications for policymakers, financial educators, and people who want to make changes that will lead to better financial outcomes.

Keywords: Financial Well-being, Financial knowledge, Financial attitude, Financial Behavior

A STUDY ON EMPLOYEE PERSPECTIVE TOWARDS WORK FROM HOME PRACTICES

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The emergence of work from home (WFH) as a dominant employment paradigm has significantly transformed contemporary organizational practices, particularly in the context of recent global disruptions. This study seeks to critically examine employee perspectives towards WFH arrangements, with specific emphasis on dimensions such as productivity, work-life balance, job satisfaction, and overall well-being. The research adopts a descriptive approach, utilizing primary data collected through structured questionnaires administered to employees across diverse industrial sectors, complemented by secondary data from scholarly sources and institutional reports. The findings reveal that a considerable proportion of employees perceive WFH as an effective and flexible work arrangement that minimizes commuting demands and facilitates improved management of personal and professional responsibilities. A notable enhancement in productivity has been observed, largely attributed to reduced workplace distractions and a more individualized work setting. Additionally, the autonomy and flexibility inherent in remote work structures have contributed positively to employee job satisfaction. Nevertheless, the study also identifies several challenges associated with WFH practices. Key issues include diminished face-to-face interaction, a growing sense of social isolation, and difficulties in maintaining a clear demarcation between work and personal life. In certain instances, prolonged working hours and increased job demands have resulted in elevated stress levels and reduced psychological well-being. Furthermore, technical constraints and inadequate home office infrastructure have adversely affected employee efficiency and performance. The analysis further indicates that employee perceptions towards WFH are not uniform, but are influenced by factors such as job role, organizational support, technological accessibility, and individual preferences. While a segment of employees demonstrates a preference for fully remote work arrangements, others advocate for a hybrid model that integrates both on-site and remote working environments. The effectiveness of WFH is largely dependent on robust communication mechanisms, supportive managerial practices, and clearly defined organizational policies. In conclusion, WFH represents a dual-faceted phenomenon that offers both substantial benefits and notable challenges within the modern work landscape. While it enhances flexibility and operational efficiency, it also necessitates strategic interventions to address its inherent limitations. This study provides meaningful insights for organizations aiming to formulate adaptive and sustainable WFH policies that align with evolving employee expectations and organizational objectives.

Keywords: Work from Home ;Employee Perspective; Productivity; Work-Life Balance; Job Satisfaction; Remote Work; Psychological Well-being; Organizational Support ; Communication Efficiency.

DIGITAL TECHNOLOGIES AND CONSUMER BEHAVIOUR: THE MEDIATING ROLE OF TRUST IN THE DIGITAL MARKETPLACE

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The rapid advancement of digital technologies has significantly transformed the way consumers search for information, evaluate alternatives, and make purchasing decisions. Technologies such as social media platforms, artificial intelligence, big data analytics, and e-commerce systems have reshaped consumer interactions with brands and businesses. However, the effectiveness of these technologies largely depends on the level of trust consumers place in digital platforms and online transactions. Trust plays a crucial role in reducing perceived risk and enhancing consumer confidence in digital environments. This study examines the relationship between digital technologies and consumer behaviour, with particular emphasis on the mediating role of trust in the digital marketplace.

Using a conceptual research framework supported by existing literature, the study explores how digital technological advancements influence consumer perceptions, attitudes, and behavioural intentions. The findings indicate that trust significantly mediates the relationship between digital technologies and consumer decision-making processes. The study highlights the importance of transparency, security, and ethical digital practices in strengthening consumer trust. The research contributes to the growing literature on digital marketing and consumer behaviour while offering managerial implications for organizations seeking to build trustworthy digital ecosystems and sustain long-term relationships with consumers in the evolving digital marketplace.

Keywords: Digital technologies, Consumer behaviour, Trust, Digital marketing, E-commerce, Online consumer behaviour.

PREDICTING POLICYHOLDERS RENEWAL INTENTIONS THROUGH AI-DRIVEN SERVICE QUALITY AND CUSTOMER EXPERIENCE ANALYTICS.

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The rapid development of Artificial Intelligence (AI) has increased its implementation in the insurance industry by reducing the delays in claims settlement. The study examines how AI-driven service quality and customer experience influence policyholders' desire to renew with the same insurer. The study views AI-oriented service quality as a complex construct including policyholders' trust perceptions, emotions and Service quality touchpoints enhancing digital intelligence systems based on established concepts like SERVQUAL and customer experience.

The analysis defines AI-driven service quality as dependability, responsiveness, assurance, and empathy enhanced through intelligent technology. Customer experience informatics mediates policyholders' trust and experience across service quality touchpoints. A systematic questionnaire is employed to collect primary data from public sector health insurance policyholders in this quantitative research. A non-probability purposive sampling technique is applied. Public sector health insurance policyholders complete a structured questionnaire via WhatsApp groups, Emails, and Direct surveys, and are assessed using PLS-SEM version (4.1.1.6) and predictive analytics.

To identify, measure, and predict the factors that influence decisions on continuation or renewal of their insurance policies, through AI-enabled Digital platforms. Determines how enhanced service quality and claims experience can drive towards higher renewal intentions and customer retention. The findings suggest that AI-enabled service quality has a significant positive impact on customer experience, influencing renewal intentions.

Keywords: SERVQUAL, Customer Experience, AI-enabled digital platforms, Renewal Intentions and Health Insurance.

CURRENCY STABILITY, ENERGY TRANSITION AND MSME RESILIENCE IN EMERGING ECONOMIES: EVIDENCE FROM INDIA

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Currency volatility in emerging economies frequently originates from external commodity shocks and global capital flow swings. For oil-importing countries such as India, crude price surges widen import bills, place downward pressure on the domestic currency, and create inflationary pass-through that compresses firm margins. Micro, small and medium enterprises (MSMEs) are uniquely exposed because of limited hedging capacity, short-term working capital structures, and high energy intensity in several sectors. This paper develops a qualitative macro-financial framework that integrates currency stability, energy transition and MSME resilience. Drawing on policy documents, sectoral case evidence from Indian MSME clusters, and recent secondary data on renewable capacity growth, oil import dependency, currency movements and MSME credit, the study identifies the principal transmission channels from external energy shocks to firm-level stress. Four sectoral case studies (textiles in Tirupur, auto-components in Maharashtra, food processing in Gujarat, and a recent rooftop/aggregated solar initiative for C&I MSMEs) validate and enrich the conceptual mapping. The analysis shows that energy transition initiatives (renewable adoption, energy efficiency, domestic component manufacturing) operate as structural stabilizers that reduce exposure to imported fuel shocks and, over time, support currency resilience by narrowing current-account vulnerability. Policy recommendations emphasize coordinated industrial, energy and financial measures to protect MSME liquidity in future shock episodes.

Keywords: Currency Stability;Exchange Rate Volatility; Energy Transition; MSME Resilience; Emerging Economies; Indian Economy;

THE ROLE OF NEUROMARKETING STRATEGIES INFLUENCING CONSUMER BEHAVIOUR IN THE ADOPTION OF ELECTRIC CARS

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Neuromarketing is an emerging technique used by marketers to understand people's feelings and emotions. Feelings and emotions are mostly revealed when people see advertisements. Neuromarketing helps understand consumer emotions, attention, and memory while they make purchase decisions. Traditional marketing analyses people's choices through asking what they like and which aspect they like most, but in neuromarketing, marketers try to analyse the emotional reaction of the consumers. The electric car market is one of the booming industries in today's era, mainly because of its sustainability, but many people are still hesitating to own one. Because of this reason, there is a need for this study to understand the minds of the consumers better. This is where the concept of neuromarketing arises. The study mainly focuses on the role of neuromarketing strategies in influencing consumer behaviour and attitude towards electric cars. With the help of neuromarketing strategies, the study delves deep into the emotions of the consumers and also understands how it affects their purchase decisions. The paper uses a questionnaire to collect responses from electric car consumers to analyse and understand their views. The findings of the study reveal that the neuromarketing strategies play a significant role in understanding consumer behaviour. The advertisement create a emotional bonding to attract the attention of the people, which will result in gaining an advantage for electric cars. The study will provide insightful ideas to marketers and researchers in understanding consumers better and improving the adoption rate of electric cars.

Keywords: Neuromarketing, Consumer Behaviour, Electric cars, Consumer Attitude, Purchase Intention, Emotional Response, Adoption

PREDICTIVE HR ANALYTICS FOR PROMOTION READINESS: A FAIR TALENT MOBILITY PERSPECTIVE

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Many Organizations continue to make their Promotion Decisions based on fragmented criteria and subjective judgment; it often leads to issues of equity, fairness, and employee confidence in the promotion system.To identify employee related factors that influence Promotion Decisions and develop an objective framework for determining if or when someone is ready for Promotion.The Kaggle HR Promotions Dataset containing approximately 54,808 employees with data on Training, Performance, and Awards received by the employee as well as a New Record Reflecting this Activity.The research relies on two theories: Organizational Justice Theory, which describes fairness, and Human Capital Theory, which describes how employee qualifications (skills, performance, and experience) influence employee readiness for promotion.

A Python Analytical Workflow has been used including descriptive statistics; correlation analysis, logistic regression and Random Forest to analyze data and determine statistically significant and predictive factors driven by Promotion decisions.A Promotion Readiness Index (PRI) is proposed to convert three human resource (HR) indicators into a single score from 0 - 100 for promoting an employee. The use of this index will support HR decision-making.The findings indicate that training results, prior performance appraisals, awards earned by an employee and their "length of service" are among the highest ranked predictors of whether an employee is ready to be promoted and support the need for fair and objective internal talent mobility decisions.The framework will assist companies in making more transparent, fair, and data-driven promotion decisions and will also facilitate employee succession and mobility within the organization.

Keywords: Data-Driven Decision Making; HR Analytics; Organizational Justice; Promotion Readiness; Talent Mobility

SOCIAL MEDIA INFLUENCE ON ESG INVESTMENTS DURING GEO POLITICAL CONFLICTS

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This study explores the influence of social media on ESG (Environmental, Social, and Governance) investment decisions during periods of geopolitical conflicts. With the growing prominence of digital platforms such as X, Reddit, Telegram, news media, and YouTube, investor behaviour is increasingly shaped by real-time information, opinions, and sentiment shared online. At the same time, geopolitical conflicts create uncertainty in financial markets and raise ethical considerations, particularly affecting ESG-oriented investments.

This conceptual paper reviews existing literature on ESG investing, social media influence, and investor behaviour under conditions of market uncertainty. It examines how social media acts as a catalyst in shaping investor perceptions, facilitating rapid information dissemination, and amplifying emotional responses during geopolitical tensions. The study highlights that, during such periods, investors may reassess their ESG preferences based on narratives related to sustainability, ethics, and corporate responsibility.

The paper proposes a conceptual linkage between social media sentiment and ESG investment decisions, emphasizing the role of information flow, behavioural biases, and digital influence. It concludes by identifying gaps in the existing literature and suggesting directions for future empirical research.

Keywords: Investment Behaviour, Geopolitical Conflicts, Social media, ESG, Green Finance.

EMPLOYEE BURNOUT AND WORK PRESSURE IN HYBRID WORK CULTURE: A RESERACH ON HR INTERVENTIONS

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The rapid adoption of the hybrid work model has significantly transformed organizational dynamics, offering flexibility while simultaneously intensifying challenges related to employee well-being. This study investigates the determinants of employee burnout and work pressure within hybrid work environments, with a specific focus on the role of Human Resource (HR) interventions. A descriptive research design employed to systematically examine employee perceptions and experiences. Primary data were collected through a structured questionnaire administered to a sample of 82 employees engaged in hybrid work across diverse sectors. The analysis identifies critical factors contributing to burnout, including increased workload, digital fatigue, role ambiguity, and inadequate work-life boundaries. Furthermore, the study evaluates the effectiveness of HR strategies such as flexible work arrangements, mental health support initiatives, employee engagement practices, and communication transparency. The findings indicate that well-structured HR interventions significantly alleviate stress levels, enhance employee satisfaction, and improve organizational productivity. The study contributes to the growing body of literature on hybrid work by emphasizing the necessity for adaptive and employee-centric HR policies. It concludes that organizations must proactively integrate well-being frameworks to sustain workforce performance and resilience in evolving work environments. Keywords: Hybrid Work Model, Employee Burnout, Work Pressure, HR Interventions, Digital Fatigue, Work-Life Balance, Employee Well-being, Organizational productivity.

Keywords:employee engagement; organizational productivity

ESG PERFORMANCE AND SUSTAINABILITY ORIENTATION AS DRIVERS OF GLOBAL EXPANSION IN THE ENERGY SECTOR

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This chapter examines the role of Environmental, Social, and Governance (ESG) performance and sustainability orientation in driving global expansion within the energy sector. In response to increasing regulatory pressures, environmental challenges, and stakeholder expectations, ESG has evolved from a compliance-based framework into a strategic tool that shapes corporate competitiveness and long-term value creation. The study adopts a mixed-method research design, combining theoretical perspectives with case study analysis of leading global energy companies that have integrated sustainability into their operational and strategic models. The findings indicate that strong ESG performance positively influences firms' global expansion capabilities by enhancing access to international capital markets, strengthening investor confidence, and enabling compliance with diverse regulatory environments. Higher ESG ratings are also associated with greater organizational resilience in managing geopolitical risks, energy transition challenges, and market uncertainties. Furthermore, ESG practices contribute to innovation, operational efficiency, and sustainable resource management, which are essential for maintaining a competitive advantage in a dynamic global energy landscape. However, the chapter cautions against superficial ESG adoption, such as greenwashing, which can damage corporate credibility and erode stakeholder trust. It emphasizes the importance of embedding transparent and measurable ESG commitments into core business strategies rather than treating them as symbolic initiatives. Overall, the study highlights ESG as a strategic enabler of sustainable growth and global competitiveness. It provides valuable insights for policymakers, investors, and corporate leaders, underscoring the need to align economic objectives with environmental stewardship, social responsibility, and sound governance practices.

Keywords: Governance; corporate competitiveness

A STUDY ON BRAND CUSTOMER SATISFACTION TOWARDS THE USAGE OF COOKING GAS IN CHENNAI

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Liquefied Petroleum Gas (LPG) has become an essential source of domestic fuel in urban households due to its efficiency, convenience, and relatively cleaner nature compared to traditional fuels. In a metropolitan city like Chennai, the usage of cooking gas plays a vital role in meeting daily household energy needs. This study aims to analyse the level of customer satisfaction towards LPG usage and identify the key factors influencing consumer perceptions and preferences.

The research is based on both primary and secondary data. Primary data were collected through structured questionnaires distributed among LPG users across Chennai, while secondary data were gathered from journals, reports, and previous studies. The study focuses on variables such as ease of booking, delivery timeliness, safety awareness, price affordability, customer service, and overall service quality. Findings from similar studies indicate that customer satisfaction in LPG services is largely influenced by service-related factors such as prompt delivery, ease of booking, and safety measures, while customer care services often show relatively lower satisfaction levels. Additionally, reliability, performance, and responsiveness of gas agencies play a significant role in shaping customer perception .In the context of Chennai, recent issues such as booking system disruptions and supply delays have also impacted consumer satisfaction levels and highlighted the importance of efficient service delivery systems The study concludes that while most consumers are satisfied with the basic utility and safety of LPG, improvements are required in customer support, timely delivery, and communication services. The research provides valuable insights for LPG providers to enhance service quality and strengthen customer relationships, thereby improving overall satisfaction levels.

Keywords: Customer Satisfaction; Consumer Perception; Delivery Efficiency; Safety Awareness; Customer Support

A STUDY ON SUPPLY CHAIN MANAGEMENT PRACTICES

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Supply Chain Management (SCM) is a vital function in any manufacturing organisation, ensuring the smooth flow of raw materials, production processes, and finished goods delivery to customers. This study examines the supply chain management practices followed in a manufacturing firm located in Chennai, Tamil Nadu, with a focus on procurement, supplier management, inventory control, production planning, logistics, and technology integration. Primary data were collected from 120 respondents using a structured questionnaire. Statistical tools including percentage analysis, chi-square test, and Karl Pearson's correlation analysis were employed. The findings reveal that the firm maintains an efficient and well-integrated supply chain system supported by ERP/SAP technology. The chi-square test confirmed a significant relationship between procurement practices and supply chain efficiency. Correlation analysis indicated a strong positive relationship ($r = 0.95$) between transportation efficiency and delivery schedule performance. The study concludes with actionable suggestions to further strengthen supply chain performance.

Keywords: Supply Chain Management; Procurement; Inventory Management; Logistics; Manufacturing.

A STUDY ON JOB SATISFACTION IN VIJAY GARMENTS LIMITED, CHENNAI

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Employee job satisfaction is a crucial factor that influences productivity, employee retention, and the overall success of an organization. This study focuses on analyzing the level of job satisfaction among employees working in Vijay Garments Limited, Chennai. The main objective of the study is to understand the factors affecting employee satisfaction, including work environment, salary and benefits, recognition, workload, and organizational support. The research is based on primary data collected through structured questionnaires distributed to employees of the organization. A descriptive research design is used, and statistical tools such as percentage analysis are applied to interpret the data collected from the respondents. The study evaluates various aspects of job satisfaction and identifies areas where improvements can be made. The findings reveal that factors such as fair compensation, supportive management, work-life balance, and recognition for work play a significant role in improving employee satisfaction. Employees who feel valued and supported by the organization tend to perform better and show higher commitment to their work.

The study concludes that maintaining a positive work environment and focusing on employee welfare are essential for improving job satisfaction and enhancing organizational performance in Vijay Garments Limited.

Keywords: Job Satisfaction; Employee Satisfaction; Work Environment; Employee Motivation.

A STUDY ON HR ANALYTICS EFFECT ON ORGANIZATIONAL PERFORMANCE

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The function of HR analytics in enhancing organizational performance is investigated in this study. Organizations are using analytics to make well-informed human resource choices as employee data becomes more readily available. The study investigates the role that HR analytics plays in attracting talent, retaining employees, and increasing productivity. Data was gathered from HR professionals in a variety of businesses using both qualitative and quantitative methodologies. The results show that companies that use HR analytics have better decision-making, lower employee attrition, and more productive workers. According to the study's findings, HR analytics is a strategic instrument that improves organizational efficacy and gives businesses a competitive edge in the contemporary corporate world.

Keywords: organizational performance; HR analytics

A STUDY ON ORGANIZATIONAL CULTURE AND EMPLOYEE JOB SATISFACTION

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This study examines the relationship between organizational culture and employee job satisfaction with special reference to Diamond Engineering Company. Organizational culture plays a vital role in shaping employee attitudes, behavior, and overall performance within an organization. A positive and supportive work environment contributes significantly to higher levels of job satisfaction among employees. The main objective of this study is to analyse how different elements of organisational culture, such as leadership style, communication patterns, work environment, and organisational values, influence employee satisfaction. Both primary and secondary data were used for the research. Primary data was collected through structured questionnaires distributed among employees, while secondary data was gathered from company records, journals, and websites. The findings of the study reveal that a healthy organisational culture enhances employee motivation, commitment, and productivity. It was observed that employees who perceive their workplace culture as positive tend to show higher job satisfaction and lower turnover intentions. However, certain areas such as communication gaps and work pressure were identified as factors affecting satisfaction levels. The study concludes that improving organisational culture through effective management practices, employee engagement, and transparent communication can lead to increased job satisfaction. Recommendations are provided to help the company strengthen its culture and create a more employee-friendly work environment.

Keywords: Employees, Organization, Motivation, Performance, Leadership, Communication, Environment, Values, Behaviour, Productivity, Commitment.

WOMEN IN LEADERSHIP: SHAPING WORK PATIENCE AND COMMITMENT AMONG GENERATION Z

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With the arrival of Generation Z workers, the types of workplace norms that are expected have changed quite substantially. The biggest changes are probably related to work patience and the level of organizational commitment. This research paper looks into how women's leadership styles mainly ethical leadership and servant leadership lead Generation Z employees to having work patience and being organizationally committed. This new generation is known for changing work attitudes and expectations.

Considering the leadership and organizational behaviour literature as the main source of knowledge, the research explores ethical and servant leadership as predictors being important. A quantitative research approach was selected, and the data collection was done through a structured survey of Generation Z workers under women managers in different companies. Purposive sampling was used at first to find suitable respondents, then snowball sampling was used to increase the sample size. Validated and previously proven scales were employed to gauge leadership styles, work patience, and organizational commitment.

The analysis of the data was done by means of Partial Least Squares Structural Equation Modelling (PLS-SEM). The outcomes are showing that ethical leadership has very strong positive effects not only on work patience but also on organizational commitment. Servant leadership, on the other hand, demonstrates a positive effect only on organizational commitment and the influence on work patience is not significant.

The interpretations of the results imply that both leadership styles matter however ethical leadership is the one that performs more consistently in shaping work patience and organizational commitment among Gen z.

Keywords: Generation-Z; Work Patience; Organizational Commitment; Women Leaders; Servant Leadership; Ethical Leadership

A STUDY ON BRAND AWARENESS IN THE LPG INDUSTRY

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The Liquefied Petroleum Gas (LPG) industry plays a vital role in meeting the energy needs of households, particularly in developing countries like India. With increasing competition among LPG providers, brand awareness has emerged as a key factor influencing consumer preference and decision-making. This study aims to examine the level of brand awareness in the LPG industry and its impact on consumer behaviour.

The research is based on primary data collected through structured questionnaires from LPG users. A descriptive research design is adopted, and statistical tools such as percentage analysis and correlation are used to interpret the data. The study explores various dimensions of brand awareness, including brand recognition, recall, perceived quality, and the influence of promotional activities.

The findings indicate that higher brand awareness significantly influences consumer trust, satisfaction, and loyalty. Factors such as advertising, word-of-mouth communication, service quality, and safety perception contribute to strengthening brand awareness. It is also observed that consumers tend to prefer well-known and trusted LPG brands over lesser-known alternatives, even when price differences exist.

The study concludes that enhancing brand awareness through effective marketing strategies and consistent service delivery is essential for gaining a competitive advantage in the LPG industry. Companies should focus on customer engagement, safety communication, and digital outreach to improve brand visibility and consumer trust.

Keywords: Brand Awareness; Consumer Behaviour; Brand Loyalty; Marketing Strategy

A STUDY ON ENHANCING OCCUPATIONAL HEALTH AND SAFETY FOR WOMEN IN AGARBATHI PRODUCTION UNITS.

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The Agarbathi Manufacturing Sector provides vital employment opportunities for women in rural and semi-urban areas. However, many workers face daily health risks such as exposure to dust, repetitive physical strain, poor ventilation, and long working hours. These conditions often lead to respiratory problems, skin issues, and physical discomfort, affecting their overall well-being.

This project focuses on improving the health and safety of women workers through a practical and easy-to-understand training program. The training introduces workers to the factory layout, safety zones, emergency exits, and evacuation procedures to ensure they are prepared during emergencies. It also includes basic first-aid training, such as handling burns and minor injuries.

In addition, the project promotes simple health and hygiene practices and encourages regular medical check-ups for early detection of health issues. Overall, the initiative aims to create a safer, healthier, and more supportive work environment for women workers.

Keywords: Occupational Health; Hygiene Practices.

A STUDY ON IMPACT OF TRAINING ON EMPLOYEE PERFORMANCE

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Training is a vital component of human resource development that significantly influences employee performance and organizational success. In today's competitive and rapidly changing business environment, organizations must continuously upgrade the skills and knowledge of their employees to maintain efficiency and productivity. This study focuses on analysing the impact of training on employee performance, with particular emphasis on how structured training programs contribute to improving employee competencies, job efficiency, and overall work quality.

The primary objective of this research is to examine the relationship between training and employee performance and to evaluate the effectiveness of training programs in enhancing employee productivity. The study is based on primary data collected through structured questionnaires distributed among employees across different departments. Secondary data were also used to support the research through journals, articles, and organizational reports. Various statistical tools such as percentage analysis and graphical representation were used to interpret the data and draw meaningful conclusions.

The findings of the study indicate that training has a positive and significant impact on employee performance. Employees who undergo regular training programs demonstrate improved technical and interpersonal skills, increased confidence, and better adaptability to changes in the workplace. Training also enhances employees' motivation and job satisfaction, which ultimately leads to higher productivity and better organizational outcomes. Furthermore, the study reveals that well-designed training programs help in reducing errors, improving efficiency, and fostering innovation among employees.

However, the effectiveness of training depends on several factors such as the quality of training content, the methods used, and the frequency of training sessions. Organizations that invest in continuous learning and development initiatives are more likely to achieve long-term success and maintain a competitive advantage. The study suggests that organizations should adopt need-based and employee-oriented training programs to maximize the benefits of training.

Keywords: Employee Training, Employee Performance, Skill Development, Training and Development

A STUDY ON THE IMPACT OF HUMAN RESOURCE PRACTICES ON ORGANIZATIONAL EFFICIENCY

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This study examines the impact of Human Resource (HR) practices on organizational efficiency at Lifecell International Pvt. Ltd., Chennai. Human Resource practices such as recruitment and selection, training and development, performance appraisal, compensation management, employee engagement, and statutory compliance play a crucial role in enhancing workforce productivity and operational effectiveness. The primary objective of the study is to analyze how HR practices contribute to improving organizational efficiency within the company. The research is based on both primary and secondary data. Primary data was collected through a structured questionnaire distributed among employees, while secondary data was obtained from company records, journals, and relevant literature. The findings indicate that effective HR practices positively influence employee performance, job satisfaction, and overall organizational efficiency. The study concludes with suggestions to strengthen HR systems for sustained organizational growth and competitiveness.

Keywords: Human Resource Practices; Organizational Efficiency; Employee Performance; Performance Appraisal; Job Satisfaction; Workforce Productivity.

A STUDY ON IMPACT OF ORGANIZATIONAL CULTURE ON EMPLOYEE RETENTION

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This study examines the impact of organizational culture on employee retention with reference to AARAA Infrastructure Pvt Ltd. Organizational culture plays a significant role in shaping employees' attitudes, behaviour's, and level of commitment toward their organization. A positive work culture helps employees feel valued, motivated, and satisfied, which ultimately encourages them to remain with the organization for a longer period.

The main objective of this study is to analyse how different aspects of organizational culture such as leadership style, communication, work environment, recognition, and career development opportunities influence employee retention. In industries like construction and infrastructure, retaining skilled employees such as engineers, supervisors, and technical staff is essential for the successful completion of projects and overall organizational growth.

The findings of the study highlight that a supportive organizational culture, effective leadership, employee recognition, and opportunities for professional growth play an important role in improving employee satisfaction and reducing employee turnover. The study concludes that organizations that maintain a positive and employee-friendly culture are more successful in retaining their workforce and achieving long-term organizational success.

Keywords: Organizational Culture; Employee Retention; Employee Motivation; Organizational Commitment; Human Resource Management.

A STUDY ON THE PERCEPTION AND ATTITUDE OF GENERATION Z CANDIDATES TOWARD AI DRIVEN RECRUITMENT IN THE TALENT ACQUISITION PROCESS

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The rapid integration of Artificial Intelligence (AI) into recruitment processes has significantly transformed talent acquisition practices, particularly influencing the perceptions and attitudes of Generation Z candidates. This study aims to examine how Generation Z perceives AI-driven recruitment tools, including automated resume screening, chatbots, and algorithm-based assessments, and how these technologies impact their trust, fairness perceptions, and overall candidate experience. Using a structured questionnaire and quantitative analysis methods such as correlation and regression, the research identifies key factors shaping candidate attitudes, including transparency, perceived bias, ease of use, and efficiency. The findings reveal that while Generation Z appreciates the speed, convenience, and innovation associated with AI driven recruitment, concerns regarding lack of human interaction, data privacy, and algorithmic bias persist. The study highlights the importance of balancing technological advancement with human-centric approaches to enhance candidate satisfaction and trust. The results provide valuable insights for organizations aiming to optimize AI-based hiring strategies while aligning them with the expectations and preferences of emerging workforce entrants.

Keywords: Artificial Intelligence; Talent Acquisition; Candidate Perception; Recruitment Technology; Digital Hiring.

A STUDY ON EMPLOYEES WORK-LIFE BALANCE AND ITS IMPACT ON EMPLOYEES PERFORMANCE IN FMCG COMPANIES

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Work-life balance has emerged as a significant concern for organizations and employees in the modern business environment. Rapid technological developments, globalization, and increased competition have resulted in higher work demands and longer working hours. Employees often struggle to maintain an effective balance between their professional responsibilities and personal life commitments. The Fast-Moving Consumer Goods (FMCG) sector, known for its fast-paced operations and competitive environment, places considerable pressure on employees to meet organizational targets and maintain productivity. This study examines the relationship between employees' work-life balance and their performance in FMCG companies. The research adopts a descriptive research design and utilizes a quantitative approach to analyse employee perceptions regarding work-life balance and its influence on their job performance. Primary data was collected using a structured questionnaire administered to employees in selected FMCG organizations. The findings of the study indicate that a healthy work-life balance significantly contributes to employee satisfaction, motivation, productivity, and organizational commitment. The study suggests that organizations should adopt flexible work policies, employee welfare programs, and supportive leadership practices to enhance employee well-being and performance. The research highlights the importance of organizational initiatives in helping employees achieve balance between their professional and personal lives.

Keywords: Work-life balance; employee performance; FMCG sector; employee well-being; job satisfaction.

A STUDY ON THE IMPACT OF WORK CULTURE ON EMPLOYEE RETENTION

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Employee retention has become a pressing concern for organizations striving to maintain a competitive edge in today's dynamic business environment. Work culture—defined by organizational values, leadership styles, communication practices, employee engagement, and opportunities for growth—plays a decisive role in influencing retention. Conversely, toxic or unsupportive cultures often lead to higher turnover, reduced productivity, and increased recruitment costs. By analyzing existing literature and case studies, the research underscores the correlation between positive work culture and employee loyalty, suggesting that fostering inclusivity, transparency, and professional development can significantly enhance retention. This study examines the relationship between work culture and employee retention, drawing insights from literature and case analyses to highlight how inclusivity, recognition, transparency, and professional development contribute to workforce stability. The findings emphasize that cultivating a healthy work culture is not only essential for retaining talent but also for enhancing organizational performance and sustainability also it aims to provide actionable insights for organizations seeking to build sustainable human resource practices and strengthen their competitive advantage through a stable workforce.

Keywords: Work Culture, Employee Retention; Organizational Values; Leadership Styles; Employee Engagement; Workforce Stability

A STUDY ON IMPACT OF EMPLOYEE RETENTION IN SUSTAINABLE EMPLOYEE PERFORMANCE

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In today's competitive business environment, employee retention has become a cornerstone for achieving sustainable performance. Employee retention plays a pivotal role in sustaining organizational performance and ensuring long-term success. High turnover rates can negatively impact productivity, increase recruitment costs, and weaken organizational knowledge, while effective retention strategies foster loyalty, job satisfaction, and resilience. This study investigates the impact of employee retention on sustainable employee performance, highlighting how practices such as career development, supportive work culture, and recognition systems contribute to improved outcomes. The findings emphasize that sustainable performance is achieved not only through individual capabilities but also through organizational commitment to employee well-being and engagement. Ultimately, employee retention emerges as a strategic imperative for building a stable, innovative, and high-performing workforce in dynamic business environments.

Keywords: Employee Retention; Sustainable Performance; Job Satisfaction; Organizational Commitment; Employee Engagement

A STUDY ON TRAINING PLAN AND EFFECTIVENESS WITH REFERENCE TO MITHRON INDIA SMART SERVICES PVT LTD

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Training and development play a significant role in improving employee's knowledge, skills, and overall job performance. Organizations design structured training programs to help employees adapt to new technologies, improve productivity, and achieve organizational goals. The effectiveness of such training programs must be evaluated to understand their impact on employee performance and organizational success.

The main objective of this study is to analyse the existing training plans followed in the organization and evaluate their effectiveness among employees. The study also aims to identify training needs, measure employee satisfaction with training programs, and examine the impact of training on employee skills, knowledge, and job performance. Both on-the-job and off-the-job training methods are considered to understand their contribution to employee development.

The findings of the study indicate that effective training programs significantly improve employee skills, job performance, and productivity. The results also highlight that well-planned training programs enhance employee satisfaction and contribute to overall organizational development. The study concludes that continuous training and proper evaluation of training effectiveness are essential for improving employee competencies and achieving organizational growth.

An effective training plan is a strategic tool that enhances employee skills, improves job performance, increases satisfaction, and drives overall organizational success.

Keywords: On-the-job; Off-the-job training; organizational development

A STUDY ON IMPACT OF HR TECHNOLOGIES ON EMPLOYEES WORK LIFE

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Human Resource (HR) technologies has become an important part of modern organizations and plays a major role in managing employees effectively. This study examines the impact of HR technologies on employees' work life. HR technologies includes systems such as digital attendance, online leave and payroll management, HR portals, performance management systems, and employee self-service applications. These tools are designed to make HR processes faster, more accurate, and more transparent.

The main objective of this study is to analyze how the use of HR technologies influences employees' daily work activities, work efficiency, convenience, and overall job satisfaction. The study also explores whether HR technologies helps in reducing manual work, saving time, minimizing errors, and improving communication between employees and the HR department. In addition, the study considers employees' attitudes towards the adoption of HR technologies and the challenges they may face while using these systems, such as lack of training, technical issues, or resistance to change.

The study is based on data collected from employees using questionnaires and personal interactions. The findings of the study are expected to help organizations understand how HR technologies affects employees work life and identify ways to improve its implementation. Effective use of HR technologies can lead to improved employee satisfaction, better work-life balance, and overall organizational efficiency.

Keywords: Human Resource Technologies, Employees' Work Life, Digital HR Systems, Job Satisfaction, Work Efficiency, Employee Self-Service, HR Automation, Work-Life Balance.

A STUDY ON CONSUMER AWARENESS OF LPG SAFETY MEASURES AND ITS IMPACT ON BRAND CHOICE

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Liquefied Petroleum Gas (LPG) has become a primary source of cooking fuel in households due to its convenience, efficiency, and environmental benefits. However, as LPG is highly inflammable, its safe usage depends significantly on the awareness level of consumers regarding safety measures. Proper handling, installation, regular maintenance, and knowledge of emergency procedures are essential to prevent accidents such as gas leaks and fire hazards.

This study focuses on analysing the level of consumer awareness of LPG safety practices and examining how this awareness influences their choice of brand, with special reference to TotalEnergies. The research is based on primary data collected through structured questionnaires distributed among LPG users. The study adopts a descriptive research design and uses simple statistical tools such as percentage analysis and correlation to interpret the data.

The findings reveal that consumers with higher awareness of LPG safety measures tend to exhibit greater trust and confidence in their LPG provider. Awareness sources such as company campaigns, digital platforms, and word-of-mouth communication play a significant role in educating consumers. It is also observed that safety perception has a direct impact on brand preference, with many consumers prioritizing safety over factors such as price and availability.

Furthermore, brands that actively promote safety awareness and provide efficient customer support services are more likely to build strong customer relationships and enhance brand loyalty The study concludes that consumer awareness of LPG safety measures is a critical determinant of brand choice. Increasing awareness through continuous education and effective communication strategies can significantly improve customer satisfaction and strengthen brand positioning in the competitive LPG market.

Keywords: LPG Safety Awareness, Consumer Behaviour, Brand Choice, Customer Satisfaction, Safety Measures, TotalEnergies, Brand Loyalty, Household Energy

A STUDY ON SERVICE BEHAVIOUR OF HOSPITAL STAFF WITH REFERENCE TO TAGORE MEDICAL COLLEGE AND HOSPITAL

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The healthcare sector is a highly service-oriented industry where the quality of patient care depends not only on medical treatment but also on the service behaviour of hospital staff. Service behaviour includes courtesy, empathy, communication skills, responsiveness, professionalism, and ethical conduct displayed by both clinical and non-clinical staff while interacting with patients and their attendants. In a hospital environment, these behavioural aspects play a vital role in shaping patient perceptions, satisfaction levels, and overall trust in healthcare services. Hence, understanding and evaluating service behaviour has become an important area of study in hospital management. This study aims to examine the service behaviour of hospital staff in Tagore Medical College and Hospital and to analyze its impact on patient satisfaction and service quality. The research focuses on key behavioural dimensions such as staff attitude, communication effectiveness, promptness in service delivery, respect towards patients, and willingness to assist. The study also evaluates how these behavioural factors influence patients' overall experience and perception of the hospital.

Keywords: Service Behaviour, Hospital Staff, Patient Satisfaction, Healthcare Service Quality, Staff–Patient Interaction, Hospital Management, Service Excellence.

A STUDY ON DIGITAL MARKETING STRATEGY WITH REFERENCE TO AARAA INFRASTRUCTURE PVT LTD

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Digital marketing has become a vital tool for businesses to enhance their market presence, customer engagement, and overall growth. This study focuses on analyzing the digital marketing strategies adopted by AARAA Infrastructure Pvt. Ltd.,a company operating in the infrastructure sector.

The primary objective of the research is to evaluate the effectiveness of the company's current digital marketing practices and identify areas for improvement. The study examines various digital channels such as social media platforms, search engine optimization (SEO), online advertising, and website performance.

Both primary and secondary data have been used for analysis, including surveys, company records, and online sources. The research highlights how digital marketing strategies influence brand awareness, lead generation, and customer relationship management within the organization.

The findings suggest that while AARAA Infrastructure Pvt. Ltd. has initiated digital marketing efforts, there is significant scope for enhancement in terms of content strategy, audience targeting, and consistent online engagement.

The study concludes with recommendations to improve digital presence and optimize marketing outcomes through effective use of digital tools and analytics.

Keywords: Digital Marketing; Online engagement

CHALLENGES IN MOOC ADOPTION AMONG ENGINEERING STUDENTS: A STUDY IN HIGHER EDUCATION

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Education is the most powerful tool which can use to change the World - Nelson Mandela Education is an important tool which is very useful in everyone's life. Education differentiates us from other living beings on earth. It empowers humans and gets them ready to face challenges of life efficiently. Education mould people a better person and enhances their intellect to learn various skills. It ensures the individual growth in the Society. As said by Kothari Commission (1964 – 1966) Destiny of India is being shaped in their Classrooms, Implementing a sound education system based on a holistic approach towards learning is quintessential for ensuring that every student gets the best learning environment to flourish. Technology be a ever growing sector as it has brought about a paradigm shift in teaching-learning pedagogies in 21th Century. Technology expands access to information and resources, allowing for more diverse and personalized learning experiences. Online Learning is the need of the hour in a young country such as India, as it makes higher education available to aspiring youth as well as adult learners, and reaches out to the unreached remotest corners of this vast nation. Online learning as defined by (Singh & Thurman, 2019),1 "learning experiences in synchronous or asynchronous environments using different devices (e.g., mobile phones, computers, laptops, etc.) with internet access. It is one of the best modes of increasing the GER (Gross Enrolment Ratio) in higher education at almost one fifth the cost. MOOC platforms influenced the academic world through many conceptual and technological changes. Many people considered growth of MOOC as a big advancement and opportunity for upgrading their knowledge. Major technological advancement and virtual reality could revolutionize MOOC's future by inclusion of courses to impart knowledge and skills to meet out industrial requirements.

Online education platforms are great national predominant contributors for making available this self learning education to the physically, socially, financially and locationally challenged students of our country. Technology has brought teaching-learning with new pedagogical techniques facilitates online education familiar. Hew, K.F. & Cheung, W.S. (2014)2 emphasis in his study by stating MOOCs are effective in knowledge acquisition and skill development, especially for self-motivated learners. MOOCs are effective when learners are self-disciplined and courses are engaging, but improvements in interaction are needed. The study concluded that course completion rates are low due to lack of commitment and interaction. Although online education is considered one of the most relevant options available to improve the status of higher education, this kind of critical quality-related issues which need to be addressed. Therefore this research is a small attempt towards assessing current scenario of online education and its employability scope among students. This paper highlights its perception and employability element of online education among students and Implication of MOOC – platforms in upskillingstudents knowledge to improve their employability quotient by making it at par with industry standards.

Key Words: Online Education, MOOC courses, Perception, Self Learning Knowledge.

EVALUATING INSTITUTION-INDUSTRY LINKAGES: CHALLENGES AND SKILL ENHANCEMENT IN SELECTED ENGINEERING COLLEGES IN TAMIL NADU

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In today's knowledge-driven economy, collaboration between academic institutions and industries is necessary for modernization, trade, and industry development. Industry-university collaborations have a long tradition globally Academic institutions like universities are imperative in accomplishing financial escalation in knowledge-based situations . The link between educational institutions and industries, particularly engineering, is crucial in bridging the gap between academic knowledge and practical applications

Such collaborations can enhance the quality of engineering education by integrating real-world industry practices into the educational curriculum, thereby improving graduates' employability and skills. Engineering colleges can benefit significantly from these linkages through various programs, including industry-sponsored projects, internships, workshops, guest lectures, and collaborative research. These interactions offer students invaluable practical exposure and hands-on experience, enriching their learning experience and keeping faculty updated with recent industry trends and technologies. Furthermore, through collaborations, industries access new talent, innovative ideas, and potential solutions to technical challenges. This study aims to evaluate the current state of institution-industry linkages in engineering colleges in Tamil Nadu, identify challenges in establishing and maintaining these collaborations, and assess their impact on students' skill enhancement and employability.

This study investigates academia-industry collaborations in top-ranked engineering institutions in Tamil Nadu, using primary data collected through a structured questionnaire from 380 respondents across the Indian Institute of Technology Madras, PSG College of Technology, and Vellore Institute of Technology etc., A proportionate stratified random sampling technique ensured equal selection probability based on the student population from each institution, conducted between February and July 2025. The study captures respondents' perspectives on the necessity of collaborations, skills enhancement, and challenges. Addressing the identified challenges is crucial for developing structured mechanisms that foster long-term collaboration between academia and industry, leading to improved educational outcomes, innovation, and mutual benefits. This study delves insights into the barriers hindering effective collaboration and their impact on skill development, vital for regional economic growth and students' employability.

Keywords: institution-industry linkage; skill development; engineering education; collaborative environments; economic growth; industry-integrated education.

A STUDY ON ORDER PROCESSING SYSTEM AND DELIVERY CYCLE TIME IN K WORLDWIDE EXPRESS

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The study examines the order processing system and delivery cycle time at K Worldwide Express, a courier and logistics company based in Ekkatuthangal, Chennai. In the competitive logistics sector, operational efficiency in order processing is a critical determinant of customer satisfaction and business performance. The study adopted a descriptive research design. Primary data were collected through structured questionnaires administered to 130 employees across departments including operations, booking, documentation, transportation, and customer service. Statistical tools including percentage analysis, Chi-Square test, Pearson Correlation, and Weighted Average were used for analysis.

Key findings reveal that system-related problems are the primary cause of delays (43%), followed by manpower shortages (25%) and coordination gaps (18%). The Chi-Square test confirms a significant relationship between years of experience and order processing time. Pearson Correlation ($r = 0.579$) shows a moderate positive relationship between technology usage and order processing efficiency. The Weighted Average score of 3.28 indicates that the system is perceived as moderately effective. The study recommends adopting advanced logistics software, digitizing documentation, and strengthening inter-departmental coordination to reduce delivery cycle time and improve service performance.

Keywords: order processing system, delivery cycle

LEVERAGING HR ANALYTICS FOR STRATEGIC DECISION-MAKING: A DATA-DRIVEN APPROACH TO WORKFORCE OPTIMIZATION

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The growing digitalization of organizations has stimulated the uptake of Human Resource (HR) analytics as anevidence-based decision-making tool. HR analytics allows organizations to convert workforce data intoactionable information, thus optimizing the workforce and organizational performance. This theory paper willanalyze the use of HR analytics in strategic decision making and the role it plays in optimizing the workforce.The research is based on the theoretical insights of the Resource-Based View (RBV), Human Capital Theory,and Decision Theory and suggests a holistic model connecting HR analytics capabilities and workforceoutcomes via strategic decision-making. The article summarizes the literature and outlines critical dimensionssuch as predictive analytics, segmentation of workforce and performance analytics. It further discusseschallenges, implications, and future research directions. The paper can also benefit the expanding area of peopleanalytics by providing a comprehensive conceptual framework to researchers and practitioners

Keywords: HR Analytics, Strategic Decision-Making, Workforce Optimization, People Analytics, Data-Driven HR

A STUDY ON INVESTMENT PREFERENCES TOWARDS REAL GOLD VS DIGITAL GOLD

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Gold has always been seen as a safe and trustworthy way to invest, especially in India where it is not just an asset but also part of tradition and culture. Nowadays, with the growth of technology, a new option called digital gold has become popular. It allows people to buy and store gold online easily, with less cost and without worrying about physical storage.
This study looks at how people choose between real (physical) gold and digital gold. It mainly tries to understand what factors influence their decisions. The research is based on data collected from people through a questionnaire, along with information from books, articles, and previous studies.

The study focuses on important factors like safety, how easily the investment can be converted into cash (liquidity), returns, convenience, and risk. The results show that many traditional investors still prefer real gold because they like owning something physically and have an emotional attachment to it. On the other hand, younger people and those comfortable with technology are more interested in digital gold because it is easy to buy, flexible, and convenient.

In conclusion, both real gold and digital gold have their own benefits. People's choices depend on their age, knowledge, habits, and personal preferences. The study also suggests that improving financial awareness can help people make better investment decisions in today's changing financial world.

Keywords: Real Gold, Digital Gold, Investment Preference, Investor Behavior, Financial Technology, Risk Perception, Liquidity, India

A STUDY ON EMPLOYEE ATTRITION ANALYSIS

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Employee attrition is a critical concern for organizations, as it directly impacts productivity, operational efficiency, and overall business performance. Attrition refers to the loss of employees due to various reasons such as resignation, retirement, or termination. A high attrition rate can lead to increased hiring and training costs, disruption in workflow, and loss of valuable skills and experience. Hence, managing and reducing employee attrition has become an essential function of human resource management.With the growing importance of data-driven decision-making, HR analytics has become a key tool in understanding workforce dynamics. HR analytics involves collecting, processing, and analyzing employee data to gain insights into patterns and trends related to employee behavior. It helps organizations identify the key factors influencing attrition, such as job satisfaction, compensation, work environment, career growth opportunities, and employee engagement.

Employee attrition analysis using HR analytics enables organizations to move beyond traditional methods and adopt a more scientific approach to workforce management. By applying statistical techniques and data analysis tools, organizations can predict potential attrition, identify high-risk employees, and design effective retention strategies. This study focuses on analyzing employee attrition through HR analytics to uncover meaningful insights and support better decision-making in human resource practices.Employee attrition analysis using HR analytics focuses on examining various factors that contribute to employee turnover. These factors may include demographic variables (age, gender, education), job-related aspects (role, salary, promotion, workload), organizational factors (work environment, leadership, culture), and behavioral indicators (job satisfaction, performance, engagement). By analyzing these variables, organizations can identify key drivers of attrition and predict which employees are more likely to leave.

Keywords:HR analytics;Employee attrition

A STUDY ON DIGITAL TRANSFORMATION IN FINANCIAL OPERATIONS AT RANE BUSINESS SERVICES

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This study titled “A Study on Payroll Management as a Link Between HR and Finance with Special Reference to Rane Business Services” delves into the dynamic changes that digital transformation is bringing to the realm of finance, particularly within organizational financial operations. With the increasing integration of technology, businesses are reimagining their financial workflows by leveraging automation tools that streamline complex processes. One of the primary areas affected by this shift is invoice booking, where automation helps reduce manual errors, enhance efficiency, and significantly cut down on processing time. This transformation not only improves operational speed but also contributes to greater financial transparency, enabling organizations to make more informed and timely decisions. The study investigates the impact of these changes on key aspects of business performance, such as profitability, cost efficiency, and overall operational smoothness. Additionally, it identifies and addresses the challenges companies may encounter during the transition, such as resistance to change, the need for training personnel, and integrating new systems with existing workflows. The research also emphasizes the importance of adopting tailored strategies to overcome these obstacles and highlights the role of leadership in ensuring a successful digital transformation journey. By analyzing case studies and drawing insights from real-world implementations, the study offers practical recommendations for companies aiming to embrace automation. Ultimately, it illustrates how businesses can enhance their financial performance, achieve sustainable growth, and remain competitive in an increasingly digital marketplace through the strategic adoption of digital tools and practices.

Keywords:automation tools, workflows

TAX PLANNING STRATEGIES FOR INDIVIDUALS AND SMALL BUSINESSES

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This internship report presents the practical training experience gained at S. Janarthanam and Co., a reputed Chartered Accountant firm engaged in providing accounting, auditing, taxation, and financial advisory services. The internship was undertaken as part of the MBA (Finance) curriculum to gain real-time exposure to financial management practices and statutory compliance procedures. During the internship, I was involved in assisting with preparation of financial statements, GST filing, income tax return filing, bank reconciliation statements, and audit documentation. The training provided practical knowledge about accounting standards, taxation laws, statutory audits, and compliance requirements under various financial regulations. This internship enhanced my understanding of financial reporting, tax planning, and audit procedures while improving my analytical, technical, and professional skills. The experience bridged the gap between theoretical concepts learned in the classroom and their practical application in a professional environment.

Keywords: Tax Planning; Financial advisory

FROM INTERACTION TO INTENTION: PREDICTING THE ADOPTION OF CHATGPT IN TRAVEL PLANNING

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Abstract

The increasing integration of generative artificial intelligence into daily digital activities is transforming how people search for information and plan their travel. Conversational AI systems like ChatGPT offer dynamic, context-aware, and interactive responses, significantly different from those of traditional search engines and social media. Although AI-based conversational tools grow in popularity, little research has explored what influences travelers' intention to use these systems for travel planning. This study investigates and predicts travelers' willingness to use ChatGPT as a travel planning assistant by focusing on new aspects of AI interaction, including perceived conversational quality, information personalisation, decision-support ability, and cognitive engagement during travel information searches. Using a quantitative approach, data are gathered from potential travelers who frequently use digital platforms for trip planning. Advanced statistical methods analyze this data to explore the relationship between AI interaction experiences and behavioural intentions. The results aim to offer new insights into how conversational AI can shape travel planning behaviors and decision-making. By introducing innovative experiential and interaction-based factors, this research enhances the theoretical understanding of AI-assisted travel planning and provides practical advice for tourism organizations and digital platform developers looking to incorporate intelligent conversational systems into travel services.

Keywords: ChatGPT, Generative Artificial Intelligence, Travel Planning, Conversational AI, Behavioral Intention, Tourism Innovation.

EXAMINING THE IMPACT OF STRESS ON TURNOVER INTENTIONS: THE MEDIATING ROLE OF WORK ENGAGEMENT

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Abstract

Employee turnover presents a major challenge for modern organizations worldwide, with stress being a significant contributing factor. This research explores how Work engagement mediates the link between perceived stress and turnover intentions. Participants included employees from various organizations. Data collection involved the PSS-10, General Work Engagement Scales, and turnover intention scales. Results show that perceived stress notably influences turnover intentions, and that Work engagement serves as a mediator in this relationship. The findings suggest that companies should prioritize stress reduction strategies to improve employee retention.

Keywords: Perceived stress, self-efficacy, turnover intention, mediation, employee retention

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