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SOUVENIR

2nd International Conference on

INTELLIGENT CONTROL, COMPUTING AND COMMUNICATIONS

(IC3-2026)

(IEEE Conference Record No. 69166)

October 15-16, 2026



Organized by

GL Bajaj Group of Institutions

23kms Milestone, NH-19, Mathura-Delhi Highway, Mathura - 281 406 (UP)
https://www.glbajajgroup.org

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Anandiben Patel
Governor, Uttar Pradesh



सत्यमेव जयते

Jan Bhavan
Lucknow - 226 027

11 Sep, 2026

Message

I am pleased to know that G.L. Bajaj Group of Institutions, Mathura, Uttar Pradesh, is organizing the 2nd IEEE International Conference on Intelligent Control, Computing and Communications (IC3-2026) from 15th to 16th October 2026, with the Technical Sponsorship of the IEEE Uttar Pradesh Section.

Such academic initiatives play an important role in promoting innovation, research, and collaboration, while contributing to the development of technology-driven solutions for the benefit of society. I am confident that the deliberations and exchange of knowledge during the conference will contribute meaningfully to advancing research and innovation in emerging areas of technology.

I extend my heartfelt greetings and best wishes to the organizers, delegates, researchers, academicians, and all those associated with IC3-2026 for its successful and fruitful organization.

Anandi Patel

(Anandiben Patel)

Telephone : 0522-2236497 Fax : 0522-2239488 Email : hgovup@gov.in Website : www.upgovernor.gov.in

S. No. - 669/C.M.U.P.(R)/2026

Yogi Adityanath



CHIEF MINISTER
UTTAR PRADESH

Lok Bhawan,
Lucknow - 226001

Date : 09-10-2026

Message

I am pleased to learn that GL Bajaj Group of Institutions, Mathura, is organising the 2nd IEEE International Conference on Intelligent Control, Computing and Communications (IC3-2026) on 15th and 16th October 2026. The participation of academicians, researchers, scientists, industry experts and students from India and abroad, along with distinguished keynote speakers and institutions from Germany, Saudi Arabia and Australia, reflects the academic significance of the Conference. Such platforms are important for sharing knowledge, presenting new research and strengthening meaningful collaboration between academia and industry.

Technological advancement and knowledge-driven innovation are shaping new possibilities across education, industry, healthcare, governance and other spheres of life. The journey towards Viksit Bharat therefore requires strong educational institutions, a vibrant research ecosystem and young minds equipped with knowledge, skills and creativity. At the same time, scientific and technological progress must remain rooted in human values and directed towards the larger welfare of society. I am confident that the deliberations at IC3-2026 will encourage new ideas, foster academic and industry collaboration and provide valuable exposure to students and young researchers. I extend my best wishes to GL Bajaj Group of Institutions, the IEEE Uttar Pradesh Section, the organisers, delegates and participants for the successful conduct of the Conference and for their continued contribution to research and innovation.

(Yogi Adityanath)

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प्रो. जयप्रकाश पाण्डेय
कुलपति
Prof. Jai Prakash Pandey
Vice Chancellor

डॉ0 ए0पी0जे0 अब्दुल कलाम प्राविधिक विश्वविद्यालय
उत्तर प्रदेश, लखनऊ
Dr. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
Uttar Pradesh, Lucknow



Dated : 02.09.2026

MESSAGE

I am pleased to know that the GL Bajaj Group of Institutions, Mathura is organizing the 2nd IEEE International Conference on Intelligent Control, Computing and Communication "**(IC3)-2026**" on 15-16 October, 2026.

The topics to be covered in this conference are comprehensive and will be adequate for developing and understanding about new developments and emerging trends in this area. I hope the interactions between the participants and the experts who will be presenting their experiences and expertise will be fruitful and objective specially for faculty and students. I shall be glad to receive a path forward drawn from this conference.

I congratulate the organizers for taking this initiative and extend my best wishes for the successful conduction of event.

(Prof. Jai Prakash Pandey)
Vice Chancellor

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PATRON IN CHIEF MESSAGE



It gives me immense pleasure to extend my warm greetings to all the delegates, distinguished guests, and contributors of the 2nd IEEE International Conference on Intelligent Control, Computing and Communications (IC3-2026). This prestigious event serves as a dynamic platform to bring together researchers, academicians, and technology enthusiasts to exchange innovative ideas, share cutting-edge research, and explore emerging developments in the fields of intelligent control, computing, communication technologies, artificial intelligence, and related areas.

Our institute has always been committed to excellence in education and research, and this conference is a reflection of our vision to bridge the gap between theoretical knowledge and practical applications for the benefit of the society and industry.

I congratulate the organizing committee and all those associated with the conference for their tireless efforts in bringing together an insightful and engaging technical program. I am confident that the deliberations, technical sessions, and interactions during the conference will generate new perspectives, encourage meaningful collaborations, and contribute to the advancement of knowledge and technology.

I also take this opportunity to thank all the authors, keynote speakers, and delegates for their invaluable contributions, which makes this conference a grand success. I look forward to the fruitful outcomes and lasting collaborations that emerge from **IC3-2026.**

With best regards,

Dr. Ram Kishore Agarwal,
Chairman

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PATRON MESSAGE



It is a matter of great pride and honor to welcome you all to the 2nd IEEE International Conference on Intelligent Control, Computing and Communications (IC3-2026). Following the successful legacy of our academic endeavors, this conference exemplifies our institute's unwavering commitment to fostering research excellence, technological innovation, and interdisciplinary collaboration.

In today's digital landscape, the convergence of intelligent control systems, advanced computing, and next-generation communications is driving global innovation. IC3-2026 provides a vital platform for researchers, academicians, and experts to share groundbreaking ideas and tackle modern engineering challenges.

I congratulate the organizing team, faculty, and volunteers for hosting this prestigious IEEE conference. Best wishes to all participants for a successful and inspiring event.

I encourage all delegates to actively participate, build strong professional networks, and explore collaborative research to solve real-world problems. Best wishes to everyone for a highly successful and inspiring event.

I extend my warmest welcome and best wishes to all the distinguished speakers, participants, and contributors for a successful, engaging, and memorable conference. May this event leave a lasting impact on your academic and professional journeys.

With warm regards,

Shri Pankaj Agarwal
Vice-Chairman,

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CO-PATRON MESSAGE



It gives me immense pleasure to welcome all delegates, speakers, and participants to the 2nd IEEE International Conference on Intelligent Control, Computing and Communications (IC3-2026). This conference marks a significant step forward in our institute's mission to drive innovation, foster academic excellence, and contribute meaningfully to the advancement of science and technology.

IC3-2026 provides a vibrant platform for researchers, academicians, and industry professionals to exchange innovative ideas in intelligent control, computing, and next-generation communications, fostering collaboration and technological advancement.

I commend the organizing committee, faculty members, and student coordinators for their vision and relentless efforts in meticulously planning this event under the IEEE banner. I also extend my heartfelt gratitude to all keynote speakers and authors for their invaluable contributions.

To all participants, I encourage you to actively engage in discussions, collaborate beyond geographical boundaries, and explore novel methodologies. It is through such shared endeavors that we can leverage cutting-edge technologies to create impactful solutions for society.

I wish IC3-2026 grand success and hope it proves to be an enriching and inspiring experience for all.

With warm regards,

Shri Kartikay Agarwal
Chief Executive Officer

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DIRECTOR MESSAGE



GL BAJAJ Group of Institutions, Mathura, a premier institution of the Braj region, is known for experiential learning, critical thinking, and practical exposure embedded in the syllabus of Dr APJ Abdul Kalam Technical University, Lucknow.

I welcome all the delegates from India and abroad to this campus and hope that the conference will prove itself worthy of Technical sponsorship with IEEE.

With great pleasure, I invite you to join this august gathering of scholars, technologists and innovators. Second International Conference on Intelligence Control Computing and Communications (IC3–2026) is a platform for intellectual synergy where cutting-edge research meets practical innovation. I am sure that the speakers from India and abroad, session chairs, and scholars will find a definite path to navigate into domains like smart systems, cyber-security, IoT, machine learning, and renewable energy systems amongst the cutting-edge technologies.

With warm regards,

Prof. Neeta Awasthy
Director



October 1, 2026

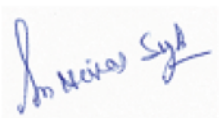
MESSAGE

It gives me great pleasure to welcome all distinguished delegates, researchers, academicians, industry experts, and students to the participating in the ***2nd IEEE International Conference on Intelligent Control, Computing and Communications (IC3-2026),*** *organized by GL Bajaj Group of Institutions, Mathura, UP during 15-16 October 2026.*

Having had the privilege of being associated with IC3 last year as well, I am particularly delighted to continue my association with the conference. It is encouraging to see this academic platform growing and bringing together researchers, academicians, industry professionals, and young minds to exchange ideas and explore new directions. We are witnessing a remarkable era in which Artificial Intelligence, intelligent control, advanced computing, and next-generation communication technologies are transforming the way we live, work, and innovate. Conferences such as IC3 play an important role in fostering interdisciplinary research, meaningful collaborations, and innovation with societal impact.

I invite all participants to engage deeply in the sessions, exchange ideas, network with peers, and explore opportunities for long-term collaboration. I am confident that the discussions and insights shared during the conference will inspire new research directions and contribute to advancements in computing and systems science.

I congratulate each one of the individuals in organizing a marvelous conference and my best wishes for the successful conference IC3-2026 to be fruitful and meaningful. I wish IC3-2026 every success.



(Prof. Sri Niwas Singh)
Director. ABV-IIITM Gwalior

Prof.(Dr.) Manish K. Gupta
Director (Academics)



KAUSHALYA - THE SKILL UNIVERSITY

(An Affiliating State University by Labour, Skill Development and Empolyment Department, Goverment of Gujarat)

Message for the 2nd IEEE International Conference on Intelligent Control, Computing and Communications (IC3-2026)

It gives me immense pleasure to extend my warm greetings and best wishes to the organizers, delegates, researchers, faculty members, and students participating in the 2nd IEEE International Conference on Intelligent Control, Computing and Communications (IC3-2026).

Having had the privilege of being associated with IC3 last year as well, I am particularly delighted to continue my association with the conference and to join IC3-2026 as a Keynote Speaker. It is encouraging to see this academic platform growing and bringing together researchers, academicians, industry professionals, and young minds to exchange ideas and explore new directions.

We are witnessing a remarkable era in which Artificial Intelligence, intelligent control, advanced computing, and next-generation communication technologies are transforming the way we live, work, and innovate. Conferences such as IC3 play an important role in fostering interdisciplinary research, meaningful collaborations, and innovation with societal impact.

I congratulate the GL Bajaj Group of Institutions, Mathura, and the entire organizing team for this initiative.

May IC3-2026 inspire new ideas, strengthen collaborations, and contribute to impactful research and technological innovation.

I wish IC3-2026 every success.

Prof. (Dr.) Manish K. Gupta
Director (Academics) & Senior Professor
Kaushalya – The Skill University, Government of Gujarat
IEEE Senior Member

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CONFERENCE CHAIR MESSAGE



It is my great pleasure to welcome you all to the 2nd International Conference on Intelligent Control, Computing and Communications (IC3-2026).

In today's rapidly evolving technological landscape, IC3-2026 brings together innovative ideas in intelligent control, computing, communications, and artificial intelligence, providing a platform for knowledge exchange, research, and collaboration.

I sincerely appreciate the contributions of our authors, reviewers, keynote speakers, and organizing team. Their collective efforts are the foundation of this conference.

I hope IC3-2026 becomes a vibrant platform where ideas connect, innovations emerge, and collaborations begin.

I warmly welcome you all and wish you a fruitful, inspiring, and memorable conference.
Let us connect ideas, inspire innovation, and shape the technologies of tomorrow.

With best regards,

Dr. Ram Veer Singh Sengar
Conference Chair

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ORGANISING CHAIR MESSAGE



Dear Colleagues,
It is my great pleasure to welcome you to the 2nd IEEE International Conference on Intelligent, Control, Computing and Communications (IC3-2026), to be held on October 15–16, 2026, at GL Bajaj Group of Institutions, Mathura, Uttar Pradesh.

IC3-2026 brings together researchers, academicians, industry professionals, and students to share ideas and discuss developments across intelligent systems, control, computing, and communications. We hope the conference will encourage thoughtful discussion, meaningful collaboration, and the exchange of knowledge among participants.

On behalf of the Organising Committee, I extend my sincere welcome to all esteemed speakers, delegates, authors, reviewers, sponsors, and entire organising committee for their unwavering efforts in making IC3-2026 a resounding success. I am grateful to everyone whose contributions and support have helped bring this conference together.

I wish you all an open, exciting and rewarding experience with new ideas being developed and new connections between people, countries and scientific fields being established here in IC3-2026, at GL Bajaj Group of Institutions, Mathura, Uttar Pradesh.

With best wishes,

Prof. V K Singh
Conference Organising Chair IC3-2026

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ABSTRACTS

The Wonders of DNA: A Story of Life and Computation

Prof. Manish Kumar Gupta
Kaushalya: The Skill University, Gujarat

Life and Computation are the two sides of the same coin of information processing. At their intersection many new opportunities are emerging for scientists, engineers and entrepreneurs. Many branches of this beautiful golden coin are well established, such as quantum computing, DNA computing and synthetic biology. This talk will give an overview of this upcoming area and will focus on research problems in DNA computing. We will show how the magic of DNA can create wonderful things in the area of DNA nanotechnology. In particular, DNA origami has potential for drug delivery systems and vaccines. We will briefly describe our contribution in the area.

AI Meets Quantum: Where Classical Intelligence Meets Quantum Computing

Dr. Ritajit Majumdar
IBM Pune, India

Artificial intelligence is increasingly becoming an integral part of the quantum computing workflow—not only as a tool for writing code, but also for optimizing, understanding, and managing quantum workloads. This talk explores how classical AI can augment different stages of the Qiskit Pattern, from mapping the problem to quantum hardware, to execution and resource management. We shall look at practical examples including AI-assisted code generation, code migration across Qiskit versions, and AI-driven transpilation. Particular attention will be given to agentic AI systems that can reason across different stages of the workflow, identify opportunities for improvement, and assist in making better decisions about quantum circuits and their execution. The talk will also explore how AI can contribute to resource estimation, helping bridge the gap between quantum algorithms and the realities of quantum hardware. Rather than viewing AI and quantum computing as separate technological trends, the talk will examine how they can work together to make quantum programming and execution more efficient, accessible, and scalable.

Beyond Words: The Multimodel Paradigm Shift in Foundation Models

Prof. Girija Chetty
University of Canberra, Australia

We live in a multi-sensory reality, yet artificial intelligence has historically operated within rigid textual or visual silos. The emergence of Multimodal Foundation Models (MMFMs) marks the structural unification of machine perception, transitioning AI from passive, unimodal recognition to continuous, cross-modal reasoning. This talk addresses the architectural and economic landscape of modern multimodality. We begin by tracing the evolution of cross-modal alignment from foundational dual-encoders to state-of-the-art 2026 native architectures, including sparse Mixture-of-Experts (MoE) and ultra-long context vision-language models. Moving beyond theory, we present a transparent cost-benefit analysis separating closed-source APIs from self-hosted, quantized open-weight alternatives—demonstrating how localized infrastructure transforms enterprise scale economics. Finally, we explore the frontier of Vision-Language-Action (VLA) agents capable of autonomous digital and robotic orchestration. Crucially, this talk demonstrates how these compressed, high-capacity models can be democratized via edge-compute frameworks (PEFT and knowledge distillation) to function entirely offline in infrastructure-starved environments. By deploying geospatial and clinical foundation models at the edge, we unlock a powerful, scalable toolkit to address planetary crises and practically achieve the United Nations 2030 Sustainable Development Goals (SDGs).

AI & SDGs – Innovating for a Sustainable Future

Dr. Kamal Upreti
Christ University, NCR Campus, Ghaziabad

Artificial Intelligence (AI) is emerging as a transformative technology for accelerating progress toward the United Nations Sustainable Development Goals (SDGs) by enabling data-driven decision-making, intelligent automation, predictive analytics, and resource optimization. It explores the opportunities, applications, and challenges associated with leveraging AI to address complex social, economic, and environmental sustainability challenges. The study examines the potential contribution of AI across multiple SDGs, including quality education, good health and well-being, clean energy, sustainable cities and communities, responsible consumption and production, climate action, and biodiversity conservation. AI-driven approaches such as machine learning, deep learning, generative AI, Internet of Things (IoT), digital twins, and intelligent decision-support systems can facilitate early disease detection, precision agriculture, renewable-energy forecasting, smart mobility, climate-risk assessment, waste management, and efficient utilization of natural resources. The paper further emphasizes the importance of responsible and inclusive AI, considering issues related to data privacy, algorithmic bias, transparency, explainability, cybersecurity, digital inequality, and the environmental footprint of AI infrastructure. A conceptual framework is proposed to connect AI capabilities with measurable sustainability outcomes while emphasizing human-centred innovation and stakeholder participation. The study highlights that technological advancement alone cannot guarantee sustainable development; effective governance, ethical standards, interdisciplinary collaboration, digital literacy, and equitable access are equally essential. The paper concludes that strategically deployed AI can serve as a powerful catalyst for achieving the SDGs and building resilient, inclusive, environmentally responsible, and future-ready societies.

Investigating Cerebras Hardware and Algorithms for HPC Acceleration

Dr. Johannes Gebert
HLRS Lab, University of Stuttgart, Germany

Cerebras' Wafer Scale Engine 3 features 4 trillion transistors, 900,000 processing elements, 44 GB of distributed on-chip SRAM, and a two-dimensional mesh interconnect. It represents a departure from conventional multi-node HPC architectures built on discrete GPUs and network fabrics. Originally designed for AI training and inference, this dataflow processor is being evaluated as an accelerator for classical HPC workloads, including sparse matrix-vector products, stencil-based PDE solvers, Monte Carlo particle transport, and FFT-based signal processing. While some applications are promising, others are a dead end. This talk surveys the architectural features that make the Cerebras platform viable for HPC, such as extreme on-chip memory bandwidth, fine-grained dataflow execution, and elimination of off-chip communication for a broad class of problems, and examines the algorithmic adaptations required to exploit them. Among them are re-tiling stencil computations across the PE mesh and restructuring sparse linear algebra to avoid irregular memory access patterns. Drawing on recent benchmarking studies, the talk discusses where wafer-scale acceleration outperforms traditional GPUs clusters, where it does not, and what this implies for the broader question of hardware-algorithm co-design in a post-Moore's-Law HPC landscape.

Practical Large-Digit π Computation on a Shared HPC Cluster: A Case Study in y-cruncher Swap-Mode Configuration on SLURM

Dr. Samar Aseeri
KAUST, Saudi Arabia

We document the process of configuring and running y-cruncher, the de facto standard software for record-scale π digit computation, in disk-swapping (swap mode) on a shared, multi-tenant high-performance computing (HPC) cluster managed by the Simple Linux Utility for Resource Management (SLURM) — Ibex, at the King Abdullah University of Science and Technology (KAUST). While swap mode is well documented for dedicated, user-owned hardware, we found no existing guidance for its use on shared academic clusters, where node-local storage is ephemeral, working directories may reside on network filesystems, and resource limits are enforced by SLURM and cluster-wide Quality of Service (QOS) policies rather than the user. We report a

sequence of non-obvious configuration failures and their root causes, a working end-to-end methodology (including an unattended sbatch batch-job pipeline), and empirical throughput measurements at 10^10, 10^11, and 10^12 decimal digits. We further identify and quantify a hard storage-bound ceiling for this environment, and report a fully diagnosed out-of-memory failure at the 10^12-digit scale, root-caused via SLURM's accounting subsystem (sacct).

Create AI-Powered Recommendation Engines: Harnessing Big Data Analytics and Artificial Intelligence to Craft Tailored Online Experiences

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The overwhelming amount of digital content, goods, and services makes it harder for users to find important information. In this work, we apply AI and big data analytics to build online recommendation engines that are tailored to each user. With recommendation systems, we can leverage large amounts of data including navigation history, preferences, interactions, and contextual information to predict user behavior and provide relevant content in real-time. To improve accuracy and adaptability, the suggested strategy combines content-based filtering with collaborative filtering and hybrid recommendation models. Neural networks and sequence models can capture complex patterns of interactions between items and users over time. One important aspect of big data technologies is their capacity to process enormous datasets in real-time. User input improves the system's functionality and suggestions. Safe and private data management methods are in place to keep users' information safe. In terms of user engagement, customer happiness, and suggestion accuracy, the experimental results show that the proposed solution surpasses existing methods. Here, we look at how AI and big data might tailor our digital encounters. Online shopping, entertainment, education, and social media can all benefit from recommendation algorithms, which improve user experience and financial benefits.

Integrate Cloud Computing with Machine Learning to Achieve Scalable Analytics: Develop Adaptive Learning Systems

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Machine learning and cloud computing have made it possible to create adaptive learning systems and scalable analytics platforms that can handle large amounts of diverse data. In contexts where data is constantly changing, traditional analytical frameworks have problems with computational scalability, storage capacity, intelligent decision-making, and real-time processing. This research presents a model for large-scale analytics that makes use of cloud computing, distributed data management, elastic computing, and adaptive learning. With cloud computing, complicated machine learning models can be trained and deployed on-demand, regardless of hardware limitations. Adaptive learning automatically updates models with new data streams to improve projected performance through incremental learning. Smart resource allocation, high availability, fault tolerance, analytical precision, and responsiveness are all supported by the framework, and it works across many application domains. Stakeholders can share learning environments and process data with the help of secure and scalable cloud services. The proposed approach beats stand-alone systems in terms of processing speed, model flexibility, prediction precision, and resource consumption, according to the tests. Building intelligent analytics infrastructures is the goal of the work, which integrates the scalability of cloud computing with the self-improving capabilities of machine learning. Many fields make use of adaptive learning, including healthcare, smart cities, education, and industrial automation.

A Multi-Layered Defense Framework Against Prompt Injection Attacks in Large Language Models

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Large Language Models (LLMs) have become integral to applications such as conversational AI, content generation, and intelligent decision support. However, their ability to interpret natural language instructions makes them vulnerable to prompt injection attacks, which can manipulate model behavior, bypass safety policies, and expose sensitive information. This paper presents a multi-layered defense framework to enhance the security of LLM-based applications against prompt injection attacks. The proposed framework integrates input validation, prompt sanitization, role-based access control, semantic verification, and output filtering to detect and mitigate malicious prompts while preserving the quality of legitimate responses. The framework was evaluated using simulated prompt injection scenarios comprising both benign and malicious prompts. Experimental results demonstrate that the proposed approach reduced the attack success rate from 80% to 15%, increased the malicious prompt detection rate to 92%, and improved response accuracy to 96% with only a minimal increase in response time. The findings indicate that a defense-in-depth strategy significantly enhances the robustness and reliability of LLM systems against evolving adversarial attacks. The proposed framework provides a practical and scalable solution for improving the secure deployment of LLMs in real-world applications.

Deep Learning-Based Speech Recognition for Low-Resource and Regional Languages

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Sensor nodes run on batteries that are rarely replaceable once a field is deployed, so the routing layer largely determines how long a wireless sensor network survives. Protocols that minimise hop count concentrate traffic on a small set of well-placed nodes and exhaust them first; protocols that chase residual energy alone wander, inflating delay and control traffic. This paper presents FAER, a routing protocol that resolves the conflict inside a single metric. A Mamdani fuzzy inference block converts three locally observable quantities normalised residual energy, queue occupancy and hop distance into one desirability score, and that score replaces the conventional distance heuristic in an ant colony pheromone update bounded by MAX–MIN limits. No node needs global topology knowledge. Evaluated in ns-3 on fields of 30 to 150 nodes against DSR, AODV, LEACH, ECRP and a Q-learning protocol, FAER postpones first-node death to round 1147 against 380 for DSR, delivers 92.16 % of packets at 150 nodes, and transports a bit for 0.714 µJ against 1.842 µJ. Control overhead grows sub-linearly with density, reaching 31.9 kb/s at 150 nodes where DSR reaches 100.2 kb/s. A sensitivity study over the pheromone weights shows the operating point is broad rather than knife-edged.

AI-Enabled Edge-Based Soil Quality Monitoring and Assessment Using LoRaWAN Multi-Sensor Networks

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A soil quality index condenses a laboratory panel into one number that a grower can act on, but the assays behind it take weeks and cost enough that most fields are sampled once every two or three years. Buried sensors are cheap and continuous, and are usually reported as raw readings that no agronomic decision rests on. This paper connects the two. Eight probe channels on a solar-powered node are individually calibrated against laboratory reference values, and a gradient-boosted regression maps the calibrated vector onto the soil-function percentile index of Lenka et al. The model is quantised to 8-bit integers and executed on the node itself, so an 11-byte payload carries an index rather than a table of readings. Over 118 held-out plots on a 26-week trial across four fertiliser regimes the estimate reaches R^2 of 0.914 against laboratory ground truth, with root-mean-square error of 0.0483 on the unit index scale, against 0.0912 for a principal-component proxy and 0.1074 for linear regression. Attribution places 58.2 % of the predictive weight on the organic-carbon proxy, available nitrogen and moisture. Inference costs 62.8 mA for 41 ms; mean node current is 0.394 mA, giving 14.8 months on a 6 Ah cell before the panel is counted.

Cybersecurity, Multifactor Authentication, and Secure Identity Management for Software-Defined Vehicular Networks

P. Kaushik[1], Jigar Soni[2],Vivekanand Kumar[3], Rajesh Kumar Tripathi[4], N. Prakash[5], Amit Upadhyay[6] .

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Vehicular ad hoc networks exchange safety-critical messages over an open wireless medium, which leaves them exposed to impersonation, replay, man-in-the-middle and denial-of-service attacks. Overlaying a software-defined control plane centralises credential state and makes revocation tractable, but it does not by itself authenticate anything. This paper specifies a certificate-chained multifactor authentication scheme for software-defined vehicular networks in which a certificate authority issues short-validity profile certificates, roadside units perform nonce-challenge verification at the network edge, and the software-defined controller anchors the revocation list so that credential withdrawal propagates without a per-unit broadcast. Unlike prior work in this area, every cost figure reported here is measured rather than asserted: elliptic-curve primitives over secp256r1 were benchmarked over 3,000 trials each, and the protocol was evaluated inside a fully specified event-driven IEEE 802.11p simulation with five independent runs per operating point. Onboarding costs 0.2528 ms of computation and steady-state message authentication costs 0.2024 ms, against an authenticated frame of 410 bytes. The simulation locates a saturation knee between 100 and 150 vehicles per roadside segment, beyond which packet delivery falls from 92.6% to 51.1% while goodput declines from its peak a scaling limit imposed by channel contention, not by cryptography, which accounts for under one per cent of end-to-end latency at every load tested.

A Smart IoT-Driven Assistive Healthcare Framework for Paralysis Patients with Wearable Sensor Integration

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This paper presents a smart, Internet-of-Things (IoT) based assistive health platform, which would be used to monitor patients with paralysis continuously, on a daily basis and to improve their recovery. The system simultaneously monitors critical physiological variables, which include body temperature, heartbeat, along with information on precise limb-movement that is obtained via motion tracking using flex sensors. The device is fabricated as a soft cuff-like wearable design that can be easily slipped around the wrist, the forearm or the foot, so this is able to fit itself to changes in the size of the limb as well as the frequency of use. Finger or toe gloves including embedded dual flex sensors will allow identifying the minimal changes in the control of movements, so the framework will be especially beneficial to patients with unilateral paralysis; they may receive control over their everyday life, recovery, and evaluation of therapy. The real-time data are fed into an Arduino Nano microcontroller, and displayed on an OLED display and sent wirelessly to a remote monitoring system and accessed by clinicians. The proposed architecture helps to minimize device burden by incorporating several sensing modalities into one compact and low-cost wearable, which leads to a maximum level of comfort of the user. It will aid individualized rehabilitation, expedite clinical interventions and enhance recovery experiences within the hospital and home-based settings.

A Balanced Ensemble-Based Intrusion Detection System for Wireless Sensor Networks Using KMeans-SMOTE, PCA, and Hybrid Stacking

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Wireless Sensor Networks (WSNs) support Internet of Things applications but remain vulnerable to cyberattacks because of open wireless communication, dynamic operation, and resource constraints. This study presents a leakage-safe intrusion-detection framework that integrates KMeans-SMOTE for class balancing, Principal Component Analysis (PCA) for dimensionality reduction, and a heterogeneous stacking ensemble comprising LightGBM, XGBoost, and CNN-LSTM base learners with XGBoost as the meta-classifier. The framework was evaluated on the WSN-DS dataset containing 374,661 observations, 18 predictors, and five classes. Data were divided using a stratified 80:20 hold-out split, while five-fold out-of-fold probabilities were used to train the stacking layer. PCA retained six components, exceeding the 95% cumulative-variance threshold. The proposed ensemble achieved 98.53% accuracy, 0.9171 macro precision, 0.9226 macro recall, 0.9186 macro-F1, 0.9937 macro ROC-AUC, 0.9543 macro average precision, a Cohen's kappa of 0.9148, and an MCC of 0.9149. It improved accuracy and macro-F1 over the three base learners, although LightGBM obtained marginally higher balanced accuracy and macro ROC-AUC. Flooding and Normal traffic achieved recalls of 0.991 and 0.997, respectively, while Grayhole remained the most difficult class with 0.807 recall. McNemar's test confirmed a statistically significant difference between the stacking and LightGBM predictions ($p < 0.001$). The findings show that heterogeneous out-of-fold stacking offers a strong overall accuracy-minority-detection trade-off for WSN intrusion detection.

Review of AI-Powered Smart Helmet for Real-Time Drowsiness Detection and Workplace Safety with using ML

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The AI-Powered Smart Helmet for Real-Time Drowsiness Detection and Workplace Safety project will be able to reduce the rate of casualties occuring due to the accidents happening in the underground mining of coal. Innocent life of workers and their families will be benefitted. A more productive, safe, risk free atmosphere will be established. Further Improvement can be done by adding more advance technology and increasing the safety gears which are technology enabled. Coal miner works in very risky conditions where they are exposed to harmful gases, high temperatures, and the chances of accidents like falls or being trapped underground. Normal helmets only protect the head but do not warn about these dangers. Current safety systems are either basic, slow, or unable to predict risks in advance. To solve this, we need a Smart Helmet that can sense gases, temperature, and location, send real-time alerts through IoT, and use AI to predict hazards before they become serious.

Secure Multi-Factor Authentication System for Enhanced User Access Control

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A safe web-based identification structure called the Multi-Factor Authentication (MFA) System was created to improve the reliability, safety, and integrity of user login procedures in contemporary applications. Traditional password-based authentication is no longer sufficient to provide user identity verification and system protection as cyberattacks, identity leaks, and illegal access attempts continue to increase. This paper presents the design and implementation of an MFA system consisting of many authentication layers—password-based login, email OTP verification, SMS OTP, authenticator app-based Time-based One-Time Password (TOTP) verification, and device/browser recognition—are shown in this work. By combining knowledge-based, possession-based, and inherence-based factors, the system ensures a highly secure and controlled verification process.

Blockchain-Based Secure Data Aggregation in IoT-Enabled Wireless Sensor Networks

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One of the solutions that have come to the rescue of security and trust problems in distributed sensing settings is the adoption of block chain technology alongside wireless sensor network (WSN) that incorporates IoT technology. One of the weaknesses of the traditional secure data aggregation schemes includes data manipulation, compromised aggregator node, and nondisclosure. The given paper suggests a secure data aggregation system with block chain incorporated that guarantees data integrity, authenticity, and immutability without utilizing centralized control. The system proposed uses aggregation on clusters with the use of a lightweight permissioned block chain to ensure the aggregated sensor data are recorded in a secure way. Smart contracts help in validation and verification of data in a robotic manner and committed in ledger. Simulation findings can be used to prove that the suggested model performs very well with 98.7% data integrity guarantee, false data injection attacks are minimized by 43 percent, and additional communication overhead is restrained to less than 10 percent in relation to traditional secure aggregation schemes. Moreover, the framework enhances

total network reliability without compromising the acceptable level of energy consumption, which challenges it is appropriate in applications characterized by resource constraints (IoT-WSN).

NavGrah Optimization: A Nine-Operator Rank-Adaptive Metaheuristic for Global Numerical Optimization and Machine Learning Hyperparameter

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This paper presents a self-contained algorithmic re-derivation and independent computer-science evaluation of NavGrah Optimization (NGO), a population-based metaheuristic whose nine update operators are named after the Navagraha (nine celestial bodies) of Vedic astronomy. At each iteration, NGO ranks its population into elite, good, average, and weak tiers and applies a distinct, mathematically defined update rule to each tier, combined with a sigmoid exploitation-exploration schedule, greedy replacement, periodic local refinement, and diversity-triggered stagnation resets. We benchmark NGO against Particle Swarm Optimization (PSO), Grey Wolf Optimizer (GWO), and a real-coded Genetic Algorithm (GA) on six classical 30-dimensional test functions (Sphere, Rosenbrock, Rastrigin, Ackley, Griewank, Schwefel) over 12 independent runs each, and on a real computer-science case study: joint feature selection and Support Vector Machine (SVM) hyperparameter tuning for a 4-class classification task. On the benchmark suite, NGO's hybrid local-search component drives near-exact convergence on five of six functions, reaching a mean best fitness of 5.07×10^{-158} on Sphere and exact zero on Griewank, while remaining competitive with GWO on Rastrigin and Rosenbrock. On the feature-selection case study — where the expensive wrapper objective required disabling NGO's local-search component for computational tractability — NGO reduced the feature set by 57% (30 → 13 features) at a small accuracy cost relative to GWO, which achieved the best overall test accuracy of 86.7%. These results characterize both the strength of NGO's rank-adaptive design on continuous landscapes and the specific conditions under which its local-refinement advantage does not transfer, providing a reproducible basis for future work on the algorithm.

Interpretable Machine Learning Models for Predicting Parkinson's Disease Progression Using Clinical and Behavioral Data

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Prediction of the progression of Parkinson's disease is crucial for proper management and development of the idiosyncratic therapeutic approach. Currently, this paper presents a machine learning approach of clinical, operational and Advantages features to categorize progression stages in Parkinson's patients. Employing the dataset of 500 patients, the demographic information obtained from patients, along with the values of symptoms' severity, medications prescribed, and physical activity levels, undergo encoding and normalization. Two among the classification models are selected for evaluation including one interpretable model, namely, Logistic Regression and another black-box model, namely, Random Forest. The Random Forest model presented a high degree of accuracy and less variance as compared to the other algorithms, while the Logistic Regression model performs exploratory analysis for identifying statistically significant predictors. To supplement the main model, SHAP is used thus further promoting model explainability and identification of vital features affecting disease advancement. This paper demonstrates how interpretable AI can be used to facilitate clinicians' comprehension of progression patterns and care plans for ND patients.

Physics-Derived Explainable Detection of High-Impedance Faults at Unseen Locations in Renewable-Active Distribution Feeders

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This study developed an explainable machine-learning detector for high-impedance faults in an 11-kV renewable-active distribution feeder. A reproducible MATLAB generator produced 1,200 training and 600 independent test waveforms. Each record covered 0.20 s at 6.4 kHz. Training faults occupied the first 10–65% of the feeder, while test faults occupied unseen 68–96% locations and used higher contact resistance. Twenty-six current features represented sequence imbalance, harmonics, cycle variation, waveform shape, and wavelet energy. Five interpretable classifiers and a residual-current threshold were compared after noise-augmented training. The decision tree achieved 92% clean-test accuracy, detected 88% of faults, and issued 4% false alarms. Accuracy remained 89.8% at 40 dB, but decreased to 79.2% at 30 dB and 60.3% at 20 dB. Even-harmonic content and cycle-to-cycle residual-current variation were the main decision factors. The results show that low-cost current features can separate most weak faults from switching and photovoltaic changes at unseen feeder locations, but severe measurement noise still requires improved sensing or retraining before field deployment.

A Compact 28.6-GHz Microstrip Antenna for 5G-Enabled Industrial Control and Automation

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This paper presents a compact 28.6-GHz microstrip antenna designed for 5G-enabled industrial control and automation applications. The proposed antenna employs a modified radiating patch, microstrip feed, and rectangular ground-plane slot within a compact 6 × 6 mm² footprint. Full-wave electromagnetic simulation is performed over 20–40 GHz to evaluate its impedance and radiation characteristics. The antenna achieves a minimum S_{11} of approximately −14.6 dB at 28.6 GHz, with an estimated −10-dB impedance bandwidth of 27.0–30.3 GHz. At the operating frequency, the simulated VSWR is 1.54, radiation efficiency is approximately 90.9%, total efficiency is 87.8%, and directivity reaches 7.14 dBi. The radiation pattern provides a 68.4° 3-dB beamwidth with a side-lobe level of approximately −11.1 dB. The proposed antenna is suitable for 5G industrial IoT, robotics, AGVs, wireless sensors, and distributed automation systems.

Comparative Performance Analysis of ChatGPT and DeepSeek Chat Using Synthetic Interaction Data

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This study provides extensive benchmarking of two state of the art conversational AI systems, GPT 4 turbo (ChatGPT) and DeepSeek Chat 1.5, based on a synthetic interaction log with extensive annotations of more than 10 000 interactions. The results of a series of descriptive and inferential analyses is not only that DeepSeek Chat 1.5 is more satisfying (mean satisfaction rating: 4.802, GPT 4 turbo: 3.995, Welch's $t < 0.01$) to the users, but also more accurate (accuracy of responses: 0.900, GPT 4 turbo: 0.803, Welch's $t < 0.01$) than the latter,

revealing statistical significance at high levels. Additionally, deepseek sessions are also longer in terms of engagement (0.578 min vs. 0.376 min). The Random Forest classifier, which is tasked with predicting the five point satisfaction scores, achieves an overall accuracy of 56.4 % (weighted F1 = 0.556). The overall accuracy of a companion regression model is RMSE = 0.0570 and MAE = 0.0457. The platform identity, query domain and session duration are highlighted as key factors influencing users' perception through feature importance analysis. The results shed light on the advantages and disadvantages of each model in different contexts and offer actionable implications for dynamic query routing, UI adaptation, and targeted refinement of conversational agents. The methodological approach of survival style cohort analysis, predictive modeling and thorough statistical testing provides a repeatable template for future AI platform evaluations.

Zero Trust Enforcement Verification against Implicit Network Trust in Service-Oriented Environments

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The rapid growth of digital data in businesses, governments, and communities shows the development of diverse networked infrastructures, highly dynamic and dispersed. Because of rapid expansion, it becomes vulnerable to hardware malfunctions, internal errors, configuration errors, and cyberattacks. So, many existing systems are facing challenges with dynamic verification and implied assurance. The Zero-Trust Network Architecture (ZTNA) has been developed using the concept of never trust, always verify. To address this limitation, this paper proposes zero trust enforcement verification against implicit network trust in service-oriented environments. The proposed model introduces identity verification; verification for access request, internal service access testing, and implicit trust detection, Zero Trust policy enforcement, and authorization are integrated. In this proposed system, access will not be allowed the user without sufficient identity, authentication, or policy validation. The service requests are continuously verified before authorization when detected implicit trust conditions are subsequently evaluated against Zero Trust access policies. Therefore, this proposed system provides high security for users and shows better results interns of parameters throughput, response time and false positive rate

API-Driven Efficient Security Middleware Approach for Request Protection

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In this era, each small-scale industry, Colleges, schools and MNCs (Multi-National Companies) uses web applications for promoting their organizations and providing services to the society. Currently, web applications have become a vital and simple medium to communicate with the society. As a result, usage of websites is increased. In addition, cyber-attacks and threats have been increasing with respect to the growth of Web attacks. In the current digital environment, web applications continuously receive requests from different users and devices. While many of these requests are legitimate, some may be abnormal or intentionally designed to attack the application. If such requests reach the application directly, they can affect its functionality, consume system resources, or expose sensitive parts of the system. To reduce these risks, security middleware can be placed between the client and the application. This middleware acts as a protective layer and checks incoming requests before they are processed by the main application. In this analysis, API-driven efficient security middleware approach for request protection is presented. Firstly, user initiates the request via client application. Next the request will passes through zero trust layer in which it will be intercepted and evaluated. Authentication will verify the requester identity and identity propagation phase maintains that verified identity as the request passes through distributed services. Authorization and security policies determine whether requested operation will be permitted and only verified/validated requests would be forwarded towards the resource or micro-service.

Compact DGS-Based Slot-Loaded Patch Antenna for Millimeter-Wave Communication and Networking

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This paper presents the design and simulation of a compact slot-loaded microstrip patch antenna with a Defected Ground Structure (DGS) for high-frequency communication and networking applications. The proposed antenna is analyzed using CST Studio Suite at approximately 25.85 GHz. The simulated results show a minimum S_{11} of −33 dB and a VSWR of approximately 1.04, indicating good impedance matching. The antenna achieves a peak directivity of 6.91 dBi, with radiation efficiency of approximately 93% and total efficiency of approximately 86%. The far-field pattern provides a 3-dB beamwidth of 66.6° and a side-lobe level of about −9.5 dB. Surface-current, electric-field, and magnetic-field distributions confirm effective excitation of the slot-loaded patch and DGS structure. These characteristics demonstrate the suitability of the proposed antenna for millimeter-wave communication, wireless networking, RF sensing, and compact communication terminals.

NetTwinAI: An AI-Powered Digital Twin for Self-Healing Enterprise Networks

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Modern enterprise networks are large and diverse, making reliable network operation essential for business continuity. However, many Network Operations Centers (NOCs) still rely on reactive approaches, where faults are detected after service disruption and diagnosis requires manual correlation of logs from multiple devices. We propose NetTwinAI, an AI-powered digital twin framework for predictive failure detection and self-healing in enterprise networks. NetTwinAI represents the network as a real-time attributed graph and applies supervised machine learning to proactively predict device and link failures before they affect services. The framework integrates SNMP and syslog-based data collection, a NetworkX topology graph stored in MySQL, Scikit-learn-based failure prediction and anomaly detection, graph-based root cause analysis, and a rule-guided recommendation and remediation engine. An interactive 3D topology viewer and Grafana dashboards provide network visualization and monitoring, while Docker containers enable modular deployment. The framework also introduces a Network Health Score to represent the current condition of the network and a self-healing decision engine that prioritizes actions such as traffic rerouting, port restart, load redistribution, or operator escalation based on predicted impact. Using a simulated enterprise network, the prototype demonstrates improvements over threshold-based fault detection in Mean Time To Detect (MTTD) and Mean Time To Repair (MTTR), while maintaining a low false-positive rate. The work also addresses scalability, security, human-in-the-loop decision making, and future extensions involving reinforcement learning and

Mathematical Modeling and Analysis of Blood Flow profile in the Retinal Tissue with Various Parameters Effect

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The Eye is an intricate and unique biological system for investigating retinal hemodynamics in both healthy and diseased states. This research is based on modeling of blood flow in the retinal tissue, elastic properties of

retinal capillaries and utilization of Young's modulus to characterize the mechanical behavior of capillary walls and its impact on hemodynamics. The Navier-Stokes equations for incompressible flow are used to develop and simulate the fluid dynamics within the retinal tissue. Also blood velocity including Young's modulus, blood viscosity, retinal tissue diameter and length, and hematocrit levels are systematically discussed. The model described how these factors modulate the blood flow and offered potential applications to understand the retinal pathologies such as diabetic retinopathy and hypertension-induced vascular changes. By using biomechanical and fluid dynamic principles, this research work became the quantitative assessment of retinal hemodynamics and paved the way for improved diagnostic and therapeutic strategies.

Self-Evolving Autonomous Ethical Hacking Framework for Zero-Day Vulnerability Prediction and Explainable Cyber Defense

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The growing complexity of cyber attacks has made the traditional rule-based penetration tests insufficient, as they have to be autonomous and intelligence based ethical hacking paradigms. The paper introduces a self-evolving AI ethical hacking framework relying on five novel algorithms (Recursive Adversarial Cognition Optimization), Neural Probabilistic Exploit Synthesis, Context-Aware Attack Graph Hyper-Traversal, Federated Deception-Resilient Learning, and Explainable Ethical Constraint Propagation to ensure limited autonomy and controlled compliance with regulation. Combining the concepts of offense and defense co-intelligence using the reinforcement learning algorithm, hypergraph exploration and probabilistic reasoning, the framework predicts, prioritizes, and validates exploits automatically and without signature databases. The performance of autonomous AI ethical hacking is presented as experimental assessment of heterogeneous network and IoT settings shows 99.92% accuracy of zero-day discovery, virtually perfect cover of attack surface, explainability of decisions, and resistance to adversarial interference, making autonomous AI ethical hacking the next generation and responsible cybersecurity intervention.

Two Sign: A Real-Time Bi-Directional Communication System for the Hearing Impaired Using Computer Vision and Deep Learning

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It is normal to isolate individuals because of barriers related to communication with effective interaction hearing or speech impairs with the broader society. To overcome this problem the following paper introduces TwoSign a two way live video system used to support smooth communication between non-sign language users hearing impaired. The proposed system is a project that uses computer vision and deep learn-ing to use sign language gestures to convert text and speech. In real time. The capturing of hand gestures is done by a normal camera and is subjected to landmark-based feature extraction then finally a classifier based on a deep neural network. In the speech recognition is used as a reversal of direction spoken words to written messages so that two-way communication could be achieved fully. The system is put in place by the use of a Application to be done in a software form to allow ease of access execution in consumer grade equipment. The experimental assessment indicates that the solution proposed is the one that is highly effective acquisition of recognition under low latency, and therefore practicable.Direct affordable and non-invasive aid communication tool.

AI Driven Wearable System for Stress Detection and Emotional Assistance

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Stress is an increasing issue in today's society, which impacts both the mental and physical well-being of people. Stress must be recognized at an early stage. AI Driven which will combine the obtained data (with wearable devices) and machine learning algorithms to determine the level of stress and offer emotional support will be proposed in this study. The system uses physiological indicators like the heart rate, electrodermal activity (GSR), temperature, respiration, and motion measurements obtained using wearable devices. It can be more accurate and personalized by utilizing publicly available data, such as WESAD, and self-report questionnaires, such as PANAS, STAI, SAM and SSSQ. In order to categorize stress into three levels; low, medium and high, various machines learning models are used, such as Support Vector Machine (SVM) and random forest, Decision Tree and Artificial neural networks (ANN), out of which one will be chosen as the core brain of the bot. The system responds to the amount of stress recognized by producing the responses in the form of music recommendations, breathing exercises or the conversation support. The system proposed focuses on the continuous monitoring and adaptive responses, and hence, is a usable solution to real-time stress control and emotional health.

Bridging the Revolutionary Gap: Between the Customer Perception and Service Quality among the Policy Holders

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Within a business competitive setting, an industry should understand the relationship customers have with their perception of value and their services in order to foster value growth and retention. The relationship between different dimensions of service quality, satisfaction and loyalty is the primary focus of the research. A quantitative research approach most suited to this study, collecting the requisite data through a structured questionnaire distributed to policyholders of different private and public insurance firms. The various components of service quality were assessed through the dimensions of the five service quality determinants, namely: reliability, responsiveness, assurance, empathy, and tangibility. Evaluating the impact of the various dimensions of service quality on customer satisfaction and loyalty utilized regression analysis. The findings pointed to a significant impact on customer satisfaction which was attributable, in large part, to reliability, assurance and responsiveness, in addition to empathy and tangibility even though their influence was more moderate. The findings on the relationship between customer satisfaction and loyalty, placed customer satisfaction as a mediator, is significant in this study as it demonstrates the impact of service experience on customer commitment and positive repurchase intentions. The findings of the research are significant in that they demonstrate and quantify the effects of improving service personalization, service communication, the resolve of customer issues on the gap in perception of the quality delivered by insurance firms to the quality expected by customers. The study satisfies a demand in the insurance sector, both in service quality and customer loyalty. The analysis provides valuable insights to managers for developing customer-oriented strategies that create and maintain trust and long-lasting relationships to promote competitiveness and sustainability

Federated Machine Learning for Privacy-Preserving Fraud Detection in Digital Financial Transactions

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Financial transactions in the digital world have been highly susceptible to fraud attacks, and centralised methods for fraud detection have privacy issues. In this study, FedFraud-DP is introduced as a privacy-preserving federated learning system that performs fraud detection using anonymous credit card transaction data. Data is divided both by time and into IID and non-IID simulated clients to mimic realistic distributed financial scenarios. The framework is compared against centralised, local-only models, FedAvg, FedProx and FedFraud-DP. The proposed privacy-preserving framework uses client update clipping and Gaussian noise addition to evaluate the privacy-utility trade-off. FedProx obtained the highest performance among the non-private federated models with an AUPRC of 0.7712 and an F1-score of 0.8211, while FedFraud-DP obtained a comparable performance among the privacy-preserving models with an AUPRC of 0.7640 and an F1-score of 0.8085.

Customer Churn Prediction: A Comparative Analysis

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The InsightsIQ system is an advanced AIpowered customer churn analytics platform developed to help businesses predict customer churn and make data-drivenretention decisions efficiently. It incorporates features like data preprocessing, advanced machine learning model training, dashboard for model comparison, churn prediction and generation of business insights. The InsightsIQ system facilitate user to upload customer dataset, perform automated cleaning and train the model using Random Forest, Gradient Boosting, Extra Trees, AdaBoost, XGBoost, and CatBoost. The preprocessing is performed using missing value handling, categorical encoding, data balancing using SMOTE, and hyperparameter optimization. The model performance evaluation has been performed using accuracy benchmarking, confusion matrices, ROC curves, heatmaps, and radar analysis through interactive visualizations improving decision-making and predictive accuracy. The application has been developed using Streamlit for the frontend interface, Python for backend processing, Scikit-learn, XGBoost, and CatBoost for machine learning implementation, and Plotly for interactive data visualization.

Apply Augmented Reality (AR) and Machine Learning for Customized Education; Develop Immersive Learning Platforms

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The fast growth of instructional technology has made personalization and immersion possible. In order to develop immersive, individualised learning systems, this study employs ML and AR. Augmented reality (AR) uses digital data superimposed on physical settings to generate dynamic and interesting learning experiences, while machine learning (ML) algorithms tailor lessons to each individual learner based on their interests, strengths, and weaknesses. In order to provide intelligent tutoring, adaptive content in real-time, and real-time feedback, the proposed system employs augmented reality interfaces and analytics driven by machine learning. Engaging with 3D models, simulations, and contextual information allows students to get a deeper understanding of multidisciplinary issues. Recommendation systems, predictive analytics, and other machine learning models help fill in knowledge gaps and make instruction more relevant to each individual. Through the

use of cloud and edge computing, scalable, low-latency access is made possible across all devices. User authentication and secure data management keep data safe. Compared to traditional e-learning platforms, experimental results show that AR-ML integration boosts student engagement, retention, and performance. Learners' interest, individualization, and performance can all be enhanced with the use of AR and ML, according to this research. Students are prepared to face technologically complex problems in the real world through the immersive learning platform's integration of theory and practice.

Enhance Edge-Cloud Computing Processing for Long-Term Patient Monitoring: A Scalable Health Data Aggregation Platform

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Wearable sensors, internet of medical things (IoMT) gadgets, and remote healthcare are driving demand for long-term patient monitoring solutions. Constraints on real-time data processing, bandwidth, scalability, and latency make centralized healthcare solutions unsuitable for continuous health monitoring. For optimal long-term patient monitoring, an extensible framework for health data aggregation improves edge-cloud computing. Healthcare analytics that are intelligent, low-latency, and dependable can be supported by the edge computing-cloud architecture. Reduced transmission overhead and faster responses to medical events are made possible by edge devices that filter data, identify features, and detect anomalies close to the patient. For all-encompassing patient care, cloud resources offer large-scale storage, powerful analytics, and long-term preservation of health records. Personalized health assessments, predictive analytics, and patient-specific tracking are all made possible by machine learning. Integrating the edge with the cloud improves healthcare service availability, privacy, scalability, and resource use. Process speed, data aggregation efficiency, response time, and durability are all negatively impacted by healthcare solutions that rely only on the cloud, according to experiments. In order to improve intelligent healthcare systems, researchers are working on a unified platform that uses distributed processing and scalable analytics to monitor patients over the long term. Possible outcomes of the proposed technique in interconnected medical ecosystems include smart hospitals, remote healthcare, care for the elderly, and treatment of chronic illnesses.

Generative AI and Digital Twins for Smart Manufacturing: A Sustainable Industry 5.0 Perspective

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Humanness, sustainability, and resilience are some of the characteristics that need to be considered when analyzing Industry 5.0. Despite the fact that the impact of the above-mentioned characteristics on sustainable manufacturing is still unknown, it is reasonable to suggest that application of the most advanced digital twins and GenAI will help reach excellent results in smart manufacturing. The goal of the research is the development and testing of the theoretical model for evaluating the relationship between GenAI adoption, digital twin capability, SMP, and I5R. The SEM approach was applied for analysis of the fabricated data from 312 manufacturing experts. The following results were obtained: the digital twin capability influences the sustainable manufacturing performance positively ($\beta = 0.54$, $p < 0.001$); GenAI adoption influences the digital twin capability positively ($\beta = 0.63$, $p < 0.001$); the I5R influences the sustainable manufacturing performance positively ($\beta = 0.58$, $p < 0.001$).

Quantitative Assessment of Air Quality Using a Mathematical Model of Pollutant Concentration in a Circular Atmospheric Region with Known Surface Concentration

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This study establishes a mathematical model to evaluate and quantify atmospheric pollution levels across defined circular zones using existing surface emission data. The formulation is based on the mass conservation equation incorporating transport, turbulent diffusion, and chemical transformation processes. Circular symmetry is assumed to describe near-circular urban area sources with radial and vertical concentration variations. The vertical eddy diffusivity is modeled as a height-dependent parabolic function. Analytical resolution of the central governing equation is achieved by utilizing Laplace transforms. The derived exact formulations are subsequently articulated using a combination of modified Bessel functions and Legendre polynomials. Numerical results illustrate the spatial and temporal distribution of pollutant concentration for representative atmospheric conditions.

Computer-Aided Gastrointestinal Disease Diagnosis Using EfficientNetB0-Based Transfer Learning

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Gastrointestinal (GI) diseases are one of the leading causes of morbidity and mortality in the world. Thus, early diagnosis is important in improving the prognosis of patients. Though endoscopy is the standard method for recognizing GI disorders, the manual interpretation of the images is labor-intensive and depends heavily on the physician's expertise. Recent advancements in deep learning led to the emergence of a new class of computer-assisted diagnosis systems for automatic disease detection. This paper presents an efficient model based on EfficientNetB0 to classify gastrointestinal diseases based on endoscopic images from the Kvasir data. The training of the model follows a two-stage approach in which the initial stage consists of learning features through the frozen EfficientNetB0 model and the second stage involves fine-tuning the model for learning features more specific to the classification domain. The results of the experiments demonstrate that the proposed model achieves an overall accuracy of 87.13% with a macro-averaged precision of 87.16%, a recall of 87.12%, and an F1 measure of 87.06% across eight categories of gastrointestinal diseases. Thus, the proposed model has proven to be a good model for learning salient features while having a low level of complexity.

Performance Analysis of a Reserve Machine Repair Problem with an Unreliable Repair Facility under Working Vacation

Praveen Kumar Agrawal[1] , **Rajesh Deolia**[2]
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This study develops a queuing model for a machine repair problem incorporating a working vacation policy and server unreliability. When one or more machines in the system fail, the repair facility consisting of (R) repair servers is activated to repair the failed machines according to the first-come, first-served (FCFS) discipline. The repair facility may enter a working vacation state during which repairs are provided at a reduced service rate. Furthermore, the repair server may experience breakdowns during both the normal operating state and the working vacation state, resulting in temporary interruption of the repair process. A repair mechanism is incorporated to restore the failed server and resume the repair operation. The system is formulated as a

continuous-time Markov chain, and the governing equations are solved using the matrix-geometric approach. Various system performance measures are evaluated, and a sensitivity analysis is carried out to investigate the effects of key system parameters on the performance of the proposed model. Furthermore, an optimization analysis is performed using the greedy selection method and the golden section method to determine suitable values of the repair-related rates and minimize the overall system cost.

Artificial Intelligence-Enabled UAV Framework for Sustainable Smart Logistics in Industry 5.0

Ankit Garg[1]
[1]*Ajay Kumar Garg Institute of Management*

The adoption of Industry 5.0 has proven to be highly important for ensuring that AI and AS technologies are integrated into the logistics process in a sustainable way. There is much potential for using drones powered by AI in order to complete tasks in a sustainable way. The main aim of this research is to develop an integrated theoretical model to assess the influence of AIC, UOI, DTI, and HMC on SSLP. Data used in the research work were gathered from 378 logistics managers across the manufacturing, e-commerce, and logistics industries. The integrated theoretical model has been developed in this research paper and validated using the PLS-SEM technique with SmartPLS and Python. It has been discovered that AI Capability has influenced UAV Operational Intelligence and Digital Twin Integration, while Human-Machine Collaboration has had a significant impact on SSLP. The integrated theoretical model has accounted for 72.8% of the variance in SSLP and has predictive validity. This research work will hopefully add bricks to the theoretical edifice of Industry 5.0.

Clinical Biomarker-Based Risk Prediction for Early Pancreatic Ductal Adenocarcinoma Detection

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Early detection of pancreatic ductal adenocarcinoma (PDAC) remains challenging because individual biomarkers often lack sufficient diagnostic accuracy to distinguish malignant from nonmalignant pancreatic conditions. This study proposes a leakage-safe and explainable machine-learning framework that integrates clinically informed feature engineering, Adaptive Biomarker Feature Optimization (ABFO), cross-fold explainability, and Dynamic Pancreatic Risk Index (DPRI) stratification. The framework was evaluated on the publicly available Debernardi cohort of 590 participants, including 199 PDAC and 391 non-PDAC cases. Eight original clinical and biomarker variables were expanded into 40 candidate features, from which ABFO adaptively selected 20 informative predictors within each training fold. Four classifiers were evaluated using leakage-safe stratified five-fold cross-validation and pooled out-of-fold predictions. Random Forest achieved the strongest overall performance, with a receiver operating characteristic area under the curve (ROC-AUC) of 0.9435, accuracy of 90.34%, sensitivity of 82.91%, specificity of 94.12%, F1-score of 0.8527, and Brier score of 0.0829. SHAP analysis identified stable age-dependent biomarker interactions and creatinine-normalized urinary biomarkers as major contributors to prediction, while DPRI provided clinically interpretable patient-level risk stratification. The proposed framework offers an interpretable and computationally efficient approach for biomarker-assisted pancreatic cancer detection. Index Terms—pancreatic cancer, PDAC, biomarker optimization, machine learning, explainable artificial intelligence, SHAP, urinary biomarkers, risk stratification.

AI-Driven Lung Cancer Screening, Risk Stratification, and Clinical Decision Support

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Low-dose computed tomography detects lung cancer effectively but cannot be offered to every symptomatic adult, so the operational bottleneck is deciding who to image. Questionnaire-based screening models are widely proposed for this role and are almost always reported through accuracy. We show that accuracy is close to uninformative for this task. On a public 309-respondent symptom cohort in which 87.4 % of records are positive, a rule that refers every respondent scores 86.2 % after de-duplication, while the strongest of nine classifiers reaches 90.5 % a margin of 4.3 points. Three classifiers are not statistically distinguishable from that trivial rule. We further find 33 exact duplicate records, contributing up to 1.2 points of inflation, and we report that self-declared smoking shows no significant association with the recorded diagnosis ($p = 0.686$, OR = 1.22) whereas allergy shows the strongest (OR = 9.65), which we argue is a face-validity problem that accuracy-only reporting conceals. We propose CTS, a Platt-calibrated logistic screener whose operating point is selected against an explicit cost ratio rather than fixed at 0.5. CTS attains the best average precision (99.01) and the highest Matthews correlation coefficient (0.607) while remaining interpretable, matching gradient-boosting ensembles that carry far greater complexity. At a 5:1 cost ratio it reaches 97.7 % sensitivity, and we show how the operating point migrates as that ratio changes. We recommend that screening studies report balanced accuracy, average precision and calibration against a majority-class reference, and that thresholds be justified by clinical cost.

Machine Learning-Based Obesity Level Classification with Robust Data Validation and Benchmark Evaluation

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Machine learning studies on the UCI obesity-level collection routinely report accuracies between 95 % and 99 %, and such figures are increasingly cited as evidence that questionnaire data can grade obesity. This paper asks what those classifiers are actually learning. Two properties of the benchmark make the reported figures difficult to interpret. First, the class labels were assigned by thresholding body mass index, and height and weight are supplied as input features, so the target is a deterministic function of two of its own predictors: a single decision tree on BMI alone recovers 93.42 % of the labels, and height and weight together give 94.55 %. Second, the dataset authors state that 77 % of records were generated with the Weka SMOTE filter. Because that filter interpolates, synthetic records carry fractional values in fields the survey recorded as integers; this signature separates the two strata at 99.24 % agreement and identifies 1596 synthetic against 515 survey records, closely matching the documented split. The strata are not equivalent. No synthetic record exists for the Normal Weight class, and Obesity Type III is supported by three real respondents against 321 generated ones. When the same seven classifiers are re-evaluated on survey records alone, the best accuracy falls from 96.27 % to 82.54 % and balanced accuracy to 69.17 %. We conclude that published accuracies on this benchmark measure BMI arithmetic and stratum membership rather than obesity prediction, and we set out reporting requirements for future work. This study extends our earlier comparison of k-nearest-neighbour and decision-tree models on the same collection, which is cited here as prior work.

Artificial Intelligence and Natural Language Processing for Speaker Diarization, Video Summarization, and Code-Mixed Languages

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Summarising a recorded multilingual meeting requires three capabilities that are usually studied apart: video summarization to select what matters, speaker diarization to attribute it, and code-mixed language processing to handle utterances that switch language mid-sentence. Reviews of these areas routinely assert that their convergence is promising, but the assertion is never tested against the literature it draws on. This review tests it. We assemble a corpus of 28 works spanning 2013 to 2025, assign each a domain tag and a method-family tag, and compute the pairwise coverage matrix. The result is unambiguous and stronger than the usual claim: 0 of 28 works address more than one of the three core domains, and every off-diagonal entry of the coverage matrix is zero. The three literatures do not merely emphasise different problems, they do not intersect at all. We further find that 78.6% of the corpus is journal-published and 85.7% appeared in 2020 or later, so the absence of convergence work is a property of an active and recent literature rather than an artefact of surveying a dormant one. Method-family analysis shows attention-based and end-to-end neural formulations dominating all three areas independently, which is what makes the missing intersection surprising: the areas have converged methodologically while remaining separate as problems.

Time-Dependent Model for Innovation Diffusion and Market Adoption

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The innovation diffusion model can be helpful to explain the spread of a new product in a market. It also helps in studying customer adoption behavior and estimating the growth of market demand. The current study presents a new innovation diffusion model, in which the rate of adoption varies with time. The model aims to reflect the changing response of customers throughout the diffusion process. It assumes that the adoption intensity will increase slowly and then stabilize over time. A closed form solution is found for cumulative adoption. The model parameters are estimated using least squares estimation. Its performance is compared with two existing innovation diffusion models. The results show that the proposed model provides a close fit to the observed sales data. The study demonstrates that a time-dependent adoption rate can be a simple and flexible model to describe the diffusion of innovation.

An FPGA-Accelerated CNN-Attention Framework for Multiclass Gas Sensor Classification

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Low-concentration gas identification using metal-oxide semiconductor sensor arrays is challenging due to weak responses and similarities among gas signatures. This paper demonstrates a deep learning based methodology for multiclass gas classification using the Gas Sensor Array Low-Concentration dataset. Three architectures, namely 1D CNN, CNN-LSTM, and CNN-Attention, are developed and evaluated for classifying six gases. The 9000 sensor-response values are represented as 900 time steps with 10 sensor channels. Experimental results show accuracies of 83.33%, 77.78%, and 88.89% for 1D CNN, CNN-LSTM, and CNN-Attention, respectively.

The CNN-Attention model achieves the best performance with 88.89% precision, recall, and F1-score. The selected model is further targeted for FPGA implementation using a C++ to HLS to FPGA workflow for efficient edge-based gas classification.

Explainable Ensemble Learning Approach for Crop Yield Prediction Using Integrated Soil and Environmental Parameters

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The conventional regression techniques fail to capture the complexities involved in agricultural behavior and have low levels of interpretability in the field of agriculture. With the shortcomings of the current approaches, this research proposes an approach that leverages ensemble learning along with explainability to predict the yields of crops using soil and environmental factors as predictors. Public datasets on crop production, weather data, and soil compositions have been used to construct the data set for our experiments with 19,689 samples and 15 features. Some data preprocessing steps like missing values analysis, logarithmic transformation of the target variable, categorical variables' encoding, and feature scaling were carried out to ensure better model stability and prediction reliability. Several regression models, including linear regression, decision tree, random forest, and extreme gradient boosting, were trained using these methods and evaluated for their performance through MAE, RMSE, and R^2 measures. Optimization for hyperparameters was carried out by Randomized SearchCV to enhance generalization capability. Experiments show that the optimized XGBoost regression model achieved the best performance compared with other baseline regression algorithms, scoring the highest R^2 (0.9538) and RMSE (0.2412). Also, five-fold cross validation gave a high average R^2 (0.9568) score with low standard deviation. SHAP-based explainability analysis confirmed that some important features such as crop attributes, soil nutrients, fertilization level, and environmental attributes greatly affect crop yield behaviors. Hence, the use of explainable AI techniques can help understand agricultural behaviors better. The presented approach shows that ensemble learning with explainability offers an efficient solution for accurate intelligent prediction and management of agricultural production.

A Lightweight Mutual-Information-Guided Ensemble Learning Framework for Real-Time Intrusion Detection in Resource-Constrained IoT Networks

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Meanwhile, the internet of Things (IoT) has increased the attack surface of the networks, and limited computation, memory and energy capacities of edge nodes make it hard for implementing conventional, feature-rich intrusion detection systems (IDS). The proposed framework is a lightweight ensemble learning based on mutual-information (MI) for feature selection techniques and a weighted soft-voting ensemble of Random Forest, Support Vector Machine and a compact Multilayer Perceptron for achieving high classification accuracy for network traffic classification problem into five classes: Normal, DoS, Probe, R2L, and U2R. MI ranking reduces the original 20-dimensional flow-feature space to the 12 most informative features, lowering Random Forest training time by 26.7% while preserving discriminative power. On a simulated IoT flow dataset of 15,000 records, the proposed ensemble attains 96.67% accuracy, an 89.85% macro F1-score, and a 99.46% macro ROC-AUC, outperforming every constituent classifier while sustaining an inference throughput above 10,000 samples per second (97.94 microseconds per sample) — well within real-time edge-deployment requirements. Results further show that minority attack classes such as R2L benefit from the ensemble's complementary decision boundaries, whereas rare U2R traffic remains comparatively harder to classify, motivating future work on class-imbalance handling. The proposed framework offers a practical accuracy-efficiency trade-off for real-time IDS deployment on resource-constrained IoT gateways.

RQ-FedHAR: Rotational Quantum PSO-Based Federated Human Activity Recognition with Communication-Efficient Client Selection

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Participant selection can reduce federated-learning communication, but utility-driven selection may amplify subject heterogeneity and participation imbalance. This paper introduces RQ-FedHAR (Rotational Quantum PSO-Based Federated Human Activity Recognition), a communication-aware framework in which Rotational Quantum Particle Swarm Optimization (RQPSO) jointly tunes five client-utility weights, client fraction, aggregation temperature, local learning rate, and FedProx regularization. RQPSO is a quantum-inspired classical optimizer that represents candidates through qubit-like phase vectors, decodes tensor-product amplitudes into a nine-dimensional policy, and learns through shortest signed rotations toward personal and global best phases. The method is evaluated on the UCI smartphone HAR data set using 17 natural subject clients, four validation subjects, and nine untouched test subjects. RQPSO, PSO, and QPSO receive identical populations, paired seeds, and exactly 96 objective evaluations across 30 runs. RQPSO attains 0.8950±0.0022 accuracy and 0.8922±0.0022 macro-F1 on unseen subjects while selecting 6.93 of 17 clients per round and reducing modeled bidirectional communication by 59.2% relative to full participation. Its macro-F1 exceeds PSO and QPSO by 0.0033 and 0.0029 on average (paired Wilcoxon p=0.0016 and p=0.0248), with lower run-to-run variance. The validation objectives and the mean communication, however, are lower for PSO and QPSO, and higher for random and full participation in terms of participation fairness. The findings indicate that RQPSO is a stable generalizing policy search method, and not an all-powerful optimizer.

Empirical Quantification of Chess Opening Performance and Resilience across Rating Differentials in Online Play

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In this case, an analysis of more than two thousand five hundred games from the Kaggle chess dataset of over twenty thousand high-quality chess games is provided and supplied with detailed descriptions of the opening choice and the strength differential of players. Therefore, after this process of data cleaning and filtering for openings with large enough samples the win, draw and loss rates by ECO code were then calculated. A chi-squared test of independence of the variables ‘opening selection’ and ‘result’ =1292.21, p<0.001 therefore; this showed that there is a statistically significant relationship between the variables. Ten of the most popular openings were plotted in terms of white-win probabilities against 100-point rating-difference bins, and it was found that some of the hypermodern defenses allow for better-than-par performance when White is less strong than Black. Thus, they support not only the conventional theory for the lines for the top performers such as Ruy Lopez Morphý Deferred but also reveal many interesting lines that, in fact, have shown good upset possibilities. Using a quantitative approach together with large scale testing in conjunction with qualitative representations in the form of heat maps may be used to achieve a more rigorous method of assessing opening choices. Subsequent developments will incorporate a predictive modeling of early-move probabilities as well as a conversion of the scribble to a network form in order to improve accuracy of the automated repertoire suggestions.

Impact of Retrieval Design on Grounding and Hallucination in Scientific Question Answering

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Retrieval-Augmented Generation (RAG) can ground language-model answers in external evidence, yet retrieval choices may alter both factual support and answer quality. This paper presents a controlled application-oriented evaluation rather than a new algorithm. The QASPER scientific-question-answering corpus supplies full papers, expert answers, and supporting paragraphs. A retrieval screen evaluates 36 combinations of BM25, dense, and equal-weight hybrid retrieval; 128, 256, and 384 lexical-token chunks; zero or 20% overlap; and top-3 or top-5 context on 180 answerable questions. A disjoint set of 90 answerable and 30 unanswerable questions then compares no context, three retrievers, hybrid retrieval with cross-encoder reranking, and oracle evidence under a fixed FLAN-T5-small generator. Hybrid retrieval with 384-token, zero-overlap, top-5 chunks reaches 0.9170 evidence recall and 0.9833 hit rate. On answerable questions, retrieved context raises token F1 from 0.0718 without context to 0.0997–0.1162 and reduces the unsupported-answer rate from 0.9333 to 0.5222–0.5889. The overall unsupported rate falls significantly for hybrid retrieval (0.7917 to 0.6417; paired exact McNemar p=0.0247). Reranking increases evidence recall to 0.9014 but does not significantly improve token F1 over hybrid retrieval. All non-oracle retrieval systems fail to abstain on the 30 unanswerable questions, whereas oracle evidence attains 0.2943 answerable F1 and 0.6333 refusal accuracy. The results show that stronger retrieval improves grounding but cannot substitute for answerability-aware generation.

Cross-Project Reliability of Machine Learning Models for Software Defect Prediction: A Calibration and Distribution-Shift Study

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If the software defect prediction is reported by the accuracy of within-project validation, there is a problem, but the deployment in practical use needs to be to a project with no labels. This paper is an application study of the reliability which is considered to be cross-project reliability instead of suggesting a new learning algorithm. Three public NASA/PROMISE datasets—JM1, CM1, and PC1—provide 8,814 modules, 1,775 defective instances, and 21 shared static-code metrics. Logistic regression, random forest, histogram gradient boosting, and a multilayer perceptron are assessed through stratified five-fold within-project validation and six directional cross-project transfers. Every transfer is repeated across five source-only calibration splits; target labels are excluded from fitting, probability calibration, and threshold selection. Mean Matthews correlation coefficient declines from 0.249 within projects to 0.179 across projects, a 28.2% relative reduction, while precision-recall area decreases from 0.357 to 0.292. Cross-project Brier score and expected calibration error increase from 0.110 and 0.043 to 0.133 and 0.117. Source-only Platt scaling reduces the uncalibrated cross-project Brier score by 33.4% and expected calibration error by 50.8%, with paired Wilcoxon p-values below 10−13. Logistic regression records the highest mean cross-project Matthews correlation coefficient (0.190), whereas random forest provides the best Brier score (0.127) and expected calibration error (0.104). The findings show that source-only calibration materially improves probability reliability without eliminating transfer degradation.

NavGrah Optimization for Wrapper-Based Feature Selection and Linear SVM Tuning in Phishing Website Detection

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Phishing detection models must balance predictive quality with a compact feature footprint. This paper applies the NavGrah Optimization (NGO) algorithm to joint wrapper-based feature selection, linear support vector machine regularization, and phishing-class weighting. A normalized 32-dimensional representation prevents scale-dependent bias across heterogeneous decision variables. The method is evaluated on the UCI Phishing Websites data set containing 11,055 instances and 30 handcrafted features. NGO is compared with particle swarm optimization (PSO) and the grey wolf optimizer (GWO) using identical initial seeds, population size, and a strict budget of 300 objective-function evaluations across 30 independent runs. On an untouched test set, NGO-SVM obtains mean accuracy, F1-score, and ROC-AUC of 0.9157, 0.9041, and 0.9709, respectively, while retaining 21.7 features on average. Relative to a full-feature default SVM, NGO removes 27.8% of the inputs with a 0.33 percentage-point accuracy reduction. NGO has the highest mean predictive scores among the three optimizers, although Friedman and paired Wilcoxon tests do not establish significant predictive superiority. The results therefore support NGO as a competitive accuracy-preserving search mechanism while also identifying sparsity and runtime as targets for a future binary multiobjective variant.

Adaptive Learning Systems in Higher Education: A Systematic Review of NLP and Explainable AI Approaches for Personalized Academic Performance Enhancement

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In the domain of Education and Learning, practice of Artificial Intelligence is gaining momentum in higher institutions intended at its positive impact. The deployment of such technologies, such as NLP and XAI, and adaptive learning structures, contributes to richer personalized learning and better educational outcomes. Studies involving integration of these technologies in a holistic approach are not extensive. In this work, a Systematic Literature Review (SLR) is presented resulting PRISMA strategies. Two hundred and three (230) research records were obtained from various databases and after screening and quality assessment, 54 studies published from 2021 to 2026 were selected. The review discusses the key research themes, methodologies, NLP methods, XAI methods, ethical considerations and future research directions. The results indicate that PLE, AI Ethics, E-Tech and Learning Analytics are the most prevalent research areas. The studies, however, that integrate analysis of student feedback using NLP with those that provide recommendations transparency using XAI are relatively scarce. Some of the identified challenges are also the lack of ethical guidelines, lack of long term evaluation studies, and that fewer implementations have been done in a developing country. In the light of this, the following conceptual NLP-XAI adaptive learning framework is proposed, in order to contribute to transparent, trustworthy and personalized learning. The study can be beneficial for researchers and educators in the ground of intelligent and explainable learning systems.

High-Performance AI Data Streaming Framework Optimized for HPC Systems Using Mofka

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The growing mismatch between accelerator computation and parallel-file-system bandwidth makes intermediate data movement a critical limitation in artificial intelligence-enabled scientific workflows. This paper proposes HPAI–Mofka, an event-driven framework that combines Mofka persistent streams with GPU-aware consumers and closed-loop adaptation of batching, partition placement, consumer concurrency, backpressure, and retention. Metadata and large scientific payloads follow separate paths so that simulation, inference, provenance, and storage progress asynchronously while events remain replayable. A methodology is defined for workload characterization, schema design, resource placement, failure handling, and multi objective tuning. Since no dedicated supercomputer experiment was executed for this study, quantitative results are explicitly model-derived from a reproducible queueing scenario. At 32 nodes, the scenario increases effective throughput from 61 GB/s for file staging to 151 GB/s, reduces burst-load p99 latency from 148 ms to 46 ms, and lowers intermediate storage traffic by 68% when confidence-aware filtering retains 32% of events. These results formulate testable hypotheses for deployment on RDMA-enabled CPUGPU clusters.

IoT-Based Intelligent Bidirectional EV Charging Station with Dynamic Power Management for Grid Stress Reduction

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The rapid growth of the adoption of EVs createssignificant charging demand, resulting in increased peaks, and an effect on renewable energy utilization on the distribution grid. This work aims to put forward an intelligent bi-directional EV charging station with dynamic power management using IoT for reducing the stress on the grid. A bidirectional DC-DC converter is employed for power transfer between the batteries and powering the ESP32 controller which samples battery voltage, current, energy and operation mode. Safe and connected operation thanks to a battery management system, protection circuitry, cooling, display and Wi-Fi communication. With regard to the power exchange, any unnecessary power exchange is reduced in both charging cases and discharging cases by the controller which dynamically adapts the charging or discharging. In the regard of the hardware solution, the results in accuracy of control decisions, in energy transferred by the solution and in successful execution of the grid-support decisions reached 98.7%, 97.9 % and 96.8 % respectively, while providing reliable real time monitoring and protection services. Results are demonstrative of the potential practicability of flexible, connected and grid responsive EV charging infrastructure.

RAG-Guarded Interview Simulation: Grounding LLM-Driven Interviewers via Retrieval-Augmented Generation and Reward Shaping

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Sharma and Das [1] developed a two-module system for placement preparation: an eligibility predictor that assesses a student's fit for a job role, and a mock interview engine driven by an LLM and a Deep Q-Network (DQN). Their system achieved a 4.7/5 user satisfaction score but suffered from a known limitation — the GPT-3.5 Turbo-based question generator occasionally fabricated questions that did not correspond to real interview

practice. The authors identified this as motivation for incorporating retrieval-augmented generation (RAG) guardrails in future work.

This paper addresses that gap. Rather than allowing the generator to produce questions freely, we ground it in a curated dataset of 12,400 real company interview questions. These questions are indexed using dense bi-encoder embeddings for retrieval and re-ranked using a cross-encoder to improve relevance. We further introduce Grounding-Constrained Reward Shaping (GCRS), a modification to the DQN's reward function that penalizes the system whenever a generated question deviates too far from the real, matched questions retrieved from the dataset.

We evaluated our approach on 2,100 data samples and 80 mock interview sessions. The rate of fabricated (hallucinated) questions dropped substantially — from 11.7% to 3.1%, representing a 73.5% relative reduction. User satisfaction improved from 4.7/5 to 4.83/5, and answerability (the proportion of questions that could reasonably be answered) rose from 84.2% to 96.4%. Notably, the eligibility prediction module was left unmodified, and its performance remained unchanged at 92.4% accuracy with an Equalized Odds Difference (EOD) of 0.08 — confirming that fairness and accuracy in eligibility assessment were preserved while hallucination in the interview module was significantly reduced.

AI-Powered Tomato And Potato Leaf Disease Classification System Using Transfer Learning And Explainable AI

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The diseases can lead to low yield in crop as well as the quality of production of the crops. Hence the identification of the diseases in the early stages will help in handling the crops. In this, an AI-based disease detection system has been proposed which will use images in order to detect the diseases in the plants through deep learning and Explainable Artificial Intelligence. The proposed system has been designed using lightweight MobileNetV2 network and transfer learning method in order to classify the images of leaves into 13 classes of diseases and one healthy leaf class. Leaf detection has been carried out to see if the uploaded image belongs to any of the disease classes before going for the process of classification in order to prevent the misclassification of irrelevant images. Grad-CAM and LIME methods have been utilized in order to visualize the parts of the leaf that are responsible for the decision made by the model. The performance of the model has been achieved with 78.14% accuracy and macro F1 score of 0.78 on test data. This system has been implemented as a web application that performs disease prediction, confidence score, visualization, information about the disease, treatment recommendation, predictions history and report download.

Mathematical Modeling & Analysis of Blood Flow in the Retinal Tissue using Young's Modulus

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Eye is a very complex biological structure which making it a unique area for studying retinal hemodynamics in both healthy and pathological conditions. The main focus of current research is modeling of blood flow in the retinal tissue, considering the elastic nature of the retinal capillaries. The author employed Young's Modulus concept to describe the mechanical behavior and its influence on blood flow in the retinal tissue. Current mathematical model based on the Navier-Stokes equations for incompressible flow, which capture the fluid dynamics within the retinal vasculature. Present work explores the factors pressure gradient, retinal tissue diameter, length of retinal tissue, and hematocrit levels which affects the blood velocity.

A Comparative Evaluation of Supervised and Unsupervised Machine Learning for Cervical Cancer Risk Prediction

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Cervical cancer is largely preventable, and machine learning is often proposed as a low-cost triage aid where organised screening is unavailable. Reported accuracies on the UCI cervical cancer risk-factor cohort routinely exceed 95 per cent, yet only 6.4 per cent of its 858 records carry a positive biopsy, so a classifier that predicts no disease for every patient already scores 93.6 per cent. This paper evaluates eight classifiers logistic regression, k-nearest neighbours, a support vector machine, XGBoost, LightGBM, AdaBoost, gradient boosting and CatBoost with a stratified 80/10/10 split, SMOTE applied to the training partition only, and validation-based tuning. LightGBM achieves the highest test accuracy (0.977), AUROC (0.980) and Matthews correlation coefficient (0.788). The test partition, however, contains five positive cases: six models share a sensitivity of 0.80 with a Wilson 95 per cent interval of 0.38 to 0.96, and gradient boosting only equals the no-information accuracy. K-means and DBSCAN yield adjusted Rand indices of 0.100 and 0.112 against the biopsy label, showing that the geometry of the risk-factor space does not align with malignancy. Between-model differences on this cohort are smaller than the uncertainty of a single-split estimate, and we specify a leakage-free repeated cross-validation protocol for future comparisons.

BGC-ProtoNet: Background-Consistent Prototypical Networks for Few-Shot Plant Disease Recognition on Unseen Crops

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Deep models for plant disease recognition are usually trained on laboratory image collections such as PlantVillage, in which every leaf is photographed against a uniform background. Such models degrade sharply when the background changes, and they require large labelled sets for every crop–disease combination, which is unrealistic for a newly monitored crop. This paper studies few-shot disease recognition on a crop that is entirely absent from training, using laboratory data only. We propose BGC-ProtoNet, which couples three components: Background Randomization Augmentation (BRA), which composites the segmented leaves shipped with PlantVillage onto synthetic gradient, texture and clutter backgrounds and therefore needs no field imagery; a cross-background episodic objective, in which class prototypes and queries are always drawn from differently backgrounded views; and a Background Consistency Loss (BCL) that forces the two background variants of the same leaf to share an embedding. Following a crop-disjoint protocol in which the ten Tomato classes are never seen during training, and under three test conditions (clean, background-swapped, and a cross condition with laboratory support and field-like queries), BGC-ProtoNet reaches 71.82 ± 0.59 % accuracy in the 5-way 5-shot cross condition, against 60.84 ± 0.58 % for an episodically fine-tuned prototypical baseline. The accuracy drop caused by replacing the background falls from 24.8 percentage points for the baseline to 1.4 points for the proposed model, indicating that most of the residual background shortcut is removed. The ablation shows that the two components are complementary, and all comparisons are performed on identical test episodes.

FSDA-Net: A Frequency–Spatial Dual-Attention Network with Rank-Consistent Ordinal Supervision for Diabetic Retinopathy Severity Grading

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Diabetic retinopathy (DR) is a leading cause of preventable blindness, and manual grading of fundus photographs is slow and subject to inter-rater disagreement. Almost all deep learning systems for DR grading consume the image only in the spatial domain and treat the five severity grades as unordered categories, discarding both the spectral signature of fine retinal lesions and the ordinal structure that the evaluation metric rewards. We propose FSDA-Net, which processes a fundus image in parallel through a spatial convolutional branch and a frequency branch operating on the 2D discrete Fourier transform log-magnitude spectrum, fusing the two by bidirectional cross-attention with a learned gated merge. A rank-consistent CORAL head is trained under a combined ordinal and differentiable soft-QWK objective with a self-paced curriculum sampler. To our knowledge this is the first architecture to use the Fourier spectrum as a jointly learned discriminative stream for DR grading rather than a domain-generalisation device. On a held-out fold of APTOS 2019, a single model without external pre-training or ensembling attains 0.8656 QWK and 74.35% five-class accuracy, with 92.77% of predictions within one clinical grade and referable DR detected at 89.26% sensitivity and 95.17% specificity.

HA-CNN: Image-Based Art Style Classification Using a Hierarchical Attention Convolutional Neural Network

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Automatic recognition of artistic style from digital images has become an important problem as museums, galleries, and online repositories digitise their collections at scale. Artistic style is expressed through subtle and spatially distributed cues such as brushstroke texture, colour palette, shading, and composition, which handcrafted descriptors capture poorly and which standard convolutional neural networks (CNNs) tend to dilute through uniform spatial pooling. This paper proposes a Hierarchical Attention Convolutional Neural Network (HA-CNN) for artist-level style classification. The network interleaves three convolutional blocks with attention modules that re-weight feature maps at low, intermediate, and high levels of abstraction, so that stylistically informative regions are emphasised at every scale before global average pooling and a compact dense classifier. The model is trained and evaluated on the Best Artworks of All Time dataset, comprising 8,774 images from 51 artist classes. HA-CNN achieves an accuracy of 86%, a precision of 0.84, a recall of 0.82, an F1-score of 0.83, and a macro-average area under the ROC curve of 0.855, outperforming a support vector machine baseline (74% accuracy) and a conventional CNN without attention (81% accuracy). The results show that multi-level attention is an effective and lightweight way to capture fine-grained stylistic cues, with direct applications in digital art archiving, cultural heritage preservation, and content-based artwork retrieval.

WasteNetR3: Benchmarking CNN and Transfer-Learning Models on a Merged Multi-Source Waste Dataset for Colour-Coded Dustbin Classification

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Correct segregation at the dustbin is the first and cheapest step of any waste-management chain, yet an item thrown into a bin may come from a household, a street, a clinic or an electronics shop. Vision models for this setting are usually trained on small single-source datasets. This paper studies a merged, multi-source corpus of about 110.8k images in 46 fine-grained classes spanning street/household litter, e-waste, medical waste and municipal solid waste, and maps every class to six colour-coded bins following India's Solid Waste, Bio-Medical Waste and E-Waste rules. We benchmark a two-layer CNN, a regularised StrongCNN trained from scratch, fine-tuned MobileNetV2 and ResNet-50, and a linear SVM on frozen MobileNetV2 features. On held-out images, fine-tuned MobileNetV2 attains 90.95% accuracy with only 2.28M parameters, on par with ResNet-50 (90.66%) and the SVM (90.45%), while StrongCNN reaches 78.21% test accuracy and the plain CNN 65.91%. Errors concentrate in municipal classes whose label semantics overlap after merging (organic waste 19% recall, recyclable 39%), whereas source-specific classes exceed 99% recall even for weak models, a sign of source shortcuts. Macro recall per target bin ranges from 96.4% (yellow biomedical) to 59.6% (green wet waste). We also audit the experimental pipeline, show that cross-split evaluation of reloaded checkpoints inflates accuracy to 96.32%, and release a leakage-free protocol.

An Explainable Gradient-Boosting Ensemble for Multi-Source Fire Risk Detection Using IoT Sensor and Meteorological Data

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Early and reliable fire-risk detection requires models that can reason over heterogeneous evidence, from indoor multi-gas and particulate sensors to outdoor meteorological fire-weather indices. This paper presents a class-balanced, GPU-accelerated soft-voting ensemble of three gradient-boosted decision-tree learners, XGBoost, LightGBM and CatBoost, evaluated on four binary fire/no-fire tasks: an IoT smoke-detection dataset (62,630 readings, 12 sensor channels), the Algerian Forest Fires dataset (243 days), the Portuguese Montesinho Forest Fires dataset (517 events) and a harmonised combination of the two wildfire datasets. On stratified 80/20 hold-out splits, the ensemble attains an accuracy, weighted F1 and AUC-ROC of 1.000 on the IoT and Algerian tasks, 0.683/0.682/0.712 on the Portuguese task and 0.711/0.710/0.805 on the combined task. SHAP analysis identifies total volatile organic compounds and barometric pressure as the dominant predictors for the IoT model. We further describe partial-sensor and single-sensor inference modes for degraded deployments. Finally, we critically examine why near-perfect scores arise on the IoT and Algerian data, pointing to temporal autocorrelation under random splitting, very small test sets and fire-weather indices that nearly encode the label, and we outline a leakage-aware evaluation protocol for future benchmarking.

Integrating Machine Learning with Reinforcement Learning and Heuristic Approaches for Optimizing Resource Usage

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Optimization of resource allocation can be viewed as a critical concern associated with cloud environments, as it highly influences system performance, cost efficiency, and user satisfaction. The present paper aims to investigate how integrating machine learning and heuristic and reinforcement learning approaches can be used to optimize the use of resources within cloud databases. The machine learning (ML) methods evolved in the study need to be trained on historical figures present within the databases. Artificial Neural Network (ANN), Decision Trees (DT), and Support Vector Machines (SVM) are used, with the latter having two specifications, implemented mediums on the data collected. Moreover, reinforcement learning methods were utilized including the Deep Q-Network (DQN) model, which makes the Meta-learning substandard. Heuristic methods employed, such as the threshold. To measure the effectiveness and efficiency of the aforementioned methodologies, comprehensive metrics were implemented, such as resources used, cost-efficiency achieved, performance of the system, scalability, and adaptability. The results revealed the following findings. The ANN model is associated with the highest accuracy rate of 98.66% when predicting the resource allocation decisions, compared with 93.4% of DT and 95.6% of SVM. Further, the employment of the reinforcements learning, and heuristic approaches is advantageous as it makes the system adaptable and responsive, with the equal of real time resource utilization. Overall, the results are highly reliable and valid as they were constructed through a deep investigation. The present research would a value to others as it unveils the pros and cons of the application of each researched technique.

Multi-Objective Optimization of Consumer Retargeting Strategies Using Deep Reinforcement Learning in Digital Marketing Campaigns

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In this study, the authors explore how to use Deep Reinforcement Learning (DRL) approaches for multi-objective optimization of consumer retargeting strategies in online marketing campaigns. While retargeting is about rekindling the interest of targeted customers who interacted with ads or websites before, campaign optimization is about making compromises between different goals, such as getting the highest possible Click-Through Rate (CTR) or the lowest possible Cost Per Acquisition (CPA) or a better Conversion Rate (CVR). In the current research, we examine four commonly-used methods: DRL Deep Q-Network (DQN), Proximal Policy Optimization (PPO), Soft Actor-Critic (SAC), and Multi-Agent Deep Deterministic Policy Gradient (MADDPG) to investigate their utility when optimizing ad bidding and display dynamically in a multi-objective context. The features that are input to the model are used to represent user behavior, contextual features and budget related information, and the reward functions are introduced to provide suggestions for efficient optimization of different goals by using scalarization and Pareto-based methods. They have been trained and tested in test environments resembling real-world retargeting situations. The performance of each model was evaluated using ACR, CTR, CPA, ROAS and stability metrics. The experiments show that SAC and MADDPG perform best among all the models in terms of achieving higher engagement rate, maximum cost-effectiveness, and consistent performance over multiple runs. This paper shows that in the online advertising domain, where actions are continuous, actor-critic methods offer greater flexibilities and robustness, leading to improved accuracy and profit for retargeting policies.

Adaptive Learning for Real-Time Recommendation Under Dynamic User Preferences

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This paper proposes an adaptive meta-learning system to support real-time personalization in dynamic consumer-preference environments for intelligent e-commerce product recommendations. To tackle the challenge of dynamically fine-tuning recommendations in the presence of limited user interaction feedback, we will examine four popular meta-learning models: Model-Agnostic Meta-Learning (MAML), Prototypical Networks, Reptile and Meta-LSTM. A large dataset of thousands of user-product interactions over various categories was gathered, preprocessed, and employed to train and test these models. The experimental findings reveal that the accuracy, ranking quality, and the user engagement scores of the proposed model, namely Meta-LSTM, are significantly higher than the other models. Specifically, Meta-LSTM achieved a Top-1 accuracy of 81.3%, an NDCG@5 of 83.7%, and a click-through rate (CTR) of 16.5%, showing itself to be the best learner when it comes to temporal user behavior and generating highly relevant personalized recommendations. The MAML adaptation speed was competitive alongside with the Reptile adaptation speed, while the adaptation accuracy of Prototypical Networks was marginally lower, which was counterbalanced by its strong adaption speed in high adaptation accuracy. The adaptation speed analysis also revealed that there was a trade-off between model complexity and the number of gradient steps required to get to a stable performance, with Prototypical Networks requiring the lowest number of steps and Meta-LSTM the highest.

Efficient Resource Utilization in Edge-Based Distributed Machine Learning Using Heuristic and Reinforcement Learning Approaches

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This research investigates the integration of heuristic and reinforcement learning (RL) approaches in a distributed machine learning framework based on the edge to optimize resource utilization. The heuristic evaluation for the efficiency of the allocation of resources between computation and communication range from 0.82% to 0.89%, thus demonstrating the efficiency of the heuristic algorithms not only in computation resources but also in energy savings during the allocation of computation and communication resources. The data from 21–28 iterations indicated that some convergence speeds were different, with a moderate, but credible emerging trend that better solutions are being reached in less time than usual. The adaptability in terms of scalability assessed was categorized as either High or Low. It showed that heuristics can adapt themselves differently in terms of proportions to the size of distributed job. The range of robustness is between 88% and 95%, depending on network conditions and device capabilities. This highlighted the ability for heuristics to adapt. Superlative training performance was noted in the reinforcement learning aspect, with values ranging from 90% to 95%, highlighting the outstanding efficiency and stability achieved by RL models. Balance between exploration and exploitation, also, showed a good balance in the scrimmage of the decision-making process (0.74% – 0.82%). As far as dynamic environments are concerned; adaptability to them consistently showed High, whereas generalization was poor quality.

Optimization of Welding Parameters for Mechanical Strength Enhancement

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This research focuses on how to get the best results from MIG welding parameters in terms of strengthening the mechanical ability of AISI 1020 low-carbon steel welded joints. Different levels of welding current (120-160 A), arc voltage (18-22 V), and travel speed (300-500 mm/min) were varied with the use of a Taguchi L9 orthogonal array. Assessment of tensile strength through experimentation showed the mechanical strength to range from 385.78 MPa to 467.02 MPa. The maximum tensile strength (467.02 MPa) was recorded at 140 A, 22 V, and 300 mm/min, whereas the minimum (385.78 MPa) was at 160 A, 18 V, and 500 mm/min. According to the results, a slower travel speed (300 mm/min) is a major factor that leads to strength improvement, thanks to the increase in heat input and a better fusion process. A tensile strength prediction model via regression was established, indicating positive effects of current and voltage and a negative effect of travel speed. The study results demonstrate that sufficient heat input plays a vital role in enhancing the performance of weld joints while reducing the occurrence of defects.

A Survey on Diabetic Retinopathy Detection and Severity Classification Models

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Diabetes Mellitus (DM) is one of the most rapidly spreading chronic diseases that cause vital health risks to individual with the growing population. This increase is largely attributes to busy lifestyles, lack of awareness about disease and unhealthy eating habits. Diabetes can impact the human body in several ways, Diabetic Retinopathy (DR) is one of the diseases caused due to diabetes and it can result severe reduced vision loss or it might lead to blindness if it is not treated. DR is one of the significant contributors behind global blindness and is a progressively deteriorating eye condition due to the consequences of diabetes. It is essential to effectively and accurately classify the severity of DR for promptly diagnosing and treatment of disease. For accurately assessing DR severity, ophthalmologists examine the retina for clinical signs and categorizing the condition into five stages: normal, moderate, mild, severe and PDR (Proliferative Diabetic Retinopathy). For timely intervention of DR, accurate and effective diagnosis is crucial. Currently, AI (Artificial Intelligence) has shown remarkable potential for the revolutionization of detection and risk assessment of DR. Disease prediction and data collection at early stage have become possible due to the recent technological advancements. Currently, Deep Learning (DL) algorithms have been used in detection and classification of DR using retinal fundus images. In this analysis, a survey on Diabetic retinopathy detection and severity classification models is presented. DR images manual examination is prone to error, labor intensive and consumes time. Often existing methods heavily depends on handcrafted features which limit the classification accuracy and adaptability for disease detection. The main aim behind this survey is performing comprehensive analysis on present status on DR research and developments in the field with advanced technologies.

Future of Digital Marketing Dynamism Through a Predictive Business Analytics Model

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Globally, the size of predictive analytics has crossed almost $12 billion in 2022 and anticipated to create a landmark up to $27 billion in 2026. Rising business activities are playing vital role in comprehending the tools of predictive models that develop business outreach in more precise and transparent way. It also assists in

mitigating the operating cost that the firms could be bearing additionally soon. It furnishes valuable insights about customers' behaviour though it engages certain kind of intricacies in digital marketing to do predictive analysis. This analysis enhances business performance by leveraging predictive tools that are Artificial intelligence driven. The study will focus upon how business analytics are acting as a reinforcement in making better decisions and providing support system to giant business tycoon.

Disease Spectrum of Diabetic Retinopathy Detecting using Deep Learning

Neeraja Veeramachineni[1]
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Diabetic Retinopathy (DR) is a debilitating eye scenario due to the uncontrolled diabetes which can cause impaired vision and vision deterioration. One of the major causes behind visual impairment and blindness across the world is Diabetes associated retinal vascular disease. DR can be classified as NPDR (Non-Proliferative DR) and PDR (Proliferative DR). Detection and treatment at early stage is crucial to prevent the progression of disease from early stages to critical (PDR) stage. DR is the most prevalent diabetics complication leads to blindness and often undetected until the critical stage, since patients seek help only if symptoms manifest and lack of expert's availability. Thus automatic DR detection can significantly helps to reduce visual impairments caused due to DR by early screening and treatment of DR. With the advancements of AI, the evaluations of DR are being automated. In recent times, Deep Learning algorithms have been used for detecting and classifying the DR using retinal fundus images. In this analysis, Disease spectrum of Diabetic Retinopathy detecting using Deep Learning is presented. This system consists of three sub-modules: Image quality assessment module, lesion-aware module and DR grading module. This disease spectrum model evaluates the quality of image, detects retinal lesions and eventually determines the severity of DR. AUC (Area Under Receiver Operating Characteristics Curve), Sensitivity, Accuracy, Specificity and Quadratic Weighted Kappa (QWK) metrics will be evaluated and this model achieves better performance

DABSE: A Multi-Criteria Adaptive Ensemble Framework for Cardiovascular Disease Prediction

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Cardiovascular disease prediction using machine learning often relies on individual classifiers or conventional ensemble strategies that primarily optimize predictive performance while giving limited consideration to model diversity, stability, calibration, and redundancy. This study proposes a Diversity, Stability-, Calibration-, and Redundancy-Aware Adaptive Ensemble (DABSE) framework that integrates these criteria into an adaptive ensemble construction process. Seven heterogeneous classifiers are evaluated using out-of-fold predictions generated exclusively from the development set. Learner contributions are determined from predictive performance, error diversity, repeated-validation stability, probability calibration, and nonredundancy, followed by probability-level fusion with a stacking model and development-set threshold optimization. Experiments were conducted on a 10,000-observation subset of a cardiovascular disease dataset, using 8,000 observations for development and 2,000 for independent testing. DABSE achieved 72.40% accuracy, 74.82% F1-score, 82.08% sensitivity, 62.74% specificity, 0.8068 ROC-AUC, 0.7891 PR-AUC, and 0.4568 MCC on the independent test set. Its Brier score was 0.1783 with a log loss of 0.5367. Compared with stacking, DABSE produced higher sensitivity and F1-score but slightly lower accuracy, specificity, ROC-AUC, and MCC.

Energy-Efficient Hybrid Footstep and Solar Energy Harvesting with Battery Storage and Real-Time Monitoring

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In places like railway stations, schools, malls, and footpaths, a lot of energy is wasted in the form of footsteps. The paper presents a Smart Step Energy Harvester, a hybrid source of renewable energy. The harvester utilizes the wasted energy in a form of footsteps and solar energy. Piezoelectric discs are placed below the mechanized walking surface. The electricity generated by piezoelectric discs is rectified and conditioned to get a stable power supply. In order to increase the performance of the harvester and to store the electricity when there is a lesser chance of people walking on the mechanized surface, a solar panel is added to the harvester. The generated power from piezoelectric discs and solar panels is fed into a power-managing and battery-charging circuit. A microcontroller development board was used for controlling the system, and an GUI was used for displaying the system status and the energy-harvesting process data. The paper studies and calculates the efficiency of the power-transfer process and the losses that occur in the conversion stages. Assuming the efficiency of each conversion stage, the paper states that the hybrid harvester can have a maximum efficiency of about 63% as compared to the piezoelectric circuit which has about 21.6% efficiency. The paper suggests an 85% overall efficiency considering the improvements in mechanical coupling, rectification, power conditioning, and energy-storage processes, but it needs to be validated experimentally. The project can be scaled up for multiple harvesters and can be wireless with an internet connection for monitoring remotely.

Deep Learning-Based Face Recognition Attendance System with Anti-Spoofing Detection

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Face-recognition attendance systems of the past are often stored in unprotected biometric embeddings or face images, which would place the company at a great risk of privacy and security breaches in case of the stored information being hacked. This paper proposes a face-recognition attendance system, which is based on deep learning and ensures privacy, with the aid of presentation-attack detection, biometric template protection, and facial recognition. The proposed algorithm, based on a pre trained Arc Face model, extracts discriminative facial embeddings and subsequently uses a key-dependent sign-permutation transformation, quantization, and template storage. As such, there is no need to store unprotected embeddings and unprotected face images in the attendance database. Identity verification is done using protected representations, and an anti-spoofing step is added before recognition to prevent presentation attacks resulting in unapproved registration of attendance. Experiments use a subset of the Labeled Faces in the Wild dataset to evaluate recognition performance, template storage effectiveness and recognition utility preservation. The proposed representation had an accuracy of91.42% with an F1-score of 91.11, a 0.04percentage-point drop inaccuracy compared to the 91.46% accuracy and 91.22% F1-scoreof the unprotected Arc Face baseline. The initial floating-point representation occupied 2048 bytes but the protected template can be represented with 512 bytes, which is a 75% decrease in the storage of a template. The results reveal that deep face recognition can include biometric-template security with a minimal decrease in recognition-performance and reduced the requirement of continuous biometric storage that render the technique suitable in automated attendance systems that are sensitive to privacy issues.

SHAP Augmented Interpretable Framework Modeling Non-Linear Pathophysiological Trajectories within Preventive Cardiology

Pramod Kumar[1], Dushyant Chauhan[2], Ankit Goyal[3,] Ashutosh Awasthi[4]
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Heart disease remains one of the causes of illness around the world. However using machine learning in hospitals is often difficult because the best models are hard to understand. This makes doctors less likely to trust them. This study presents a way to explain machine learning for heart disease. The study uses a dataset from the Framingham Heart Study which contains than 4,000 patient records. It tested on four models—Multi-Layer Perceptron, XGBoost Random Forest and Extra Trees—using metrics such as accuracy, F1-score and runtime. The results show that tree-based models are much better than the network. Extra Trees performs the best achieving a test accuracy of 99.43% anF1-score of 99.43% a positive rate of 0.56% and a runtime of about 3.2250 seconds. To make things clearer we used SHAP to explain how each model makes decisions. The explanations show that factors such, as blood pressure and older age are there a sons the model makes its choices. Combining models with clear explanations gives a good balance between being accurate, fast and easy to understand. This helps doctors decide which patients are at risk.

Cardiovascular Disease Classification Using Randomized Ensemble Trees with LIME Explainability

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Heart disease remains a leading cause of sickness and death around the world. Yet using machine learning in care is hard because the models are difficult to understand a problem called the black-box problem. This study tackles that problem by mixing learning with explainable artificial intelligence or XAIon the Framingham Heart Study dataset that has more than 4,000 patient records. To balance the cases the study used artificial over sampling of the minority class. Five models—Decision Tree, Multi-Layer Perceptron, XGBoost Random Forest and Extra Trees—were tested with 10-fold cross-validation. Extra Trees turned out to be the classifier giving the highest average training accuracy of 99.43% (variance 0.20 CPU time 3.23 seconds).It also performed best on the hold-out test set with 99.43%accuracy 99.42% recall, 99.44% specificity 99.45% precision and only a 0.56% false-positive rate. By contrast Decision Tree was the weakest with 80.77% accuracy. Multi-layer Perceptron was slower taking 16.8 seconds. Local Interpretable Model-agnostic Explanations or LIME was used to give instance-level explanations. LIME helped spot risk factors for each patient such as glucose levels over 87 mg/dL and systolic blood pressure over150 mmHg. This patient-specific information helps doctors review cases that need attention. The main contributions of this study are the creation of a framework based on attributes its evaluation with suitable metrics the use of LIME, for single predictions and the study of explainability to make the model clear.

Emerging Trends and Recent Advances in Artificial Intelligence Applications in Food Packaging

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The passive and static containment of food packaging is now shifting towards dynamic, adaptive and data-driven systems with the power of sensing, communicating and forecasting, the status of packaged food in real time. This fundamental transformation in food packaging is possible due to AI technology which comprises of machine learning (ML), natural language processing, deep learning (DL), computer vision, hyperspectral, spectroscopic imaging, gas and biosensor integration, generative AI-assisted material design and edge –enabled

IoT sensing. This study is compiled based on the latest peer-reviewed literatures which are based on AI applications in food packaging value chain with great advancement in smart and intelligent packaging, detecting quality and defects, predicting shelf life and monitoring freshness in food industry using machine vision. AI-assistance has also enabled traceability and consumer interaction, automated seal inspection, Life-cycle assessment (LCA) for sustainable material.

The obstinate research gaps for AI application in food packaging is being faced by small and medium-sized businesses (SMEs) is non-existence of standardized, overtly accessible datasets for working out explicit packaging models, the field also faces persistent challenges, like high sensor and computation costs, energy consumption of embedded electronics, model transferability across products and environments, and unresolved questions of data privacy and regulatory standardization, the deficiency of factual validation outside of lab settings, the dearth of regulatory coordination across authorities, and the great deployment costs.

Besides the management-related implications for packaging businesses, food manufacturers, and regulators aiming to operationalize AI responsibly and cheaply, the study concludes with theoretical contributions to technology adoption and diffusion-of-innovation frameworks in food science.

Fatigue Detection with Interpretable Multi-Feature Machine Learning Using Webcam

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This research paper explores the issues of cognitive fatigue and attention state estimation in real-time and without invasiveness in the form of eye-movement behavior observed through the conventional RGB webcams. Cognitive fatigue is an important issue that influences safety and performance in transportation, education, and occupational settings, but current fatigue-detecting systems are commonly limited by the high cost of hardware, intrusive sensing, and the inability to apply in real-time. In an effort to overcome these shortcomings, we introduce a machine learning-based gaze analysis system, which can be used to extract ocular biomarkers in the unconstrained video streams without requiring infrared cameras and special devices. The suggested methodology uses facial landmark detection to estimate the features of the blink, gaze stability, and eye openness, such as the rate of blink, PERCLOS, fixation stability, and pupil movement. When training a Random Forest classifier on features that are aggregated over time ocular, the accuracy is 98 percent with a ROC-AUC of 0.9805 on the classification of eye-state and fatigue. The importance of the features analysis shows that the most discriminative is the predictor of PERCLOS, as it can contribute about 35 percent of the decision made by the model. On a consumer grade hardware, the system runs at 30 frames per second, and it is estimated that the costs of the system will reduce by around 80 percent when compared to infrared-based eye-tracking solutions. These findings indicate that ocular analytics using webcams, coupled with effective feature engineering and ensemble learning, can be used to offer an effective and scalable alternative to continuous fatigue monitoring in the field.

Uncertainty-Aware Machine Learning Benchmarking for Retail Demand Forecasting and Inventory Planning

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Uncertainty at the product level is a critical issue in sales forecasting and inventory management since higher uncertainty leads to greater forecast error and higher inventory costs. In this paper, a benchmarking methodology for machine learning models considering uncertainty is developed using the Online Retail data set.

As a result of preprocessing, 530,104 records were converted to product-level and product-week demand metrics. Coefficient of Variation was used to determine products with low, moderate, and high levels of uncertainty. Moving Average Baseline was benchmarked against Random Forest, Gradient Boosting, and XGBoost models. High-uncertainty products turned out to be the biggest group generating higher forecast errors. The Moving Average Baseline outperformed all other models; however, Gradient Boosting was the best ML algorithm.

Cybersecurity Enhancement Through ANN-Based Malware Detection and Classification

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In line with the evolution and widespread use of digital devices and technologies, the sophistication and prevalence of cyber-attacks have escalated over time. Traditional antivirus software based on known signatures is unable to tackle newly created malware as their working principle is based on signatures. As an alternative solution to this problem, this work aims at proposing a framework of malware detection based on artificial intelligence using artificial neural networks and analyzing PE files. The framework will involve using the REWEMA data set consisting of 3,136 malicious and 3,136 benign executable files. In terms of data preprocessing for training the ANN classifier, some relevant attributes related to PE files such as header, API call, opcode sequence, entropy, and imports are selected. The proposed framework automatically classifies unknown executables into either benign or malicious categories, thus enabling threat analysis and alerts. Experiments conducted reveal that the proposed framework attains a performance of 97.84% accuracy, 97.12% precision, 98.31% recall, and 97.71% F1-score, outperforming conventional techniques of antivirus software and heuristics in detecting malware. This is also supported by the lower false positive rate (2.05%) and lower false negative rate (1.69%). Therefore, the results show the proposed framework to be effective in dealing with contemporary cybersecurity threats through artificial intelligence.

Explainable Temporal Graph-Risk Learning with Federated Simulation for Illicit Transaction Detection in FinTech Networks

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Detecting illicit transactions in FinTech networks is a challenging task due to transaction imbalance, graph structure and time-evolving nature. Most of the current approaches apply random splitting and static features which may lead to overly optimistic performance and future-window unawareness. In this work, a novel explainable Temporal Graph Risk Learning approach, called TG-RiskX, based on Elliptic++ dataset is proposed. The proposed approach integrates transaction and risk-memory features, namely connectivity, neighbor history exposure, recent illicit activity, and fraud concentration. An incremental train/validation/test protocol is used for the evaluation of future detection. Various modifications of TG-RiskX are compared to ML and static GNN baselines. The XGBoost model obtained the best PR-AUC of 0.6820, while TG-RiskX with LightGBM classifier demonstrated comparable PR-AUC of 0.6814, however with higher recall rate.

A Multilayer Dynamic Vertex Framework: An Explainable Graph-Theoretic Model for Heterogeneous Multiplex Networks

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Multilayer and multiplex networks provide a powerful framework for representing systems composed of multiple interacting subsystems. Classical multiplex models typically assume identical node sets across layers, an assumption that is often violated in real-world systems such as brain networks, biological regulatory systems, and heterogeneous temporal processes. In this work, we introduce a fully explainable, graph-theoretic formulation of heterogeneous multiplex networks in which layers may contain unequal node sets and are coupled through explicitly defined inter-layer adjacency matrices. Using a block-structured supra-adjacency matrix representation, we unify intra-layer and inter-layer connectivity into a single global graph operator. The proposed framework preserves analytical tractability, supports spectral and dynamical analysis, and provides transparent interpretability by construction. This formulation extends classical multiplex network theory and enables principled analysis of heterogeneous, multilayer systems.

Adaptive Financial Behavior Analysis and Security Framework

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As it is well known, e-commerce platforms, online banking, and digital payments have all grown significantly over the last several years and will continue to do so. Although this speeds up and simplifies our financial operations, it also raises the possibility of financial fraud in any sector of the industry. Unauthorized transactions and identity theft are examples of fraudulent behaviors that can result in financial losses for both users and financial institutions. As a result, it is now essential to identify fraudulent transactions promptly, effectively and most importantly, properly. Our research's main goal is to first understand the importance of working on raw dataset as it contains N number of anomalies, inconsistencies, null or missing values. Secondly it is important to try and test other models as well. many models work best for one kind of dataset and other for other kind of datasets. There are so many models present in the field of machine Learning. Each model has its own advantage and disadvantage, and we check the best one by calculating their performance chart.

Enhancing Military Communication Networks Through Composite Labeling in MANETs

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This paper investigates the application of composite labeling in various network-related graph structures, with a particular focus on enhancing network security in Mobile AdHoc Networks (MANETs). Composite labeling, a technique ingraph theory, ensures that adjacent edges in a graph are labeled with composite numbers whose greatest common divisor (gcd)is not 1, thereby adding a layer of complexity and security to communication networks. This study applies composite labelingto critical graph structures, including the Star graph, Crown graph, Comb graph, <K1,n;K1,m>, P3 ⊙ Km, P2n−1 ⊙ K2m, F2,n,the Prism graph Πn, (Cn - v1) ⊙ K2m−1, and the Cartesian productof a cycle graph with n vertices (Cn) and a star graph with nleaves (Sn), all of which are proven to admit composite labeling. By assigning composite-number-based encryption keys to communication links, the risk of cryptographic vulnerabilities and key prediction is significantly reduced, ensuring the resilience of MANETs against attacks. This research highlights the practical importance of composite labeling in securing data transmission in military and other high-security network environments.

Odd Gracefulness of Some Snake Graphs and Its Application in Agricultural Irrigation

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Graph theory is about analyzing the edges and nodes that exist between each other. Graphs spanning a structure can be studied to find solutions to many issues related to matching, layout, networking, optimization, and operation. The idea of odd graceful labeling was first presented by Gnanajothi [2] in 1991. We have demonstrated in this work that connection of two A(QSn)graphs and two DA(QSn)is odd graceful. Odd graceful labeling is useful in applications where overlapping of paths must be avoided.

Optimizing Communication Networks through δ-Labeling of Unicycle Graphs.

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This paper delves into the concept of δ-labeling, first introduced in 2021, a novel addition to graph theory with significant implications for real-world applications such as Network Intrusion Detection Systems (NIDS). Graph labeling, a critical aspect in engineering and computer science, is explored through the open problem of determining which graphs support δ-labeling. This study extends δ-labeling to unicycle graphs and presents generalized results that enhance the utility of graph labeling in optimizing communication networks and securing data against intrusions within NIDS frameworks.

Prime Labelling of Some Combined Graphs

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Let G(V,E) be a graph with p-vertices and q-edges. A bijection mapping f: V → (1, 2, 3, ... ,P) is called a prime labeling if for each edge e = uv such that gcd(f(u), f(v)) = 1. A graph that admits prime labeling is called a prime graph. There are many kinds of graph labeling, one of which is prime labeling. In this paper, the prime labeling technique is applied by combining some graphs, namely the cycle, wheel, star, friendship, fan, and gear graphs. Also, a combination of wheel and cycle is applied in the field of smart grid networks, in which the electricity flow is continuous. The work aims to build the theorem and promote an application.

Multi-Station Smart Gauging System with PLC Integration

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The design and development of a system for industrial automation named the Multi-Station Smart Gauging System with PLC Integration is intended to improve the quality inspection procedure in manufacturing industries. The system uses USB based digital probes to provide precise multi-point measurements, a Programmable Logic Controller (PLC) to control the machine operation, and a desktop-based Human Machine Interface (HMI) to monitor the process and make decisions. The systems can perform automatic measurement of the size of the object through multiple sensors, process the collected information, compare the measurement values with preset tolerance levels, determine if the object is acceptable or non-conformable, and present the u5;results on the HMI screen. This enables operators to monitor the process effectively and all information

gathered during the process, including the final outcome, will be saved in an Excel file for future use. By eliminating unnecessary steps in the process, the proposed system greatly minimizes human error in manufacturing industries.

Non-Invasive Diabetes Screening Using Clinically Curated Features and Machine Learning

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Diabetes is a disease prevailing worldwide that occurs when blood sugar is too high. Early identification of disease is essential to prevent its progression and long-term effects and complications. Although laboratory-based diagnostic tests provide accurate assessment but they are not suitable for large scale population screening because of their cost and limited accessibility. This study presents a machine learning model using non-invasive features for diabetes screening. The non-invasive features we used are routinely available demographic, anthropometric, lifestyle, dietary, psychosocial, and socioeconomic variables derived from the National Health and Nutrition Examination Survey (NHANES).

Feature selection was performed independently within each cross-validation fold using XGBoost feature importance to select the top 15 predictors from a curated pool of non-invasive variables. The curated feature pool included three meaningful engineered features, Waist-to-Height Ratio (WHtR), Sugar/Fiber Ratio and Weekly activity. Feature selection frequencies across folds were analyzed for the stability of the selected predictors. Multiple machine learning classifiers including Logistic Regression, Random Forest, XGBoost, LightGBM and CatBoost were evaluated. CatBoost achieved the best overall performance with a ROC-AUC of 0.863, PR-AUC of 0.674, an F1-score of 67.08% and a recall of 80.69%, demonstrating effective identification of individuals at risk of diabetes.

Smartphone-Based Fingerprint Authentication with RSA Digital Signatures for Secure Mobile Document Verification

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However, conventional authentication mechanisms, which include password/PIN-based systems, are subject to hacking and replay attacks. The purpose of this research is to introduce a smartphone-based biometric digital signature mechanism, where fingerprint authentication is combined with RSA asymmetric cryptography for secure digital signature generation and verification. The proposed mechanism captures the fingerprint of the user via smartphone camera and performs preprocessing, feature extraction, and geometric matching before applying the RSA key pair generated just once during enrollment for digital signature creation. In order to evaluate the proposed FRIR+RSA scheme, this work uses the NIST fingerprint database as well as some simulated experiments. The results indicate that the proposed method brings down the False Acceptance Rate (FAR) from 6.8% to 5.1%, reduces the False Rejection Rate (FRR) from 6.2% to 4.3%, improves the True Acceptance Rate (TAR) to 95.7%, and produces an Equal Error Rate (EER) of 4.7% along with the Area Under the Curve (AUC) value of 0.95. Also, the scheme demonstrates its robustness under noisy fingerprints as it has an average processing time of 156 ms.

A Hybrid Multilingual Ensemble Framework for Phishing Detection Using Cross-Lingual NLP and Machine Learning

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Phishing attacks remain a serious threat to cybersecurity through the growing complexity of the attacks and the use of multilingual content in such attacks which helps them avoid detection by traditional systems. Many phishing detection techniques are meant for English language and perform poorly on multilingual emails and websites. In this paper, we present a Hybrid Multilingual Ensemble Framework for phishing detection, which uses cross-lingual NLP, hybrid features engineering, threat intelligence from outside and machine learning ensembles. The framework includes steps like language detection, intelligent preprocessing, creation of multilingual semantic embeddings, feature fusion and adaptive weighted soft voting, which is done using Random Forest, Support Vector Machine, XGBoost and Artificial Neural Network classifiers. We use the information about email contents, URL lexical properties, domain reputation and cybersecurity threat intelligence to create our phishing risk assessment framework. Experiment results show that the proposed framework produces the overall accuracy of 96.8%, the precision of 96.54%, recall of 97.08%, F1-Score of 96.81%, AUC of 0.989 and Average Precision (AP) of 0.983, which outperforms the machine learning techniques.

Proactive Crowd-Crush Risk Forecasting Using Motion Divergence and Bottleneck Geometry

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Crowd crushes remain a persistent cause of mass-casualty incidents at festivals, religious gatherings, and stadium events, and most operational safety systems still rely on reactive density thresholds that flag danger only after dangerous compaction has begun. This paper proposes a proactive, lightweight risk-forecasting method that fuses two complementary signals: (i) a Motion Divergence Risk Indicator (MDRI), computed from the spatial divergence of a locally averaged pedestrian velocity field, capturing convergent, compressive flow that precedes density build-up; and (ii) a Bottleneck Geometry Factor (BGF), a closed-form structural risk multiplier derived from the width-contraction ratio and funnel convergence angle of a chokepoint, computable in advance from architectural drawings. The two signals are fused into a single forecast score, RISK(t) = MDRI(t) × BGF, evaluated in real time from tracked pedestrian positions or optical flow. We evaluate the approach in a social-force simulation testbed spanning bottleneck widths, taper angles, and inflow rates (120 trials, including a grid varying bottleneck angle independently of width). Across trials, the corrected BGF correlates with peak observed crowd density ($r = 0.82$, 95% CI [0.74, 0.88]), and cross-correlation confirms convergent motion measurably precedes local density accumulation. Relative to a density-threshold baseline calibrated on a safe reference geometry, the fused RISK score reduces the false-alarm rate on non-crush trials from 61.4% to 36.8% (McNemar's $p = 0.004$), a significant reduction, at a modest cost of 4.4 s (about 11% relative, 95% CI [2.5, 6.7] s) of forecast lead time in trials that progressed toward crush. These results suggest that combining a cheap, physically interpretable motion signal with static site geometry is a promising, low-cost complement to existing CCTV- and density-based crowd safety systems

Algorithmic Hiring versus Human Judgment Employee and Recruiter Perspectives on Hiring Effectiveness in AI-Enabled Talent Acquisition

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Existing systems rely on static rules or opaque models, which can exacerbate bias, lack explainable models, and fail to account for recruiter judgment, especially when screening large applicant pools, reducing screening time and hiring consistency. The proposed system will be a combination of both, this involves using the AI for filtering and ranking, transfer learning as well as attention-driven relevance scoring, validating the hiring decision of recruiters, incorporating blockchain as an audit trail, bias detection, explanation of AI decisions, and federated learning for privacy-preserving updates. Architecture allows for objective choices and selection, with some human supervision. The result of the experimental evaluation showed that the proposed system provides higher accuracy in recruitment (92.4%), better reduction of bias (89.1%) and processing efficiency (91.3%) & transparency (87.4%) as compared to Existing systems. It has been revealed that the algorithmic component of AI plus human judgment is an effective and fair approach to delivering greater effectiveness, trust and speed in modern recruitment for multiple recruitment types and organizations around the world in various use cases.

ARFEN++: A DINOv2-Based Adaptive Feature Refinement and Enhancement Framework for Robust AI-Generated Image Detection

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Photorealistic images produced by modern generative models are becoming increasingly difficult to separate from genuine photographs, which raises concerns about the trustworthiness of digital media, the spread of misinformation, and the reliability of forensic analysis. This paper introduces ARFEN++, a lightweight detector of synthetic images built on a frozen self-supervised DINOv2 Vision Transformer. The 768-dimensional DINOv2 descriptor of an image is passed through an Adaptive Feature Refinement (AFR) block, which applies a learned residual correction, and a Feature Enhancement Attention (FEA) block, which assigns importance weights to individual channels, before a compact multilayer perceptron makes the final decision. Because the backbone is not fine-tuned, only about 1.45M parameters are optimized. Evaluation on the CIFAKE benchmark covers standard classification scores, error analysis with the confusion matrix, threshold-based ROC and precision-recall analysis, and t-SNE projections. ARFEN++ reaches an overall accuracy of 98.02%, which is higher than the CIFAKE results reported for several recent detectors. A multi-seed ablation further shows that the DINOv2 representation supplies most of the discriminative power, while the AFR and FEA blocks mainly raise recall on the synthetic class.

Beyond Pixels: A Comparative Study of Scene-Graph Representations and Semantic Propositional Evaluation in Image Captioning

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A task where the machine could generate the caption with details using both computer visions and natural language processing (NLP) is known as Image captioning which will be done using deep learning. With correct use of model or algorithm it can generate a spot - on details for the provided image as input. This caption generator can be proved helpful for visually impaired people and other industries as well. By making image caption generator speak aloud we can help visually impaired people hear the generated caption which provides

the flawless facts about the image and using their imaginations they can actually get what the image is about. Apart from this there are other uses for the image caption generator. The main complication one faces when building such model is that they want their model to generate the accurate text or caption and translate visual features which parallelly inclines with the image. The image contains objects, scenes and the relationship of one object with the other. We use convolutional neural networks (CNNs), recurrent neural networks (RNNs), Long Short – Term Memory (LSTM), attention mechanisms and autopilot, they increase model performance by handling various complex models. This is especially different from the traditional rule-based systems which is limited because they have hand- coded rules and it does not learn from the data, while the other is highly flexible, accuracy is comparatively high and is easier to maintain. The datasets that are commonly used is MS COCO, Flickr8k, Flickr30k and Conceptual Captions [11], [12]. Each image inserted in these datasets has multiple human- written captions, which ultimately helps the model to train itself in different ways to describe the same scene in different ways. After all this, we will be using the evaluation metrics to be sure that our model is giving the accurate and precise outputs or not. For that we will be using BLEU, METEOR, CIDEr, SPICE [14], [31]–[34. To sum up, image captioning.

AI-Native Operating Systems for Intelligent FinTech: A Survey of Agentic Architectures, Event-Driven Computing, and Autonomous Financial Infrastructure

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The nature of financial technology is being fundamentally reshaped by markets that move at machine speed, an unrelenting flow of heterogeneous data and the need to make decisions in the face of uncertainty, systemic risk and regulatory limits. In this environment, AI-native intelligent operating systems are fast becoming the indispensable infrastructure for fintech of the next generation. In this paper we bring together three fields: the theory of finance, agentic AI and the design of AI-native OS with event-driven and governance-as-code approaches. On the finance side, we cover the essentials like liquidity provision, fraud detection and monitoring stress propagation between institutions. From a systems vantage point, we show how an intelligent OS can meet those demands via predictive autoscaling, real-time anomaly detection and an execution environment that is both cryptographically sound and able to balance throughput with latency. What emerges is a conceptual framework in which AI is no longer a siloed service but an operational part of the whole, one that keeps a watch on market conditions and adjusts to new regulations or regime shifts as they come. Of course, making this work means coming to terms with legacy systems, putting in place the right data governance and ensuring your organization is ready for a degree of autonomy. We also look at where things are headed: self-optimizing infrastructure, federated learning that doesn't compromise on privacy, and neuro-symbolic reasoning.We survey the practical side of these developments in algorithmic trading, advisory, DeFi, credit, compliance, and beyond. Ultimately, by combining finance theory with the capabilities of agentic AI and an AI-native OS under human oversight for the big calls, we outline a way forward for financial infrastructures that are smarter, safer, and more scalable than what has come before.

Advanced AI-Based Speech Recognition and Natural Language Processing for Efficient Processing of Low-Resource Languages and Dialects

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Bengali is among the six most widely spoken languages in the world, yet the resources available for building speech recognisers in it remain thin. Annotated corpora are small, regional pronunciation departs sharply from the broadcast standard, and an agglutinative morphology inflates the effective vocabulary. This paper presents DACT-Bangla, a dialect-adaptive recogniser that pairs a twelve-block Conformer encoder with a six-block Transformer decoder and trains the two jointly under a combined connectionist temporal classification and attention objective. Two design decisions separate the system from prior work. First, a 64-dimensional bottleneck adapter, gated by a learned dialect embedding, is inserted after every encoder block, so that porting the recogniser to an unseen region updates only 1.83 M of 43.6 M parameters. Second, beam search is restricted by a grapheme-to-phoneme lattice mask that suppresses hypotheses violating Bengali consonant-cluster phonotactics. Trained on 219.9 h of speech drawn from OpenSLR-53 and Common Voice, the system reaches a word error rate of 11.72 % and a character error rate of 4.87 %, against 15.42 % for a fine-tuned wav2vec2 XLSR-53 baseline. An ablation attributes 2.51 points of the improvement to the adapter and 1.19 points to constrained decoding. All corpora, splits and configuration files are public, and the training recipe follows the ESPnet directory convention.

AI-Based Coronary Risk Prediction and Clinical Decision Support Using Leakage-Free Machine Learning

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Reported accuracies for coronary artery disease prediction on the Statlog (Heart) benchmark now routinely exceed 95 %, yet these figures are rarely reproducible. This paper identifies a specific and pervasive cause: preprocessing operations such as outlier trimming, standardisation, feature selection and synthetic minority over-sampling are fitted on the complete dataset before the train-test partition is drawn, so information from the evaluation partition reaches the learner. We construct a four-level protocol that relaxes these constraints one at a time and quantify the resulting inflation. On the same 270-record cohort, the identical model moves from 82.41 % under a fully constrained protocol to 84.44 % once SMOTE precedes the split, and a single favourable partition reaches 89.66 %. We then re-benchmark seven classifiers under 10-fold, 10-repeat stratified cross-validation in which every fitted transformation is confined to the training partition. A reciprocal-rank-fusion filter, RRF-9, combines the ANOVA F ordering with the ridge coefficient ordering and retains seven attributes in 100 % of folds. The proposed calibrated heterogeneous vote reaches 84.11 % accuracy (95 % CI 82.79–85.43), 0.9011 AUC and 0.682 MCC, and attains a Brier score of 0.1226 that is significantly better than all six baselines. Accuracy is statistically indistinguishable from random forest, Light GBM and XG Boost, which we report rather than conceal. The evidence indicates that the discriminative ceiling of this cohort lies near 84–85 %, that published figures above 90 % should be treated as protocol artefacts, and that calibration rather than raw accuracy is where ensembling still pays.

AI-Based Computer Vision for Multi-Class Tomato Foliar Disease Detection and Classification

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Tomato (Solanum lycopersicum) foliar disease reduces marketable yield in all major production areas and the time period that disease can be economically controlled is short. Manual scouting is not possible that large. This paper reports a two-stage screening pipeline in which a purpose-built convolutional encoder performs feature distillation and a bagged decision-tree ensemble performs the terminal classification, deliberately separating representation learning from the decision boundary so that each component can be tuned against its own failure mode. The encoder applies five convolution-rectification-pooling stages followed by batch normalisation and a 1,024-unit bottleneck regularised by dropout; the resulting embeddings are consumed by a random forest of 52 estimators. Evaluation uses a publicly distributed corpus of 23,371 field and laboratory images spanning eleven foliar conditions, held out under a class-balanced protocol of 500 images per class. The pipeline attains 93.82% overall accuracy with a macro-averaged F1 of 0.932. A per-class error-asymmetry analysis, not previously reported for this architecture family, shows that residual error concentrates almost entirely in two visually confusable conditions and is dominated by false positives rather than missed detections an operationally favourable bias for a screening instrument, since the cost of a redundant inspection is far below the cost of an undetected outbreak.

AI-Based Computer Vision for Robust Medicinal Plant Disease Detection and Classification

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Automated leaf-disease identification is regularly reported at above 95 % accuracy, yet field deployments underperform those figures by a wide margin. The usual explanation is that laboratory imagery differs from field imagery, but the size and shape of that penalty are rarely measured, because the two conditions are almost never paired for the same lesion. This paper builds a controlled testbed in which they are. We procedurally generate 1300 medicinal-plant leaf images across five conditions healthy, chlorosis, necrotic spotting, powdery mildew and rust pustules under two imaging regimes: a uniform laboratory background with fixed illumination, and a cluttered field background with illumination gain varying over a 2.3-fold range, colour cast, and partial occlusion. Ground truth is known by construction, and every leaf exists in both regimes. Six classifiers are trained on a 47-dimensional descriptor combining HSV and CIELAB colour moments, grey-level co-occurrence texture, local binary patterns and lesion morphology. Within either regime the results reproduce published performance: 91.46 % in the laboratory and 89.15 % in the field. Trained in one regime and tested in the other, accuracy falls to between 29.23 % and 82.92 %, and the ordering of the classifiers reverses. The RBF support vector machine, third-best in distribution, becomes worst under shift at 29.23 %; the random forest degrades least, retaining 82.92 %. A descriptor ablation shows the mechanism: colour moments transfer at 81.85 % while texture descriptors transfer at 58.00 %, despite texture performing respectably in distribution. We report this as a simulation study; no physical imagery was available, and every generator parameter is stated so the testbed can be reproduced or replaced with field data.

AI-Based Assistive Reading Systems Using Edge Computing and Server-Side Image Recognition

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Printed matter remains largely inaccessible to people with severe visual impairment, and the assistive readers that address this are priced well above what most users in low-income settings can meet. Commodity microcontrollers are frequently proposed as the remedy, but a microcontroller cannot perform optical character recognition or speech synthesis: the memory, arithmetic and model-storage requirements of both exceed what these parts provide by orders of magnitude. This paper therefore treats the design question as one of partitioning rather than of component selection. Capture, compression and audio playback are placed on a camera-equipped microcontroller costing USD 25.40 in parts; conditioning, recognition and synthesis are placed on a shared server. The partition raises an empirical question that determines the whole design, namely how much capture resolution the recognition stage actually requires, since resolution sets payload, upload time and battery cost simultaneously. We answer it by measurement: across six sensor modes with realistic handheld degradation, character error rate collapses from 11.91% at VGA to 0.16% at SVGA and then flattens, so resolution beyond SVGA buys no accuracy while multiplying payload by 3.9 and end-to-end latency by 1.19. A separate degradation sweep shows the system is essentially immune to sensor noise up to $\sigma = 25$ and tolerates 5° of skew at 2.53% error, but fails catastrophically beyond 2.0 px of defocus. Focus, not sensor quality, is the binding constraint on a low-cost reading aid.

Energy-Efficient Quantum Approximate Optimization Algorithms for AI Task Offloading in FPGA-Deployed Portable Medical Ultrasound Devices within Sustainable Edge-IoMT Infrastructures

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Portable medical ultrasound devices are making the vital real-time imaging capability accessible in a wider range of clinical and home settings than ever before. The ability to perform diagnostic procedures anywhere from intensive care units to third-world villages is limited, however, by the power and thermal budgets of the battery-operated field-programmable gate arrays (FPGAs) at the heart of such devices. This work introduces an innovative method that utilizes carefully selected realizations of the Quantum Approximate Optimization Algorithm to offload computation-intensive artificial intelligence inference tasks from the local FPGA to nearby edge nodes in a sustainable medical device network while maintaining diagnostic image quality. The problem of deciding what artificial intelligence tasks, if any, should be offloaded is formulated as a multi-objective optimization task with an emphasis on the energy consumption of both local acoustic sensors and radio transceivers, the computational load on the edge server, latency constraints imposed by the medical procedure, and the diagnostic quality of the produced images. The method is particularly effective due to the utilization of warm-starting heuristics and hardware-aware compilation that allow the majority of computations to take place on the energy-efficient local FPGA. The numerical results demonstrate that in terms of energy consumption the introduced methodology outperforms the established heuristic and reinforcement learning based approaches while providing reasonable diagnostic image quality. The results also indicate that the proposed algorithm is able to extend the battery lifetime of portable ultrasound devices in a realistic clinical setting and thus enable truly ubiquitous medical imaging.

Multiple Disease Prediction Using Machine Learning: A Comprehensive Review

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The growing incidence of chronic and infectious diseases highlights the need for intelligent healthcare systems for early disease detection and timely clinical decision-making. Medical analysis and forecasting the risk of diseases using methods like Support Vector Machine (SVM), Random Forest (RF), Logistic Regression (LR), Decision Tree (DT), K-Nearest Neighbours (KNN), Artificial Neural Networks (ANN) and ensemble learning have been proven to be very promising with Machine Learning (ML) in the medical field. But current research is disease specific and suffers from scalability, generalisation, explainability, and deployment issues. This paper aims to conduct a systematic literature review for 15 studies, which are analysed in terms of their datasets, disease predictors, and evaluation metrics. The following 6 gaps are identified: single disease focus, lack of generalisation, limited explainability, lack of integration with ML, limited clinical validation and lack of a unified multi-disease framework. Based on these findings, a literature-derived conceptual architecture for Diabetes, Heart Disease, and COVID-19 is proposed with an ensemble decision layer. The framework serves as a basis for further implementation and validation of reliable, scalable, and interpretable healthcare decision support systems.

Swarm Intelligence-Driven Resource Orchestration for Real-Time OCT Image Enhancement and Wireless Transmission in Implantable IoMT Systems over Li-Fi Enabled Hospital Infrastructures

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Introducing implantable Internet of Medical Things (IoMT) devices with new capabilities. It is about to perform real-time image-enhancing operations for Optical Coherence Tomography (OCT). It represents a significant opportunity to shape future hospital ecosystems. This paper proposes a novel swarm-based approach to orchestrating resources for simultaneous OCT image enhancement. Along with wireless transmission via Li-Fi links. The approach emulates generic behavior patterns of swarms to realize multi-agent coordination. During resource allocation for noise removal, contrast improvement, and removal of artifacts in OCT scans for faster and more reliable wireless transmission. In hospital environments while managing power constraints. Simulation and hardware experiments demonstrate that the approach can lead to improvements in image quality by up to 45%. It is in terms of PSNR and SSIM, transmission speed by up to 60%, and greater energy efficiency compared to existing approaches. It also tackles a range of challenges associated with implementing implantable IoMT devices. Particularly in terms of achieving high-quality image enhancement and wireless transmission. It simultaneously balancing power consumption. The work also creates opportunities for future research in the area of connected healthcare.

Threshold-Calibrated CatBoost Framework for Cardiovascular Risk Prediction

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However, there still exists the problem of the timely detection of Cardiovascular Disease (CVD) as one of the most significant causes of mortality across the globe. Standard regression models often do not consider the complex interactions between health factors involved. Thus, we propose using amachine learning approach for estimating the risk of having CVD by mplementing the data from the BRFSS dataset from2020. As our baseline solution, we used a soft-voting classifier based on three algorithms—XGBoost, LightGBM, and Logistic

Regression with RFECV—that gave a balanced accuracy score of 0.802 and 0.761 recall. In order to improve these scores, we constructed a new machine learning model based on Cat Boost algorithm and threshold tuning. Our optimized algorithm gave us a higher level of accuracy with a balanced accuracy of 0.959and 1.0 recall, which shows that our approach gives better diagnostic performance because of its better understanding of the relationships between different health factors.

Artificial Intelligence and Machine Learning in Drug Discovery: Methods, Applications, Clinical Translation and Future Directions

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The development of new drugs is a high-cost and high-risk process for applied sciences. The process takes about 10 to 15 years to complete with a high monetary investment. It is estimated that over 90% of drug candidates do not succeed during human clinical trials. The last decade saw the emergence of a new set of computational strategies: artificial intelligence (AI) and machine learning (ML). They are capable of learning the relationships between a drug's molecular structure and its biological activity and pharmacokinetics in a much shorter time by using previously gathered experimental data. The purpose of this paper is to organize the scattered studies in order to be able to evaluate the drastic changes initiated by AI and ML in the pharmaceutical R&D value chain. The major structures in pharmaceutical AI and ML R&D will be examined with the focus on the methods used in the research. The comparisons done in the studies will be examined, with the focus on the proposed methods to improve ensemble tree methods, graph neural networks and other methods in ML. The focus will include how they can be applied to improve research in the field of drug development. The studies that focus on the drug candidates DSP-1181, ISM001-055, halicin and others will be evaluated in order to assess the claims and attainments. The review also notes some of the limitations of data quality and the applicability domain, benchmark inflation, interpretability and regulatory acceptance. The review concludes that AI currently acts more as an accelerator for the discovery phase rather than a replacement for experimental and clinical validation.

Confidence-Gated CNN–GCN Fusion for Low-Resolution Chest Radiograph Classification: A Controlled Empirical Study

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Hybrid convolutional and graph neural networks (CNNs and GCNs) provide complementary representations for medical image classification, yet the practical benefit of confidence-based adaptive fusion on low-resolution radiographs remains unclear. This paper presents a controlled empirical study of CNN-only, GCN-only, fixed logit fusion, and confidence-gated adaptive fusion for binary pneumonia classification on Pneumonia MNIST. The adaptive fusion model employs a lightweight multilayer perceptron (MLP) gate that predicts a per-sample mixing coefficient from the prediction-confidence statistics of both branches. All configurations are evaluated under identical training conditions across three independent runs with different random seeds. GCN-only achieves the highest mean accuracy (0.8723 ± 0.0026) and weighted F1 score (0.8669 ± 0.0026), while adaptive fusion obtains lower mean accuracy (0.8510 ± 0.0081) and F1 (0.8417 ± 0.0095). Fixed 0.5/0.5 fusion performs competitively (0.8611 ± 0.0165 accuracy, 0.8536 ± 0.0179 F1) but does not consistently outperform the best single-branch model. Analysis of the learned fusion weights reveals limited sample-dependent variation, indicating that the adaptive gate primarily learns a near-constant calibration rather than true per-sample adaptation. These findings provide a reproducible benchmark of CNN, GCN, and fusion strategies on a low-resolution chest radiograph dataset and underscore the importance of rigorous empirical evaluation in medical image analysis.

Multi Modal Intelligent Media Generator and Interpreter

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This work presents an AI-based framework that has bidirectional understanding of text and images. The system provides only two functionalities. First, image generation from text using CLIP models and Stable Diffusion, and second image captioning using BLIP architectures. The main objective is enabling users to view ideas by image generation using just text prompts and to understand visual data by reading textual outputs called captions. This is implemented using PyTorch and Hugging Face Transformers. The system uses deep learning and natural language processing to increase alignment and accuracy. The two user-friendly interfaces (online and extension) are built that allow usage of both modules. This dual-mode approach contributes to assistance for visually impaired users along with enhancing visualization and caption generation. The results demonstrate that the solution is efficient in producing relevant images based on context and better image captions. It also has potential in education, design, accessibility, and digital content creation applications. Additionally, the architecture of the system is modular allowing the seamless integration of captioning frameworks and improved diffusion models without a lot of structural changes. The system improves interaction of AI-driven visual tools by humans using combination of generative and interpretive capabilities into a single platform. To adapt the models for user needs and specialized datasets, the framework also supports domain-specific fine-tuning through techniques such as LoRA. This work highlights the importance of multimodal AI systems as a bridge between vision and language making digital environments more interactive and accessible.

Smart Nutrient Circulation in Hydroponic Farming thru Energy-Efficient IoT Architecture

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Plants can be grown in PVC pipes, which are constructed of plastic. These pipes are round in shape and feature tiny holes for seeding. One above the other, the pipes are placed on metal or wood frames. The plants always receive the water and nutrients they require since pumps are used to move water thru these pipes. As the world's population grows, it may become difficult to feed everyone in the near future. Farmers are beginning to employ novel techniques to cultivate soil-free plants in order to address this. Growing plants in water with specific nutrients rather than soil is known as hydroponics, one of these methods. In this manner, plants can grow larger and more quickly. We can produce more food with less area thanks to this innovative agricultural method, which is incredibly beneficial. The essay also discusses the difficulties some nations encounter when attempting to implement these new farming techniques and how businesses and governments may contribute to improving farming for all.

Multi-Scale Attention-Enhanced Swin Transformer for Automated NPK Deficiency Classification in Hydroponic Lettuce

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As the hydroponic farming system is becoming popular, the need for intelligent nutrient monitoring systems for early detection of plant nutrient deficiencies has arisen. Nitrogen(N), phosphorus(P) and potassium(K) are the most important macronutrients for lettuce development and may have subtle visual symptoms that are not easily detected by manual inspection. To deal with this problem, this paper introduces a new Multi-Scale Attention-Enhanced Swin Transformer(MSA-Swin) to accurately recognize NPK deficiencies in hydroponic lettuce

leaves with RGB images. The proposed framework combines a hierarchical Swin Transformer backbone model with new Multi-Scale Attention Module(MSAM) that captures multi-scale convolutions in parallel and dual attention mechanisms to effectively learn both local texture variations and global attention contextual features to address nutrient stress. Create training, validation, and testing sets, recorded photos are pre-processed by resizing, normalizing, boosting contrast, and augmenting the data. The retrieved deep features are classified into four groups using a Softmax classifier potassium deficiency, phosphorus deficiency, nitrogen deficiency, and healthy. With accuracy of 99.08%, precision of 98.96%, recall of 98.88%, F1-score of 98.92%, and ROC-AUC of 99.42%, the experimental results demonstrate that the suggested MSA-Swin model can outperform traditional CNN and transformer-based models, such as ResNet50, EfficientNet-B0, Vision Transformer, and standard Swin Transformer.

DSLKA-Net: A Deeply Supervised 2.5D Network with Multi-Scale Attention and Large Kernel Attention for White Matter Hyperintensity Segmentation from Multi-Modal MRI

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White Matter Hyperintensity (WMH) segmentation from multi-modal MRI is a challenging task due to sparse lesion distribution, severe class imbalance, and high morphological variability. This research proposes DSLKA-Net, a novel hybrid encoder-decoder framework built upon UNet, which includes four architectural innovations: Atrous Spatial Pyramid Pooling (ASPP) at the bottleneck for multi-scale feature extraction, attention gates on all skip connections for lesion-focused feature gating, large kernel attention (LKA) blocks at each decoder stage for long-range spatial context, and deep supervision across all decoder levels with weights [0.10, 0.20, 0.30, 0.40]. The network accepts a 6-channel 2.5D input (3 FLAIR + 3 T1 axial slices), which provides volumetric context while maintaining 2D computational efficiency. Experiments were conducted on the Singapore cohort of the MICCAI 2017 WMH Segmentation Challenge (20 subjects), divided into 16 training subjects and 4 validation subjects. The class imbalance was addressed through a slice sampling strategy and a combined DiceBCE loss. Training used the AdamW optimizer with cosine annealing LR scheduling for 250 epochs and mixed-precision training (AMP). A joint grid search was conducted over 9 thresholds and 4 component sizes to find the best validation dice with each epoch,along with four-pass test-time Augmentation.DSLKA-Net achieves a validation DSC of 0.86 and a test DSC of 0.84, with a test recall of 0.91 and IoU of 0.73 on the external, Singapore cohort, outperforming existing state-of-the-art methods. These results demonstrate the effectiveness of the proposed framework for robust and clinically reliable WMH segmentation.Model interpretability was provided through Grad-CAM on the ASPP bottleneck with lesion-conditioned saliency maps.

Mitigating Hallucinations in Legal RAG on General Criminal Law Dataset Using Hybrid Retrieval Citation Verification Techniques

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Large Language Models (LLMs) integrated with Retrieval-Augmented Generation (RAG) offer promising capabilities for legal question answering by grounding responses in external legal evidence. However, retrieving relevant documents does not guarantee that generated responses are adequately supported, creating a critical reliability gap involving unsupported claims and invalid citations. This study proposes an evidence-aware Legal RAG framework that integrates retrieval, citation verification, evidence sufficiency assessment, and adaptive hallucination mitigation. Retrieval effectiveness is first investigated using Bidirectional and Autoregressive Transformers for Embeddings (BGE-M3) dense retrieval, Best Matching 25 (BM25) sparse retrieval,

Reciprocal Rank Fusion (RRF), and hybrid score fusion on the FIRE AILA and Legal Bench-RAG datasets. Citation reliability is subsequently evaluated using Categories 3 and 4.2 of the Legal Cite Bench benchmarks with a Groq-hosted large language model. Based on these evaluations, an end-to-end Legal RAG pipeline is developed using an Indian bail judgment corpus, incorporating document preprocessing, BGE-based embeddings, FAISS indexing, BM25 retrieval, and RRF-based evidence fusion. Therefore, the proposed framework establishes an integrated evaluation pipeline in which retrieved evidence is assessed for sufficiency before response generation, while generated responses are evaluated for factual grounding and citation validity, thereby connecting retrieval effectiveness, citation reliability, evidence sufficiency, and response grounding to improve the reliability of LLM-based legal question answering and reduce unsupported legal responses.

The Role of IoT in Healthcare: Enhancing Patient Monitoring, Diagnosis, and Treatment

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By providing continuous system surveillance and more organized health service management in an instant, the Internet of Things (IoT) is reshaping the healthcare industry. By improving the connected advanced devices, wearable healthcare gadgets (such as smart watches), Cloud Computing, and intelligent automated systems Personalized Treatment Plans and a high disease activity state. This will result in improving healthcare services, early disease detection, and save money by reducing unnecessary hospitalizations and help to maintain a smooth flow. This research paper gives a thorough review of the application of IoT in healthcare industry, displaying its major advantages such as improved patient health by live data tracking, improved access to care, and data helps in future decision making. Additionally, it discusses the significant barriers that may come among the complete deployment of IoT solutions in the healthcare industry, incorporating information security, cyber vulnerabilities, multiple constraints, and system robustness. Finally, the paper demonstrates future ambitions and paths of IoT in the medical sector, noting that it needs sound regulatory frameworks, conventional protocols and contemporary analytics to be used to reach its potential in enhancing the health systems across the world.

PA-HMMBLB: Priority-Aware Hybrid Min-Min Max-Min Balanced Load-Balancing Algorithm for Cloud Task Scheduling in IaaS Environments

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Scheduling within clouds remains a critical bottleneck influencing resource usage, make span, and response time. The heuristic methods standardized in industry Round Robin (RR), and Max-Min force respondents to compromises between knowing the running times of jobs and fairness to users to avoid starvation. Comparatively, along with classical heuristics, we designed and evaluated anew deterministic hybrid scheduler called PA-HMMBLB. The low load on the earliest-completion algorithm is combined with anti-starvation mechanisms for large jobs and periodic relief for small jobs, which dynamically virtual machine (VM)load. Against a scenario with 20,000 tasks, PA-HMMBL B achieved a make span of 13,761.73 s with a surprisingly good resource utilization of 99.98%. Our approach outperformed the standard heuristic, as well as meta-heuristic, methods on through put-oriented IaaS clouds.

ChurnSense: A Feature-Engineered Framework for Employee Attrition Prediction

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Employee attrition imposes substantial recruitment, training, and productivity costs on organisations, making early identification of at-risk employees valuable for proactive retention. This paper presents ChurnSense, feature-engineered, a leakage-safe machine learning framework for predicting employee attrition. Using a publicly available dataset of 4{,}653 employee records and 8 raw attributes, seven interaction and cohort-based features were engineered from statistics computed solely on the training partition (stratified 70:15:15 split), yielding 21 encoded predictors. Four classifiers -- Random Forest, Decision Tree, Support Vector Machine, and Gradient Boosting were trained and compared on held-out validation and test partitions (698 records each). Random Forest achieved the best overall standing, attaining the balanced test-set accuracy (86.53%), precision (86.9%), and Matthews correlation coefficient (0.695), with an F1-score of 0.785 and ROC-AUC of 0.879. This outperforms four independently reported employee-attrition studies, including a fourteen-classifier benchmark evaluated on essentially the same dataset (79.59%). The results indicate that leakage-safe feature engineering materially improves attrition prediction, and ChurnSense offers HR management a reliable, resource-efficient decision-support tool for targeting retention interventions.

A Hybrid Machine Learning Approach for Future Event Prediction Using Fine-Tuned BERT, Random Forest, and XGBoost Classifiers

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Effective prediction of future events is key for **making decisions in important fields such as climate change,** geopolitics, public health, and economics. Although expert-based forecasting has been the traditional method, there has been a **need to increase accuracy and precision by utilizing data-based** and machine learning approaches. This paper suggests a new pre-training process for an enhanced BERT-based language rep**resentation model which outperforms the large model on several** forecasting tasks. In order to overcome the problem of task-specific architecture creation, knowledge distillation is applied **in the pre-training process. A triple loss function including** language modeling loss, distillation loss, and cosine distance loss is applied to extract the right linguistic features such as **semantics, context, and syntactic structures for future event** forecasting. The proposed model reduces the model size by40% and computational time by 60%, while maintaining 97%**language understanding capability of the base model. The model** is compared to benchmark models such as XGBoost and Random Forest and it is found to be much better than these methods in **terms of prediction performance.**

Lightweight Apple and Corn Disease Classification Using Spatial–Channel Attention

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Early and accurate diagnosis of plant diseases is crucial to minimising crop losses and to effective agricultural management. Based on leaf images, deep learning has been used to automate the classification of diseases, but as the models become more complex, they consume more computational resources and may be impractical in resource-poor settings. In this study, a lightweight plant disease classification framework with a Spatial Location Channel Attention Module (SLCAM) is proposed, specifically for Apple and Corn leaf diseases. The proposed solution employs spatial and channel-wise feature information to highlight the patterns that are

disease-specific while minimizing the effect of less informative features. Selected images from the Plant Village dataset were used in the experiments with a 70:15:15 training/validation/testing ratio. The overall accuracy of the proposed model was about 97.44%, and the accuracy of the evaluation results for the crops was Apple 99.27% and Corn 99.75%, respectively. The model was also compared with the Hybrid CNN–ViT and VGG19–Logistic Regression in terms of classification performance and model complexity. SLCAM has 7,148,632 trainable parameters, while VGG19Logistic Regression and Hybrid CNN–ViT have 20,050,547 and 55,820,051 trainable parameters, respectively. The findings show the strength of the SLCAM in the accurate and computationally efficient classification of plant diseases.

HAGS: A Hybrid Extractive-Abstractive Framework for Generative Summarization of Social Media Streams

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The rise of social media creates a continuous flow of a large number of short, noisy, and extremely repetitive textual posts, making it hard to identify and summarize the most useful information within a stream. In this work, a Hybrid Extractive-Abstractive Generative Summarization framework for social media streams is introduced. The framework utilizes semantic relevance, diversity, and social engagement signals to select a small amount of posts and apply a pretrained sequence-to-sequence generative model for abstractive summarization. Social media content is preprocessed to clean URLs, mentions, retweets, and formatting while preserving the hashtag information. Then, tweets are aggregated in temporal summarization units and preprocessed using extractive baselines including Lead selection, TextRank, and semantic Maximal Marginal Relevance (MMR). The proposed extractive approach relies on sentence embeddings from the pretrained MiniLM model and combines semantic relevance, redundancy removal, and normalized social engagement signals. The selected evidence is provided to a pretrained BART model for the summary generation. The framework is evaluated using reference-free measures including compression, redundancy, semantic coverage, and novelty. The experiments on a Twitter dataset with 4,237 tweets showcase the implementation and comparison of different summarization approaches on daily tweet clusters. The results offer a preliminary evaluation of the usefulness of evidence selection for generative summarization and provide a starting point for further evaluation based on human-generated references.

XAI-FusionNet: Multimodal Deep Learning and Explainable AI for Breast Cancer Detection — A Review and Conceptual Framework

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This paper reviews the growing body of research on multimodal deep learning and explainable artificial intelligence (XAI) for breast cancer detection across mammography, ultrasound, and histopathology. Rather than reporting new experimental results, it organizes the existing literature around four themes — modality coverage, fusion strategy, representation learning, and explanation technique — with particular attention to early, feature-level, late, and attention-guided fusion, alongside Grad-CAM, SHAP, and LIME as explanation methods. What emerges from this synthesis is a field that is clearly moving toward integrating complementary diagnostic evidence, but one where direct comparison across studies remains genuinely difficult, since datasets, patient pairing, preprocessing choices, and evaluation protocols rarely match from one paper to the next. A recurring theme is that explainability needs to be treated as something to validate, not just a heatmap bolted onto an otherwise opaque model. Building on this synthesis, the paper puts forward XAI-FusionNet as a conceptual, literature-grounded framework that combines modality-specific encoders, adaptive feature fusion, and dual-level explainability — offered here as a research design for future work, not as an experimentally validated model. The review closes by identifying where the field's real gaps lie: patient-paired multimodal

cohorts, common-protocol comparisons across fusion strategies, robustness when a modality is missing, explanation faithfulness, and clinician-centered validation.

Differentiable Rank-Adaptive Tensor Train Quantum Machine Learning with Scalable Gradient Estimation

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This paper proposes Differentiable Rank-Adaptive Tensor-Train Quantum Machine Learning (DRA-TT-QML), a framework that jointly learns variational quantum-circuit parameters and tensor-train bond ranks. Conventional tensor-train quantum models require manually selected integer ranks, creating a costly trade-off between compactness and expressivity. DRA-TT-QML replaces discrete truncation with differentiable soft gating of singular values. Each tensor-train core is unfolded, decomposed by singular value decomposition, and reconstructed after a sigmoid gate compares every singular value with a learnable threshold. Thresholds and core entries are optimized end to end. To reduce backward-pass cost at large ranks, randomized singular value decomposition approximates gradient propagation, while exact decomposition is retained in the forward pass. A sparsity-promoting regularizer encourages compact effective ranks. Experiments reported for HEP-Mass and QSAR-Bioactivity show that the proposed model achieves 82.6±0.9% and 77.2±1.1% accuracy, respectively, using approximately 180 effective parameters, compared with 1,024 parameters for the full variational quantum classifier. The ablation study reports an average effective rank of 4.1 and 12.6 s per epoch; exact-decomposition backpropagation requires 45.8 s per epoch under the stated setup. These results indicate that differentiable rank adaptation can preserve predictive performance while reducing model size and avoiding exhaustive rank searches. The framework provides a scalable foundation for structured quantum learning on high-dimensional scientific data, although hardware-noise robustness and convergence guarantees remain open questions.

AI for Pollution Control Using ML Models in Air and Water Quality Management and Innovative Approaches to Reduce Industrial Waste and Emissions

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Since industries have grown all over the world pollution has remained a critical issue with much emphasis placed on minimizing air and water pollution. Challenges posed by today's evolving industrial pollution cannot be solved by conventional monitoring and regulation techniques, which present AI and ML as the potential breakthroughs. The following is a comprehensive work on the status quo of AI-based approaches for the monitoring and control of air and water pollutants with a keen focus on predictive models and artificial neural networks, deep reinforcement learning. Thus using these sophisticated methods, industries can predict leaching levels, decide the appropriate use of material resources, and alter emission management in real-time to greatly decrease waste and pollution. Moreover, we share cases, concerns, or how AI might help to achieve greener industry solutions. This paper's results support AI's use in developing flexible and real-time solutions to deal with pollution issues while promoting industrial growth for better environmental consequences.

Behavioural and Financial Determinants of Equity Investment Decisions: Two-Dataset Explanatory and Predictive Evidence

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Behavioural-finance studies typically establish whether psychological and financial factors explain investment decisions, but they rarely ask whether the same information improves prediction for unseen observations or replicates across datasets. This study addresses that gap using two independent survey datasets: a primary investment-decision dataset (N = 145) and a cross-context financial-choice dataset (N = 400). Hierarchical regression quantifies incremental explanatory contribution, while repeated nested cross-validation evaluates out-of-sample predictive value under locked preprocessing and model selection. The behavioural block is strongly supported in both datasets, adding $\Delta R2$ = 0.380 and 0.224 and improving held-out RMSE by 24.84% (23/25 outer-fold wins) and 12.28% (25/25 wins), respectively. Financial literacy and investment experience are context-dependent: they provide no reliable incremental explanatory or predictive value in Dataset 1 ($\Delta R2$ = 0.028, p = .118; RMSE change = −0.31%), but contribute in Dataset 2 ($\Delta R2$ = 0.065, p< .001; RMSE improvement = 4.03%, 21/25 wins). Ridge regression is numerically strongest under the locked six-model comparison, with mean outer-test RMSE of 0.7074 and 0.6719. The evidence therefore distinguishes association, incremental explanation, and prediction and shows that behavioural information generalises more consistently than the incremental financial block.

A Multimodal AI Framework for Predictive Safe Navigation and Real-Time Emergency Detection

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Transit safety is a complex issue because of constantly changing patterns of crime and late reaction to emergencies. In our research, we propose an enhanced version of Safe Route system based on an integrated approach of using predictive machine learning model along with explainable artificial intelligence, guidance, audio recognition, and surveillance by AI to perform prevention rather than warning and addressing the issue after it happened. The system first gathers information on crimes that occurred in the past. Then, SHAP explains the rationale behind the prediction performed by the XGBoost classifier including influencing factors. Risks connected to particular route segments are calculated based on probability of crimes committed on these segments. Multi-objective A* search technique helps find safe routes taking into account such criteria as crime probability, travel time, infrastructural robustness and availability of emergency services. Audio distress cases can be detected using CNN BiLSTM architecture and aggressive behavior in low visibility conditions using Zero DCE, YOLOv8 and 3D CNN models. The experiment proves that our algorithm is capable of providing an accuracy level of about 98.65% for the crime risk prediction, 93.45% for scream detection, and 89.75% for violence recognition, which is why it surpasses the traditional algorithms using clustering, even though they may appear similar to ours initially. Finally, continuous GPS tracking sets new standards for safer routes by making it possible to provide up-to-date information about accidents, weather, and traffic conditions.

A Comprehensive Analysis and Hybrid Statistical Framework for Detecting Distributed Denial-of-Service Attacks in Cloud Computing Environments

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Managing a wide range of online resources and delivering multiple cloud-based IT services has made service availability a critical concern for Cloud Service Providers (CSPs). Due to the vulnerabilities of the internet, the distributed architecture of cloud platforms, various security challenges within cloud service models, and the inherent features of cloud environments, cloud systems are highly exposed to threats that impact service availability. Among these threats, Distributed Denial of Service (DDoS) attacks stand out as one of the most severe and difficult to control, mainly because of their distributed and dynamic nature, which often results in major service disruptions. Although numerous research groups have introduced intrusion detection mechanisms and CSPs claim to deploy advanced defenses, no existing solution can fully eliminate the risk of DDoS attacks. The diverse behaviors and evolving patterns of these attacks further complicate accurate detection. This paper examines and compares current DDoS detection methods across key evaluation parameters, highlights their strengths and weaknesses, and proposes a hybrid statistical framework designed to more effectively reduce the impact of such attacks and provide a superior alternative to existing detection approaches.

Healthsyncai: An Ai-Enabled Digital Healthcare Platform for Mental Health and Clinical Intelligence

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An increasing number of people with mental conditions and the disjointed state of the traditional healthcare provision system has posed significant problem to the contemporary medical systems. To this day, most of the digital health platforms combine mental health support and clinical service as two independent features, which leads to incoherent care, improper coordination, and poor use of patient data. The proposed paper, HealthSyncAI, is a scalable, AI-driven, cloud native healthcare solution that includes mental health intelligence, stress management, doctor discovery, appointment organization, and longitudinal health analytics within one ecosystem. The platform is a combination of conversational AI, structured behavioral data capture and role-based clinical workflows to improve access, early intervention and data-driven decision making. The experimental evaluation indicates that it is better to use, has smoother processes, and stable performances when it is used alongside other healthcare systems. Keywords: Healthcare, Mental Health Informatics, Telemedicine, Health Analytics, Cloud-Native Systems.

Two-Level Preference-Based Web Service Composition in Saas Clouds: Challenges and Future Research Directions

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There has recently been considerable interest shown in the problem of web service composition in SaaS cloud computing because of their dynamicity and scalability requirements as well as the quality driven characteristics required. Most studies related to QoS optimization of SaaS cloud computing environment have been done in the past without including considerations about the aspect of trust, privacy, and economics in the process of making

decisions. In addition, previous research had always considered just one side of the coin i.e. the end user and not taken into consideration the perspective of the service providers at all. This work proposes a novel idea of a two-level preference management framework for web services composition in SaaS cloud computing which considers not only the perspective of the end users but also of the service provider as well. Some quality parameters are included like throughput, response time, latency, availability and reliability together with some others like cost and SLAs. Also, to enhance security, some privacy and trust considerations have been included as well. To manage conflicts between user and service provider preferences, the Gale-Shapley stable matching algorithm will be adopted. It is noted from extensive literature review that while most existing approaches provide an adequate foundation for QoS optimization, there exists some gap in the field of two-level preference management framework and QoS-cost-SLA-trust-privacy combination.

Practical Large-Digit Π Computation on A Shared HPC Cluster: A Case Study In Y-Cruncher Swap-Mode Configuration On SLURM

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We document the process of configuring and running y-cruncher, the de facto standard software for record-scale π digit computation, in disk-swapping (swap mode) on a shared, multi-tenant high-performance computing (HPC) cluster managed by the Simple Linux Utility for Resource Management (SLURM) — Ibex, at the King Abdullah University of Science and Technology (KAUST). While swap mode is well documented for dedicated, user-owned hardware, we found no existing guidance for its use on shared academic clusters, where node-local storage is ephemeral, working directories may reside on network filesystems, and resource limits are enforced by SLURM and cluster-wide Quality of Service (QOS) policies rather than the user. We report a sequence of non-obvious configuration failures and their root causes, a working end-to-end methodology (including an unattended sbatch batch-job pipeline), and empirical throughput measurements at 10^10, 10^11, and 10^12 decimal digits. We further identify and quantify a hard storage-bound ceiling for this environment, and report a fully diagnosed out-of-memory failure at the 10^12-digit scale, root-caused via SLURM's accounting subsystem (sacct).

Recovery Outcomes in A Small Covid-19 CBC Cohort: An Auditable Ensemble and Explanation Study

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We examine that question with 103 public patient records. Data preparation created medication and oxygen indicators, a neutrophil-to-lymphocyte ratio (NLR), and a hospital-stay interval; the last variable was excluded from the selected admission-time predictors to avoid using information that becomes known later. Candidate inputs were screened by mutual information and reduced to eight through recursive elimination driven by a Random Forest. We tuned twelve individual algorithms and constructed stacking and majority-vote combinations from five tree-based learners. In the prespecified 21-record hold-out set, stacking made no classification errors and consequently returned 1.000 for all seven reported measures. Across 10 training-set folds, Random Forest produced the largest mean accuracy (0.9875 ± 0.0375). Attribution values from the XGBoost learner gave the greatest importance to ventilation, age, RDW, and platelet count. The very small test set and absence of evaluation at another hospital make these findings preliminary, irrespective of the high numerical scores.

A Secure IOT-Enabled Smart Mask with Machine Learning-Based Anomaly Detection for Real-Time Respiratory Health Monitoring and Early Disease Prediction

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Smart wearables, which are capable of monitoring the state of health on a continual basis, have become feasible due to advances in IoT technology. One approach to realizing this is through the development of smart masks, which are meant to monitor respiratory health, exposure to air pollution, and potential exposure to airborne diseases. Smart masks comprise sensors, microcontrollers, wireless communication module, and a cloud platform used for the gathering, analysis, and transmission of physiological and environmental data. This research proposes to design a smart mask system that utilizes IoT technology in order to monitor health related factors such as respiratory rate, body temperature, oxygen saturation, humidity, and air quality. The data collected from the smart mask is securely transmitted over the internet to the cloud platform for analysis and generation of alerts. The use of machine learning-based anomaly detection, device authentication, and lightweight encryption is done to ensure reliable and secure operation of the system. It is evident from the results obtained from the experiment that the proposed smart mask system is able to reliably transmit data with minimal energy consumption for monitoring respiratory health and pollution exposure.

Machine Learning-Based Early Disease Prediction and Risk Detection System

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Early detection of illness risk plays an important role in providing a quick diagnosis, preventive measures, and a good health outcome. In this research, an Early Disease Pre-diction and Risk Detection System based on Machine Learning has been developed to assess patient health information and provide early disease-risk assessments. The proposed method is feature selection, supervised machine learning, class-imbalance management, feature engineering, handling missing values, and data preprocessing methods. Logistic Regression, Decision Tree, Random Forest, Support Vector Machine and XGBoost are evaluated using accuracy, precision, recall, F1-score and ROC-AUC. A 94.18% accuracy, F1-score of 93.76%, and ROC-AUC of 96.21% indicate that XGBoost performs the best in terms of predictive performance. To increase transparency and identify the elements of the clinical features that contribute to the prediction of a given patient, SHAP-based explainability is included. The recommended strategy is to use both interpretable risk assessment and predictive modelling, which can offer a useful framework for assisting medical practitioners in making preventative decisions, and highlight the early stages of disease risk. Future extensions could be extended clinical validation, real-time monitoring, multi-modal healthcare data, and larger multi-institutional datasets.

SEMANTICGUARD: A Drift-Aware Selective Re-Embedding and Hybrid Coverage-Gap Ingestion Framework for Efficient Rag Systems

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Retrieval Augmented Generation (RAG) systems use vector databases to identify documents upon which the replies created by root were based on another knowledge. While the actual text doesn't change any more, the embedding model or processing pipeline might have changed, and the embeddings will decay over time to become less and less accurate without ever getting wrong. One of the challenges with full corpus re-embedding is the resources, but consistency is important. In this paper, budgetary document import and selective embedding correction systems is presented allowing to correct documents selectively in case of an error in the embedding, while maintaining a budget-friendly total resource consumption. After ranking the documents by semantic drift (the cosine distance between the newly computed embeddings and the stored embeddings), the highest-drift items that fit in a given budget are re-embedded in the repair module. The ingestion module ranks incoming documents based upon both the subject representativeness and the coverage gap uniqueness. SemanticGuard achieves high semantic accuracy with 94.9% and 95.4% of Full-Rebuild nDCG@10 with 20% budgets and 95.4%, 99.6% and 99.6% in cross-model drift validation on arXiv abstracts, Indian news and financial analyst-rated headlines respectively against multiple baselines. This demonstrates that they can be retained with high quality and not too much computation.

Performance And Computational Analysis of Deep Learning Models for Rice Leaf Disease Classification

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Rice is one of the most crucial staple crops and serves as an important food security crop in the world. But several leaf diseases and damage caused by insect pests affect the production of rice and early and accurate identification is crucial to minimize losses to the crop. The traditional approach to disease identification primarily depends on visual identification by the farmers and agricultural professionals, which is time consuming, labour intensive and prone to human error. This paper compares and evaluates four deep learning models that classify rice leaf images into 10 classes: custom Convolutional Neural Network (CNN), ResNet50, DenseNet121 and MobileNetV2. To avoid data leakage in a cross-split scenario and remove duplicate images, a data-integrity procedure was implemented before the model training process. The resulting data set consisted of 17300 images and was split into a training, validation and test set, in a ratio of 70/15/15. The accuracy, precision, recall, weighted F1-score, Matthews correlation coefficient, and Cohen's Kappa were used for evaluating the models, besides the computational measures. The test accuracy of ResNet50 was the best at 99.38%, DenseNet121 at 94.81% and MobileNetV2 at 94.19%, and the custom CNN at 68.60%. The results show that the transfer learning approach is beneficial for the classification of rice leaf diseases, and the MobileNetV2 model is a good choice for resource-limited deployment due to its good balance between classification performance and computational efficiency.

Ai-Enabled IOT-Based Smart Asthma Monitoring and Predictive Disease Tracking System

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Asthma affects approximately 339 million people worldwide and is characterized by unpredictable, recurrent exacerbations of wheezing, breathlessness, chest tightness, and coughing, which account for the majority of asthma-related hospitalizations. Conventional monitoring through spirometry, peak-flow tests, and patient diaries is limited by poor compliance and recall bias and cannot provide real-time information, delaying the detection of exacerbations. We propose an AI enabled IoT architecture for continuous, unobtrusive asthma monitoring comprising two sensing units connected through an ESP32-S3 microcontroller: (i) wearable physiological sensing (heart rate, SpO2, acoustic cough and wheeze detection, thoracic kinematics) and (ii) ambient environmental sensing (VOCs, PM2.5, temperature, and humidity). Sliding-window statistical and MFCC-based acoustic features are fed into classical (Random Forest, XGBoost) and sequence (LSTM) models to predict exacerbations. Models are deployed on-device using TensorFlow Lite Micro with INT8 post-training quantization, enabling low latency, privacy-preserving inference without continuous cloud dependency. The architecture further incorporates MQTT-based cloud alerting, longitudinal EHR analytics, OTA model updates, and a lightweight intrusion-detection layer for IoHT security. Literature benchmarks indicate that INT8 quantization retains over 98% relative accuracy while reducing flash usage by about 71% and inference latency by over 50%. The paper also details the firmware pipeline, an indicative power budget, a threat model, and the ethical, privacy, and regulatory considerations for deployment, and outlines deployment challenges and future

A Comparative Study of Machine Learning Approaches for Cardiovascular Disease Prediction

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Now a days, cardiovascular disease cases are increasing in a rapid rate which results silent death in worldwide. The most challenging task for the doctors is to predict the disease at its earlier stage. So, machine learning approaches like logistic regression, support vector machine (SVM), decision tree (DT), gradient boosted tree, random forest (RF), K-nearest neighbor (KNN), naive Bayes have been used for the prediction and treating diseases early on. In this paper, an ensemble classification approach is also presented to find the better accuracy by selecting algorithms like RF and SVM. At the end, its performance is also measured and contrast with existing techniques using evaluation metrics. The discussed ensemble approach yields better accuracy of 96.1%, precision 93.58%, sensitivity 99.03%, specificity 93.14% and F1 score 96.23% on the Kaggle heart disease dataset. This demonstrated results shows, robustness of ensemble approach for the accurate and reliably prediction of heart disease.

A Framework for Crypto Currency Price Prediction Using Integrating Machine Learning

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In recent years, experts, investors, and the media have paid close attention to cryptocurrencies because of their volatile nature and potential for huge profits. An increasing amount of research has been conducted in an effort to forecast cryptocurrency prices, which are significantly impacted by a number of technological, sentimental, and legal issues. This paper investigates advanced quantitative techniques for bitcoin price prediction by systematically examining academic research from 2014 to 2024. From simple statistical analysis to complex machine algorithms, it includes a wide range of predictive models. In order to overcome these challenges, with a focus on datasets related to Bitcoin, Ethereum, Binance Coin, and Litecoin, this study uses machine learning learning techniques to predict cryptocurrency closing prices. To deal with the complexity of bitcoin data, a feedforward neural network, a neural network, and a decision tree algorithm were used. This review demonstrates the intricacy and quick development of the industry by carefully examining numerous approaches and factors that affect cryptocurrency price predictions, including as blockchain features, technical indications, and market sentiment. The analysis provides basic recommendations for future research by identifying important research gaps and understudied regions. To make sure that future research are both creative and effective, these suggestions aim to link theoretical advancements with useful, profit-driven bitcoin trading applications. Lastly, the data's performance is evaluated using Root Mean Squared Error (RMSE), Mean Squared Error (MSE), R-squared and Mean Absolute Error (MAE)

Machine Learning Driven for Intelligent Financial Fraud Detection

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Financial fraud, which is defined as deceptive methods of obtaining financial advantages, has recently increased throughout businesses and organizations. For detecting such fraudulent activity, traditional methods like human verifications and inspections are inaccurate, costly and time-consuming. However, the number of frauds continues to increase yearly along with the latest technologies. As a result, we suggest a machine learning-based secure fraud detection methodology. According to the evaluated studies, the most common fraud type handled by machine learning (ML) approaches is credit card fraud, and notable ML algorithms for fraud detection such as the Artificial neural network (ANN) and Random Forest (RF). Through utilizing fraudulent and integrated transaction patterns to train the dataset, the new incoming transactions are predicted using machine learning algorithms. In the Bitcoin network, to detect fraudulent transactions, machine learning algorithms are used in combination with blockchain technology. The suggested model classifies transactions and predictions transaction patterns using XGBoost techniques. To evaluate the accuracy, we also compute the model's precision and recall. The proposed smart contract is affected to a security study, along with a recommended attacker model to address limitations and difficulties, in order to show the system's resilience. Lastly, F1-score, accuracy, precision, and specificity are used to evaluate the data's performance

Optimized Heart Disease Prediction Through Combined Feature Selection and Extension Model

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Currently, heart disease is one of the most significant causes of deaths across the world. Heart disease seriously threatens the human life due to high mortality and morbidity. Prediction of heart disease is a significant issue in healthcare fields, in which early and accurate diagnosis saves patient lives and reduces the cost of medical care. Accurate prediction and diagnosis of heart disease is essential for early detection, treatment and prevention has become crucial issue. Precise and timely diagnosis of heart disease is crucial to safeguard patients from additional harm. Prediction of heart disease is one of the most challenging issues that offers computerized estimation of heart disease risk level as a result additional actions can be taken to save patients life. Researchers have suggested different techniques to improve the efficiency and accuracy of heart disease clinical diagnosis. Various variables affecting the health include elevated cholesterol, excessive BP (Blood Pressure), irregular pulse rate and many more make it as most challenging in order to diagnose the heart disease. Recent studies show that the usage of data driven approaches, such as ML (Machine Learning) and DL (Deep Learning) models are highly useful in medical fields for accurately diagnosing heart disease in less time. In this analysis, optimized heart disease prediction through combined feature selection and Extension Model is presented. Combination Random Forest (RF) + Adaboost + Decision Tree (DT) + voting) is used as extension model for the prediction of heart disease. Sensitivity, Accuracy, specificity, Precision and F1-score are measured and compared with popular classifiers. This model achieves better performance than earlier methods

Early Detection of Parkinson's Disease Using Extension Model

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The increasing age of our society is connected to a rising number of people suffering from disorders. One such disorder is Parkinson's Fisease (PD). It is very difficult to detect indications of Parkinson's disease like bradykinesia, rigidity, and tremor accurately even today. A doctor's detection is the basic for treatment. It provides only a temporary estimation of indications that will change from hour to hour and are subject to subjectivity among specialist, as well as within the same observers. Automated symptomatic evaluation has become a lot of consideration in order to optimize treatments in between doctor visits. Still, no device is able to accurately evaluate all three cardinal symptoms. The existing clinical diagnosis some time fails to detect the disease at an early stage. To address this limitation, this analysis proposes a Early Detection of parkinson's disease using extension model integrated with variational decomposition and Extension model (random forest + adaboost + decision tree + voting) for early identification of Parkinson's disease. In this proposed system, Variational decomposition is used to decompose the signal into meaningful intrinsic components that enables multi-resolution analysis for disease-related patterns. In feature selection, relevant features are extracted and optimized. Therefore, in this proposed system Random Forest, Decision Tree, AdaBoost and Voting Classifier are integrated to provide strengths of multiple algorithms to enhance prediction performance. Therefore, observational results demonstrate that described model improves detection accuracy, precision, recall and F1-Score

ARENIQ: NDWI-Based Satellite Change Detection Fused with Citizen-Verified Reporting for Waterbody Encroachment Monitoring in Chengalpattu District

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Lakes, rivers in the Chengalpattu District, Tamil Nadu are in trouble, and ponds and wetlands are in trouble, too. Threats to them are cities expanding without plan, build without permission and people are taking sand from rivers without permission. Waste is also disposed of by people. Filling up land. These factors all make flooding in cities more difficult to manage and are exacerbating the problem. They are also harming the environment. Reducing the amount of fresh water available to local residents.People now are taking steps to monitor these water bodies by doing a lot of walking to see what's happening and listening to the criticism of the people. This is time-consuming and labor-intensive and often people are only alerted to issues after they have resulted in significant damage.This is why we created ArenIQ, a system of satellites and citizens that supervise water bodies. ArenIQ examines water bodies in the past with pictures from satellites and computer systems. It can identify those areas that are wet and those that are dry. It can inform when somebody has constructed anything or removed sand or dumped waste. If it discovers something, it communicates with the management. If they don't do anything, then another message is being sent.We also created a website and a phone application to enable individuals to report issues. They are able to photograph. Place it on a map and we can see it with the pictures and from a satellite. That will allow us to monitor water bodies on a constant basis. Ensure they are secured. ArenIQ is a means to safeguard the water bodies in Chengalpattu District as it involves the integration of computers and satellites and people working together.

A Multimodal Retinal Imaging Approach for Diabetic Retinopathy Detection

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Background Diabetic retinopathy (DR) is one of the most common and earliest complications of diabetes. Your designed to them from being globally the leading cause of Visual Cortex , for preventing vision loss. Abstract This paper provides a deep learning fundus retinal snapshots as well as optical coherence tomography (OCT) photographs. The dataset consists of 1,548 fundus pairs and 1,113 optical coherence tomography (OCT) images, one for normal and other for DR-affected groups. We perform the same separation of convolutional neural. (CNN) models were trained by each imaging modality image Then, they built a multimodal fusion framework to improve diagnostic accuracy by combining features from both fundus and OCT images. The models were trained, validated and trained on a data split of 70%-15%-15% The results indicate that the fusion approach incorporates more information than single-modality models due to its ability to capture additional vascular and structural information. This approach provides an accessible and practical method for detecting DR, while: be incorporated into as sessments of clinical workflow. The multimodal method can assist ophthalmologists in the decision-making syndromes-allowing for more uniform diagnosis and earlier observation of diabetic retinopathy

Quantum Recurrent Neural Networks and Quantum Machine Learning for Time Series Forecasting A Hybrid QLSTM Framework

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Time series forecasting underpins decision-making across finance, energy, transportation, healthcare, and climate science. Classical recurrent architectures such as LSTMs and GRUs, while powerful, suffer from vanishing gradients, limited long-range memory, and rapidly growing parameter and computational costs. Quantum machine learning (QML) offers a fundamentally different inductive bias: classical data are mapped into an exponentially large Hilbert space in which superposition and entanglement can, in principle, represent correlations that are classically intractable. This paper provides a comprehensive treatment of quantum recurrent neural networks (QRNNs) and their application to time series forecasting. We (i) review the core building blocks parameterized quantum circuits, data encoding, and hybrid classical–quantum optimization; (ii) survey QRNN architectures, including quantum LSTMs, fully quantum recurrent circuits, and quantum reservoir computers, together with recent variants such as HQGRU, L-QLSTM, and QSegRNN; (iii) position QRNNs within the broader QML-for-forecasting landscape spanning quantum kernels, quantum generative models, and quantum attention; (iv) propose a hybrid quantum–classical LSTM framework with time-embedded data re-uploading and zero-noise extrapolation; (v) design a rigorous experimental protocol with standard benchmarks, baselines, and metrics; and (vi) analyze open challenges—barren plateaus, hardware noise, qubit limits, and the expressivity–trainability trade-off alongside a research agenda toward practical quantum advantage. Throughout, we emphasize the sobering evidence from recent large-scale benchmarks, in which well-optimized classical models generally match or exceed current quantum models, and we identify the conditions under which QRNNs could plausibly become competitive.

Quantum App Development Framework for Secure Communications

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Quantum communication, and quantum key distribution in particular, offers a form of security that rests on the laws of physics rather than on the difficulty of mathematical problems. Yet the practical adoption of this technology has been slowed by a persistent gap between the hardware that provides the guarantees and the software that application developers actually use. Existing quantum software kits are aimed almost exclusively at circuit design and algorithm simulation; they offer little support for the everyday concerns of secure communication, such as managing key buffers, negotiating sessions, or recovering from link failures. This paper presents Q-SecApp, a layered development framework that makes quantum-secured communication practical for mainstream software engineering. The framework comprises a hardware abstraction layer, an autonomous key and state management engine, a hybrid quantum-classical transport protocol called Q-TLS, and a clean application programming interface. We derive the mathematical models that govern key generation, decoy-state estimation, and entanglement swapping, and we evaluate the framework under realistic threat models and metropolitan-scale network conditions. The results indicate that QSecApp introduces negligible software overhead while preserving the information-theoretic properties that make quantum communication attractive in the first place.

Beyond Visual Artifacts: A Unified Audio-Visual Framework for Robust Deepfake Detection

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Synthetic media generation technologies are evolving rapidly, making existing single-modality deepfake detection tech-niques increasingly unreliable. This work proposes a multimodal deep learning framework that fuses visual and acoustic infor-mation through hierarchical cross-attention fusion. The three-stream architecture uses EfficientNet for spatial features, a 3D CNN with bidirectional LSTM for temporal dynamics, and a Mel-spectrogram Transformer for acoustic patterns. A gated attention mechanism adaptively weighs each modality by its reliability, and an uncertainty-quantification branch flags low-confidence predictions for human review. Evaluated on Face Forensics++, the Deepfake Detection Challenge, and FakeAVCeleb datasets, the combined three-modality approach achieves 96.15% accuracy, outperforming the best single modality by over ten points. Cross-modal attention improves performance by 8.4% over naïve concatenation, and the framework degrades by only 4% on unseen forgery methods, showing strong generalization.

PULMOENSEMBLE: Integrating Various Modes to Categorize Pulmonary Conditions

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Pulmonary diseases must be correctly classified and classified in a timely manner as there can be overlap of clinical features in different diseases. Many automated diagnostic systems use a single modality to obtain complementary information from medical images, clinical characteristics and respiratory signals is a task for which conventional automated diagnostic systems are often not able to provide the required information. In this paper, we introduce a novel multimodal ensemble framework, called PulmoEnsemble: Integrating Various Modes to Categorize Pulmonary Conditions, to exploit pulmonary conditional information in various modalities to make a more robust disease categorization. The proposed approach is to conduct modality-specific preprocessing and feature extraction and then to fuse adaptively and integrate the features at different modalities by ensemble-based decision making. Discriminative representations are learned by means of deep convolutional and transformer-based models, and ensemble integration to enhance the stability of the prediction, across pulmonary conditions. The performance is compared for each model (CNN, EfficientNet, Vision Trans-former, and traditional ensemble baselines), and compared with the others through accuracy, precision, recall, specificity, F1 score, and AUC-ROC. Ablation experiments are also performed to investigate the effect of each modality on the final prediction. The proposed framework aims to use complementary information that can be missed by single-modality methods to increase the robustness and generalization of the classification.

GNN–Based Molecular Graph Deterioration for Lipophilicity Prediction in Drug Finding

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There are a lot of challenges that could be challenges that could be contests. The standard machine learning methods need to have descriptors such as features built by humans to describe molecules while GNNs can take in graph-like molecules, as the nodes represent atoms and the edges represent chemical bonds. In this way, the relational and structural data may be more naturally incorporated in the model. In this case, we use a Graph Convolutional Network (GCN) to predict molecular properties, lipophibenchmark. We use a Graph Convolutional Network (GCN) in this case to predict molecular properties, namely, lipophilicity (logD), with the input of a dataset of about 4200 molecules obtained as an offshoot of the MoleculeNet benchmark. The formulation of the problem is a graph-level regression problem, in which each molecular graph is estimated to have a single continuous value. The architecture is composed of a series of graph convolution layers, then global pooling and a linear output. The findings reveal that the model performs well on training data, which means that it is able to learn meaningful molecular representations. Nevertheless, the behaviour on test data is relatively worse implying problems like overfitting and small size of data. Content-Based Image Retrieval of Indian Traditional Textile Motifs Using Deep Feature Fusion and Efficient Similarity Search

Content-Based Image Retrieval of Indian Traditional Textile Motifs Using Deep Feature Fusion and Efficient Similarity Search

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Content-based image retrieval (CBIR) can support visual exploration of traditional textile collections when textual descriptions are unavailable or insufficient. This paper examines a deep-feature retrieval framework for Indian traditional textile motifs using representations extracted from pretrained InceptionV3 and InceptionResNetV2 networks. The 2048-dimensional and 1536-dimensional descriptors are concatenated to form a 3584-dimensional representation, followed by principal component analysis (PCA) and distance-based ranking. The experiments separately examine individual CNN representations, feature fusion, PCA dimensionality, similarity measures, and category-restricted search. Evaluation is performed on the Indian Traditional Art Forms Dataset (TIAD), containing 22,547 images from nine categories. Precision@20, Recall@20, mean average precision (mAP), and retrieval time are used to evaluate retrieval effectiveness and computational cost. Feature fusion improves retrieval performance over the individual CNN representations, while PCA provides a lower-dimensional representation without reducing the measured retrieval performance in the evaluated settings. Category-restricted search further reduces the number of database comparisons, although its candidate-set size varies with the category assigned to a query. The results illustrate the trade-off between representation richness, retrieval effectiveness, and search cost for image-based retrieval of Indian traditional textile motifs.

A Machine Learning Assisted IC–IR MPPT Strategy for DFIG-Based Wind–Solar Hybrid Power Systems

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This study elaborates an enhanced Wind–PV hybrid energy system (WPVHES) employing an intelligent Maximum Power Point Tracking (MPPT) techniques to prevail the intermittency and nonlinearity objections of solar and wind systems. Conventional MPPT methods for instance Perturb & Observe (P&O) and incremental conductance (IC) show limitations under fluctuating environmental conditions, leading to power losses and slow dynamic response. To overcome this, intelligent controllers including Fuzzy Logic Control (FLC), Artificial Neural Networks (ANN), and adaptive hybrid MPPT schemes are execute for wind PV hybrid energy systems (WPVHES). MATLAB/Simulink results signifying the proposed intelligent MPPT substructure offers faster convergence, higher tracking accuracy, improved DC-link stability, and better overall power quality compared to conventional techniques. The findings confirm that intelligent MPPT strategies remarkably boost the efficiency, reliability, and energy yield of Wind–PV hybrid systems, making them highly suitable for modern renewable energy applications.

Fuzzy Logic Based Prediction of Syngas Yield from Municipal Solid Waste Gasification Under Uncertainty

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Municipal solid waste (MSW) gasification is an emerging waste-to-energy technology that offers a sustainable solution for waste management while simultaneously generating valuable energy products. However, the gasification process is inherently complex due to the heterogeneous nature of MSW, nonlinear interactions among operating variables, and uncertainties associated with feedstock characteristics and process conditions. These factors make accurate prediction of syngas yield a challenging task. To address this issue, a Mamdani type fuzzy logic model is proposed for predicting syngas yield during the gasification of municipal solid waste. The developed model incorporates four significant input parameters, namely moisture content, carbon content, gasification temperature, and equivalence ratio, which are known to strongly influence gasification performance. Linguistic variables and appropriate membership functions are employed to represent these parameters and effectively capture the uncertainties present in the system. A comprehensive fuzzy inference system is established using expert knowledge and process relationships, while the centroid defuzzification technique is utilized to obtain crisp output values for syngas yield prediction. The proposed model is validated using experimental data collected under different operating conditions, demonstrating satisfactory agreement between predicted and observed results. Furthermore, a detailed numerical example is presented to illustrate the step-by-step implementation of the fuzzy logic framework and its practical applicability. The findings indicate that the proposed fuzzy logic model provides a reliable, transparent, and interpretable approach for syngas yield prediction. The model can serve as an effective decision-support tool for process evaluation, operational optimization, and performance enhancement in MSW gasification and other waste-to-energy applications.

An Integrated Hybrid Passive-Active Solar Tracker Using Thermomechanical Actuation and Ai Optimization

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Solar tracking systems (STS) play a pivotal role in maximizing the efficiency of photovoltaic (PV) installations by dynamically orienting solar panels to face the sun throughout the day. With an emphasis on sensor-based systems, motorless designs utilising Shape Memory Alloys (SMAs), and AI-integrated trackers, this paper explores the latest developments in solar tracking technologies. The proposed Hybrid Passive-Active Solar Tracker (HPAST) combines AI-based optimisation with passive thermomechanical actuation. The paper offers a sustainable, scalable, and economical solution by introducing the HPAST concept and conducting a thorough review of recent literature. Enhancements in efficiency, dependability, and long-term viability are highlighted through the use of performance metrics, comparative analyses, and conceptual illustrations. This system provides answers to issues that have historically restricted solar tracking systems, such as high energy consumption, motorised actuation, and frequent calibration.

Develop Embedded Systems with Integration of Internet of Things: Improve Smooth Communication, Monitoring, And Control Among Interconnected Smart Devices

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SAVEETHA

The Internet of Things (IoT) and embedded system development have revolutionized the way devices communicate and function in real time. Embedded systems that facilitate communication, monitoring, and control of smart devices are the focus of this research. The isolation and poor connectivity of typical embedded systems hinder their scalability and adaptation in dynamic contexts. In order to get over these limitations, the suggested system makes use of Internet of Things protocols, cloud connection, and edge computing. Incorporating sensors into embedded nodes, along with communication modules and either distributed or centralized processing units, allows for continuous data sharing. Data is transmitted swiftly and effectively with lightweight protocols like as MQTT and CoAP. Intelligent control is provided by edge-level automated decision-making algorithms, and real-time monitoring is made possible by dashboards hosted in the cloud. By linking devices made by different companies, Internet of Things integration facilitates system compatibility. Data is protected by authentication and encryption. When compared to more traditional systems, the results show significant improvements in response time, latency, and resource usage. In order to facilitate next-generation interconnected systems, our research develops smart embedded-IoT frameworks that are scalable, energy-efficient, and intelligent for use in smart homes, healthcare, industrial automation, and smart cities.

Performance Analysis of GTO-Based Unified Power Flow Controller Under Various Fault Conditions

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In this paper, the performance of GTO based Unified Power Flow Controller (UPFC) is studied under various transmission fault conditions. The UPFC, a very control tool for voltage, active power and reactive power, is modelled using 48-pulse topology of GTO converter in detail. A MATLAB/Simulink model is created to analyze its dynamic response. In this study, the operation of the UPFC is presented in the following fault scenarios: single line-to-ground fault, line-to-line fault, double-line-to-ground fault and three-phase fault. It is observed from the results that the GTO based UPFC is effective to maintain the bus voltage during disturbances. It can also enhance active/reactive power support during transient events. Comparative analysis shows the influence of the fault type and severity on the system performance. These results demonstrate the applicability of the GTO based UPFCs to high power transmission applications as well as to educational research.

Performance Analysis of VSC-HVDC And DVR For Demand Flexibility and Grid Voltage Stabilisation

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To enhance the quality of power in the modern distribution networks, this study proposes a coordinated control method, involving a Dynamic Voltage Restorer (DVR) coupled with a VSC-HVDC transmission interface. DVR and HVDC converter can be energized and voltage supported in real-time due to a two-layer supervisory controller. In other grid disruptions (faults, renewable ramps, weak grids), the results of simulations indicate that this coordinated solution: improves the stability of voltage, reduces harmonic distortion, and enhances the resiliency of grids with a high rate of renewable energy.

Deep Reinforcement Learning (DRL)-Based Coordinated Control of An Electrical Spring Integrated withVSC-HVDC

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The growing inclusion of renewable energy resources into the current power system is bringing many difficulties in voltage regulation, power quality, and reliable power transfer because of the inherent unpredictability of renewable energy sources and load variations. This research suggests a DRL based coordination control scheme for an Electrical Spring (ES) embedded with a Voltage Source Converter-based High Voltage Direct Current (VSC-HVDC) transmission system that would allow increasing demand flexibility and stabilizing grid voltages. Under this proposed solution, the Electrical Spring would be coupled with non-essential loads of the VSC-HVDC power system, which allows intelligent voltage regulation and demand-side management while keeping critical loads at acceptable levels of supply voltages. DRL algorithm is applied to learn the optimal control action by continuous interaction with power system environment and taking into account the real-time measurements, such as voltage of the power grid, DC-link voltage, active and reactive powers, renewable energy production, and load demand. The suggested control algorithm is tested through simulation in MATLAB/Simulink for various operating conditions such as variability in renewable energy

sources, sudden changes in load condition, and variations in grid voltage. It can be seen from the simulation results that the proposed controller has been able to provide better performance in terms of voltage regulation, DC link voltage stabilization, demand flexibility, lower total harmonic distortion (THD), lower transmission loss, and dynamic response when compared to PI-based controllers traditionally used in literature. The proposed scheme provides an intelligent solution for future renewable energy dominated smart grids with respect to power quality.

AI-Based Textile Inspection and Automated Woven Fabric Defect Recognition Using Computer Vision

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Defect inspection determines the grade, and therefore the price, of every roll of woven fabric leaving a mill. Manual inspection sustains roughly fifteen metres per minute and degrades with operator fatigue, which is well below modern loom output. Purely convolutional inspection systems close the throughput gap but obscure the reasoning behind each decision, and a mill supervisor who cannot see why a roll was downgraded will not act on the verdict. This paper specifies the Logical Learning Scheme for Fabric Defect Detection (LLSFDD), a four-stage pipeline that encodes each candidate region into three geometrically interpretable descriptors a linearity measure, a dark-region ratio and a void ratio and partitions the resulting descriptor space with explicit rules, deferring only the residual band near the partition boundaries to a learned assignment. The scheme targets the four defect classes that dominate loom output: missing warp, missing weft, holes and oil staining. Cross-validated against a convolutional baseline across nine training checkpoints from 100 to 300 epochs, LLSFDD attains 97.90% mean accuracy against 91.37% for the baseline, a mean advantage of 6.54 percentage points, while mean loss falls from 3.89 to 1.19. The baseline degrades over the checkpoint range at -0.15 points per hundred epochs whereas LLSFDD improves at 0.085, indicating that the rule-constrained partition resists the overfitting that the unconstrained baseline exhibits.

Adaptive Multi Horizon Forecasting of Electric Vehicle Charging Station Utilization Using Hybrid Machine Learning and Time Series Models

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Electric vehicle charging station availability prediction is very important in pricing strategies and resource management in smart grid societies. In this study, a combined model based on Random Forest and Gradient Boosting as tree-based regressors and basic time series (ARIMA) for modelling are proposed to model hourly utilization rates based on the gathered information from 800 charging sessions from different states of the world. This section separates autogenous variables into the categorical temporal features (hour of day, day of week, and ambient temperature) and ARIMA that quantifies inherent autoregressive patterns. Regarding the performance evaluation using the five-fold time-series cross-validation, for the ARIMA(1,1,1) we get MAE of 17.36 %, RMSE 20.58 % for the Random Forest the values are MAE of 20.72 %, RMSE 24.75 % and for the Gradient Boosting MAE 20.33 %, RME 24.29 %. Temperature is found to be the most influential feature while other two factors affecting the population density are the day of the week and the time of the day. The error

distribution histograms therefore highlight the significance of including station level features and contemporaneous grid level performance in a reliable model. The proposed framework also sets up a standard for allowing several-horizon predictions of the EV charging utilization with the future work in the use of enhanced neural and ensemble structures.

Laplace-Transform–Informed Neural Regression for Precise Parameter Estimation of Second-Order Linear Dynamics

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A hybrid analytical–data-driven framework is proposed for precise identification of second-order linear dynamical systems. By leveraging the Laplace-domain representation G(s)=1/(ms^2+cs+k), the exact step response of a mass–spring–damper model is generated under zero initial conditions. Additive Gaussian noise is then superimposed to emulate realistic measurement uncertainty. A feed-forward neural regressor is trained to invert time–response pairs [t,ynoisy(t)] into the underlying physical parameters m, c, and k. The synergy between transform-based simulation and machine learning yields parameter estimates with sub-percent error—even in the presence of moderate noise—demonstrated by empirical recovery of m=1.0, c=0.5, k=2.0 as m^=1.016, c^=0.498, and k^=2.012 (MSE =1.5×10−5). This approach provides increased applicability, reliability and precision of the system identification and control, diagnostics and design intentions in vibration analysis and design.

Evaluating The Reliability of Hybrid Renewable Energy Systems in Rural India Using Monte Carlo Simulation

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The arrival of hybrid renewable energy systems in rural electrification in India is becoming more of a necessity, and the performance of such systems is inherently dependent on the stochastic nature of solar and wind resources. A single hybrid solar–wind–battery power system is evaluated in this study by probabilistic reliability assessment, for providing power to a rural village of 50 households. This system consists of 10kW of PV, 5kW of wind and 20kWh of battery energy storage. The uncertainty of renewable generation and load demand over one year is represented by 10,000 scenarios in a Monte Carlo simulation framework. The solar irradiance distribution is simulated by a Beta probability distribution, and the wind speed and electrical load are simulated by the Weibull and Normal probability distributions, respectively, and calibrated with the climatic information of the region and the typical consumption profile of the rural areas. Based on the simulation results, the mean daily energy production of solar PV and wind generation are 39.28 kWh and 18.88 kWh, respectively, while the mean daily load is 15.00 kWh. The explicit quantification of battery charge and discharge dynamics, and of unmet load events, has resulted in a Loss of Load Probability (LOLP) of 0.41%, showcasing a very high level of battery supply reliability. Moreover, sensitivity analysis shows that the variability in renewable resources and the battery storage size have a significant impact on system reliability and operational risk. The results yield quantitative information on optimal component size and reliability-based planning of decentralized rural electrification. The proposed framework is easily extensible for other geographical areas, different system configurations, and is generic due to its probabilistic approach, providing a powerful decision-support tool for large-scale deployment of hybrid renewable energy systems.

Symbiotic Sliding‐Window Fourier Thresholding and Deterministic Laplace‐Domain Invocation for High‐Fidelity Fault Diagnosis in Wind Turbine Vibrations

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A combined approach for fault detection in wind turbine vibrations, based on Fourier frequency analysis and transient evaluation in the Laplace domain, is shown to be effective in detecting anomalies in bearings and structures at an early stage of their development. The methodology is tested with synthetic vibration data based on established testing procedures for normal blade motion and the incorporation of high frequency fault signatures and exponential decay events. The system employs a fast Fourier transform operation to detect peaks above an adjustable threshold and a sliding window approach to provide real-time processing with overlapping windows, allowing real-time data to be delivered to the fast Fourier transform. Once the anomaly signatures containing the frequencies which are relevant to the fault are detected, the corresponding window performs a second-order mass–spring–damper model response simulation with Laplace transform. The dual-domain strategy has two roles: it detects the initiation of faults in both the temporal and spectral domains, and describes abnormal mechanical behavior during the disruption events. The performance evaluations demonstrate that the detection system is able to detect the 10 Hz faults in 0.5 s time windows effectively and is robust against periodic vibrations and Gaussian noise contamination. A computational solution developed in this work allows for the implementation of the toolbox in the field to keep track of the health of turbines. For wind energy system monitoring operations, the hybrid scheme yields superior performance in terms of sensitiveness and timing accuracy whilst significantly rejecting false alarms, when compared to the spectral based or transient based ones.

Integrating Explainable XGBOOST With SHAP And Lime for Spatiotemporal Modeling and Policy-Oriented Impact Assessment of Ten-Year Solar Adoption in Indian Villages

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The ideal understanding of solar adoption over the very long-term is a process of utmost importance in establishing energy policies that will assist in the augmentation of renewable energy usage. This paper utilized an explainable AI approach integrating an XGBoost regression model appended with SHAP and LIME explanations to forecast the ten-year solar adoption rates across different geographical areas. By doing so, for the XGBoost model, utilizing the same features as before, an RMSE of 0.151 is reached and variance of 47.7% of the adoption outcomes is explained establishing we now have a black's box baseline. By using SHAP analysis, we have identified that the initial electricity access has the strongest impact on the predicted adoption across the world than income and population. They offer local and instance-based decision bounds, indicating how each feature for a certain region changes the prediction. In this method the real comparison is made between the raw prediction and Feature Effects, with a clear understanding of price difference of interpretability and a higher level of accuracy. These policy impacts estimate the marginal value of enhancing interconnectivity of the grid and directs specific efforts to increase the adoption of solar. The suggested approach can be viewed

as a general method of how to apply the XAI to prospective studies in energy adoption that translates high-level mathematical computations into policy benchmarks.

Multi-Stage Innovation Pathway Modeling for Carbon Market Transition in India

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India's evolving carbon market requires evidence on how low-carbon innovation translates into credit-market participation and development. This study proposes an Innovation-to-Carbon-Market Transition (ICMT) approach integrating market structure, innovation pathways, credit issuance, conditional issuance magnitude, credit utilization, and mitigation outcomes. Using 1,907 India-based voluntary carbon-market projects, project-level models were combined with robustness tests, out-of-fold validation, independent-source evidence, and conditional scenarios. Renewable Energy accounted for 86.64% of issued credits, while wind, solar, and hydropower collectively represented 83.03% of technology-level issuance. Innovation pathways were significantly associated with issuance and retirement, with respective model AUROCs of 0.7535 and 0.7626. External CDM evidence further supported technology-related heterogeneity in mitigation outcomes. The findings demonstrate that carbon-market evolution reflects distinct stages of technological participation rather than aggregate credit supply alone. ICMT provides an integrated empirical basis for assessing innovation-driven market development while maintaining associational and non-forecast interpretations.

Empirical Validation and Explainable Prediction of Innovation Adoption Drivers and Barriers in Energy-Sector Firms

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Innovation in energy-related industries depends on organizational capabilities, collaboration, market exposure, and institutional support, yet their empirical importance and cross-country generalizability remain uncertain. Using OECD Business Innovation Statistics and Indicators for mining, quarrying, energy, water supply, and waste-management services, this study examined 80 country-period observations from 33 countries, with expanded complete-case sensitivity samples. Country-clustered regression, country and time fixed effects, influence diagnostics, winsorization, leave-one-country-out testing, and nested country-grouped machine-learning validation were applied. R&D expenditure share and innovation collaboration showed positive but statistically non-robust associations. Government innovation support produced the strongest and most persistent positive association, whereas internationalisation remained positive but specification-sensitive. Predictive testing showed that the primary two-driver model did not outperform the grouped mean baseline for unseen countries, while the expanded four-driver model achieved only modest improvement and weak out-of-fold explanatory power. Overall, innovation adoption was highly context-dependent, with institutional conditions appearing more informative than isolated organizational indicators.

Performance And Emissions of Karanja Oil and Its Blends in A Single Cylinder Diesel Engine

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The depletion of fossil fuels and growing environmental issues have further enhanced the need for the development of alternative fuels. Biodiesels, such as those obtained from non-edible oils like Karanja oil, i.e., Pongamia pinnata, have been identified as potential alternatives to conventional fossil fuels. The main aim of the current study is to experimentally investigate the performance and emission characteristics of a single-cylinder agricultural engine running on Karanja oil biodiesels and their blends at varying load conditions. Experiments were conducted using B0, B10, B20, B30, and B40 blends and varying load conditions from 0 to 100%. In addition to emission parameters like CO, HC, CO_2, NOx, and smoke opacity, performance metrics like Brake Thermal Efficiency (BTE), Brake Specific Fuel Consumption (BSFC), and Exhaust Gas Temperature (EGT) were examined. According to the findings, the B20 blend performed best with BTE near diesel and lower CO and HC emissions. Nevertheless, a higher biodiesel content resulted in an approximate rise in NOx emissions. According to the study's findings, Karanja biodiesel blends provide a sustainable and eco-friendly substitute fuel that can be used in crops diesel powered engines without any modifications.

Agentic AI For Autonomous Supply Chain Orchestration And Risk-Aware Decision Making

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The Current environment of supply chains calls for decision systems that can react to demand uncertainty, risk, disruption, contextual changes and changing inventory states without having an inflexible analytical pipeline. In this paper, we introduce the design of an autonomously orchestrated multi-agent architecture for demand-driven supply-chain decision support. The system includes demand forecasting, demand-risk assessment, scenario-based inventory planning, price and event contextual analysis, decision optimization with constraints, orchestration, and deterministic auditing. The relevant specialist agents are selectively engaged depending on forecast uncertainty, risk, context and planning, while actions are selected based on utility minimization. In our experiments, the forecasting model showed MAE equal to 0.7227, RMSE equal to 0.8447, WAPE equal to 0.1062 and sMAPE equal to 0.1109. In the case of 13 system scenarios in total, dynamic orchestration used 51 agent engagements in contrast to 65 in the case of the baseline where all agents were called, which resulted in a 21.5% reduction in the number of agent calls. The system created four different workflows and actions, preserving full auditability with an average audit completeness rate of 1.0, no faithfulness violations and trace reconstruction failures. Failure tests also confirmed warning, escalation and fail-safing based on agent criticality.

Adaptive Battery Degradation Modelling for Intelligent Electric Vehicle Health Management

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Accurate and adaptive tracking of lithium-ion battery degradation is central to the safety, residual value and total cost of ownership of electric vehicles (EVs). Conventional state-of-health (SOH) estimators either rely on fixed empirical ageing laws that drift away from the real cell as operating conditions change, or on purely data-driven regressors that generalize poorly to unseen usage profiles. This paper proposes an adaptive degradation modelling framework for intelligent EV health management that couples a recursive least squares (RLS) semi-empirical fade model, re-calibrated online from sparse capacity check-ups, with a gradient-boosted residual corrector driven by measurable resistance, voltage, charging-time and thermal features. The framework is evaluated on a physics-informed simulated cycling dataset of twelve cells operated between 15 and 45 °C and between 0.5 C and 2.0 C, with eight cells used for training and four unseen cells for testing. The proposed model achieves an SOH root-mean-square error of 1.14 %, which is 29 % lower than the strongest data-driven baseline and 62 % lower than a static empirical model, while detecting the 80 % end-of-life point within 18 cycles on average. Ablation and sensitivity studies show that both the adaptive update and the residual learner are necessary, and that accuracy is retained for check-up intervals of up to 100 cycles.

Integrating Voice Technology into Ai Chatbots for Enhanced Real-Time Interaction

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This article explains the development and enhancements of an AI-powered Chatbot with voice interaction capabilities using OpenAI's GPT-4 model, advanced speech recognition, and text-to-speech (TTS) technology. The system provides a smooth experience to the users that are both text-based and voice-based, facilitating seamless and natural user interaction. It shows the system's capabilities in the field of e-learning, virtual assistants, and customer support. We look at its design, methods, performance assessment, and real-world applications. Some key issues, such as scalability and accuracy of voice recognition, are discussed and explained, along with potential future system improvements and enhancements. The goal of this research is to shed light on potential integrations of multimodal AI systems into contemporary applications and growing technology.

Create Intelligent Forecasting Models: Predicting the Weather Using Machine Learning (Ml) And Time-Series Analytics

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Agriculture, disaster management, transportation, and city planning all rely heavily on weather forecasts. Although they are successful, traditional numerical weather prediction systems are computationally expensive and have difficulty with short-term and localized forecasts. This study introduces a smart forecasting system

that uses machine learning and sophisticated time-series analytics to enhance the efficiency and accuracy of predictions. The model finds hidden temporal patterns and nonlinear linkages using historical data on humidity, air pressure, wind speed, and temperature. LSTM, SVM, Random Forest, and Gradient Boosting are able to capture both the short-term fluctuations and the long-term interdependence of weather data. Data models are enhanced through the use of seasonal decomposition, trend analysis, and noise filtering. For precise forecasts, the suggested method employs feature engineering and hyperparameter tuning. When compared to independent ML methods and statistical methods, hybrid ML-time series models demonstrated superior accuracy, scalability, and adaptability in experimental settings. Regional climate modeling and real-time forecasting are both made possible by the system. Intelligent, data-driven weather forecasting systems that are efficient, scalable, and capable of addressing modern environmental concerns may be built using ML and time-series analytics, as demonstrated in this work.

Enhance Autonomous Healthcare Systems: Integrate Artificial Intelligence and IOT for Real-Time Functionality Assessment of Patient Risk

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Advancements in digital healthcare have sped up the use of smart, interconnected medical devices for data-driven, preventative clinical decision-making. Autonomous healthcare systems might be enhanced by AI and IoT by continuously tracking patient risk. The episodic nature of tests and the resulting delays in response make traditional healthcare inadequate for managing patients' evolving conditions. The integrated strategy uses cognitive analytics, automated risk interpretation, and continuous physiological monitoring to overcome these limitations. The Internet of Things (IoT), smart sensors, and linked medical platforms can gather a patient's vitals, behavioral indications, ambient factors, and medical history, according to a study. Adaptive learning, pattern recognition, anomaly detection, and predictive modeling are some of the ways that AI-based analytical layers employ this multidimensional data stream to evaluate patient risk in real-time. Notifications, prioritizing of treatment routes, and decision support for healthcare professionals are all features of the system. Reliability, data security, interoperability, and clinical responsiveness are all enhanced by the architecture. Patient outcomes and healthcare resource utilization are both enhanced by the AI-IoT ecosystem's ability to detect health deterioration early and enable personalized therapy. This research explores the potential impact of autonomous healthcare systems on healthcare delivery and lays the groundwork for smart healthcare networks that can detect, prevent, and adjust to patient risks.

Intelligent Embedded Systems for Real-Time Breath Alcohol Detection, Occupant Verification, And Automated Vehicle Ignition Interlock Control

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Low cost, tin-oxide based breath alcohol sensors are appealing for vehicle interlocks, but are not widely believed upon for two reasons that are typically not discussed. Their resistance is as much dependent on ambient temperature and humidity as it is on ethanol concentration, so a device that is calibrated in the laboratory is off in a cold cabin; and nothing in a conventional interlock makes it known that the individual taking the sample is the person who will be operating the vehicle. This paper presents the interlock TC-BAI which addresses both problems as design requirements. A second sealed MQ-3 element provides a differential reference that eliminates common-mode baseline drift and a bivariate correction surface fitted over the 5-45 °C

and 20-90 %RH range removes the baseline sensitivity to the environment. The ignition permission is also made based on simultaneous capacitive contact at the seat contact and steering wheel contact within 200ms of the ignition being turned on, making this impossible when a sample is provided from a position outside of the driving position. The mean absolute error is 0.0163 mg/L with the R^2 value of 0.962 and the area under the receiver operating characteristic of 0.986 at the statutory threshold of 0.030 mg/L, for over 134 paired samples, while the same hardware without compensation has an area under the receiver operating characteristic of 0.874 at the same threshold. In the 30 days baseline drift decreases from 39.3 to 4.8 µg/L. Normally open relay, thus any fault will inhibit the start.

IOT-Enabled Assistive Healthcare Automation and Reliable Appliance Control for Palliative Care Environments

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Assistive appliance control lets residents with limited mobility operate lighting, ventilation and bed actuators without calling for help, and lets caregivers do so remotely. Existing microcontroller-based systems provide a cloud path and a local path in parallel, but almost universally treat the cloud as authoritative on reconnection. This paper identifies the consequence, which has not previously been quantified: when the network is unavailable and a resident operates a physical switch, the cloud retains a stale view, and on reconnection it overwrites the device silently reverting an action a person deliberately took. In a domestic setting this is an annoyance; in a care room, where the actuated loads include lighting and bed positioning and the occupant may be unable to intervene a second time, it is a safety defect. We specify a versioned reconciliation protocol in which every channel carries a monotonic version, the device is authoritative for physical state, and cloud writes derived from a stale view are rejected rather than applied. Evaluated over 30 independent one-hour runs per operating point across five packet-loss conditions, the conventional scheme produces between 5.57 and 7.33 silent reversions per hour, while the proposed protocol produces none by construction, at a cost of roughly eight per cent additional control-plane messages. Local-path latency of 13 ms is maintained irrespective of network state.

Intelligent Robotics and Kinematic Optimization for Autonomous Façade-Cleaning Systems

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Façade-cleaning robots are usually reported through a single headline efficiency figure, with the baseline unspecified and the measurement protocol undescribed, which makes competing designs impossible to compare. This paper replaces that practice with a reproducible kinematic benchmark. We model a glazed pane as an occupancy grid with frame margins and mullion obstacles, and simulate two locomotion strategies: a conventional two-column alternating-suction gait constrained to a fixed serpentine over the pane interior, and a modular hub-and-legs gait with a narrower footprint and an additional edge-following pass. Coverage, path length and suction-cycle count are measured over 12 randomised layouts per configuration and four obstacle densities. The modular gait covers 98.38 % to 98.42 % of reachable area against 86.32 % to 88.52 % for the conventional gait, and its advantage widens with obstacle density because it recovers the perimeter band each

mullion creates. That coverage is not free: it costs 1.79 to 2.51 times the path length and 5.0 to 23.4 times the suction cycles, the latter bearing directly on seal wear, pump duty and battery endurance. An aspect-ratio sweep shows the coverage gain ranging from 10.25 to 16.99 percentage points, largest on wide panes where the conventional serpentine leaves proportionally more unswept margin. We report this as a simulation; no physical prototype was available, and every model parameter is stated so that measured trials can replace it.

Low-cost equal water distribution and supply management system using SCADA for apartments

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Water is one of the most essential resources for human life and the environment. With increases population and urbanization, the demand for water is continuously rising, making efficient management and conservation increasingly important. In large residential apartment, improper distribution, excessive consumption, and lack of monitoring can lead to significant water wastage. Therefore, an effective system is required to monitor water availability and ensure its controlled and equitable distribution. This work presents a smart water management system designed for apartment building to improve water utilization and minimize unnecessary consumption. The proposed system continuously monitor the available water level and control the distribution of water to individual flats. The allocation can be determined according to the number of occupants and their estimated daily water requirement, thereby promoting fair usage among residents. Water flow can also be monitored to identify excessive or unusual consumption and support better resource management. Based on the record consumption, the system can assist in generating water usage information for individual flats. The proposed solution integrates SCADA for real-time supervision, monitoring, and control of the water distribution process. An ESP32- based IOT platform is used for data collection and communication, while solenoid valve and flow sensor support automated control and measurement. The system aims to reduce water wastage, improve distribution efficiency, encourage responsible consumption, and provide reliable monitoring of water usage in residential apartment.

Multivariate Characterization of Thermal Influence and Battery Capacity Mediated Performance in Global Electric Vehicle Charging Networks

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The state of ambient temperature is considered as a factor that affects electric vehicle battery charging; however, concrete and comprehensive data is limited. It focuses on 800 true charging sessions across a number of geolocations to assess the impact of climate on charging, in terms of the rate measured in kWh per hour and the probability of the session being completed. When using a simple regression model that adds the interaction term between temperature and battery capacity made ORLS, the resulting coefficient assigning to temperature (–0.054 kWh/h per °C, p = 0.890) is not significant, while assigning a significant positive coefficient to battery capacity (0.329 kWh/h per kWh, p = 0.002). However, based on the temperature, this model accounts only 3.7% of variation (R^2 = 0.037), which shows that temperature alone does not cover significant variation. Using a random forest classifier with ambient temperature, battery capacity and charging cost as inputs results to an average accuracy level of 62% to predict the session outcome with a high value of recall for interrupted sessions but low value of recall for completed sessions. Some of the findings show that thermal conditions play a very little role in determining charging performance and reliability but the battery characteristics and operational factors greatly influence the charging performance. For future works, it will require additional research to

implement dynamic grid loads, temporal usage pattern, and superior thermal management data to devise suitable adaptive charging profile with regard to temperature.

LSTM-Augmented Deep Q Network Energy Dispatch with Ensemble Efficiency Classification in Hybrid Storage Systems

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Variable renewable energy sources' integration into Hybrid Energy Storage Systems (HESS) requires proper ways of forecasting, evaluation and dynamic dispatching techniques in real-time. This paper aims at developing an integrated artificial-intelligence model accompanied by deep learning, ensemble classification, and reinforcement learning in order to enhance the overall HESS performance. First, based on the LSTM technique, forecast of the expected solar, wind, and storage state-of-charge future states at the step and multi-step horizons can be made. Then, a gradient boosting decision tree classifier identifies Low, Moderate and High efficiency regimes regarding the predicted and actual system data. Last of all, a Deep Q Network agent trains an energy allocation policy of the battery, supercapacitor, hydrogen, and the grid that penalizes for power loses and fluctuation in state of charge. After using the proposed algorithm on a real-world dataset of renewable inputs, storage level, load demands and power flows at 5 minutes intervals, it has been proved that the proposed approach is significantly better than rule-based approaches since it leads to reduced cumulative power loss and higher classification accuracy. Such effects show the advantage of applying AI-based approaches to the development of reliability and performance of batteries in smart-grid systems.

AN IOT WEARABLE - ASSISTED HEALTH MONITORING SYSTEM FOR PCOS MANAGEMENT

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One in five females worldwide lives with Polycystic Ovary Syndrome (PCOS), a persistent endocrine condition. Tracking daily bodily shifts matters most when managing symptoms - yet many physicians rely solely on check-ups twice per year, missing fluctuations between appointments. Introducing a wearable health tool built on Internet of Things technology designed specifically for PCOS oversight. At its core sits an ESP32 chip paired with sensors capturing heartbeat, skin warmth, blood oxygen levels, and motion patterns continuously. Data flows without delay, offering insight into how the individual's body responds hour by hour. Behind the screen, processing kicks off as a device runs data through a Random Forest model alongside logic-based checks, spotting potential health issues instantly. Each user gets their own live digital copy, stored safely in a Supabase-powered cloud system that adapts outputs to personal habits. Instead of static reports, updates flow continuously, shaped by how individuals respond over time. Interaction happens via a mobile app built with Flutter, letting people record symptoms, follow monthly patterns, and receive alerts fine-tuned to them. When tested, the Random Forest approach reached 91.6 accuracy, outperforming the rule-driven method at 83.8 - both clearing the minimum goal of 80. Rather than waiting for doctor visits, support now unfolds daily, shifting PCOS management into something proactive, continuous, and uniquely fitted.

Secure Image-Based Authentication Scheme Using Image Shuffling

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Traditional alphanumeric passwords force a trade-off between memorability and strength: complex passwords are hard to recall and get reused, while simple ones fall quickly to guessing, dictionary, and keylogging attacks. Existing authentication schemes attempt to address this, but ultimately still store some form of the user credential in a central database—creating a single point of failure when that database is breached. This project proposes a Secure Image-Based Authentication Scheme that defeats database-breach attacks through session-based image shuffling: at registration, a unique string identifier is generated for each user, rendered as a high-contrast image, split into 256 tiles, and shuffled by the server, so the credential stored in the database is a visually unintelligible mosaic rather than any recoverable plaintext. During registration, the server generates a personal string identifier for the user; this identifier is embedded within a shuffled tile image stored in the database, while the permutation sequence used to shuffle the tiles is maintained securely by the backend server. Session tokens, HTTPS/TLS, and a rate-limiting lockout policy further protect the scheme against replay and brute-force attempts. A prototype was implemented using a Python backend with a relational database for shuffled-image storage, and its resistance to database breaches, brute-force guessing, and credential theft was analyzed against traditional text passwords and hash-based storage schemes. The analysis shows that the tile-permutation space of $256! \approx 8.58 \times 10^{506}$ makes reconstruction of the original credential computationally infeasible, while keeping authentication effort within a range acceptable to real users.

Hybridizing Rolling Chi-Square–Based Benford Deviation with Isolation Forest in anASYNCIO-Driven Streaming Pipeline for Sub-Second Fraud Detection in Banking Transactions

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The proposed framework for the identification of fraud in banking systems in real-time is based on the combination of Benford's Law and unsupervised learning algorithms. The empirical CDFs of the leading digits of transaction amounts are tested against the logarithmic Benford baseline at every time step separately and the deviation scores of the tested distributions are incorporated into an Isolation Forest model together with behavioural and contextual features, namely, login attempts, consistency of the device used in subsequent transactions, and transaction frequencies during a certain period. The complete pipeline is built and deployed in Python, Google Colab for sub-second real-time prediction and training of the model is done by scikit-learn. On the real dataset of 2,512 records supplemented by synthetic fraud injections, the proposed solution has about 92 % detection rate, a 15 % False Positive Rate decrease compared with Isolation Forest, and AUC of 0.94. As shown in the feature importance check, Benford deviation belongs to the most significant variables; geographic inconsistency and higher temporal frequency increase the overall system sensitivity. The proposed method thus provides an inexpensive, but highly effective, way through which financial institutions that desire distributional-based fraud detection in real-time may implement it.

NAVGRAH Optimization For MAKESPAN-Aware Task Scheduling and Load Balancing in Heterogeneous Cloud Computing

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This paper applies NavGrah Optimization (NGO), a nine-operator rank-adaptive metaheuristic, to independent-task scheduling and load balancing across heterogeneous virtual machines (VMs) in cloud computing. Each candidate solution is encoded as a real-valued task-to-VM assignment vector and decoded via a floor-based mapping; a weighted fitness function jointly minimizes makespan and a load-imbalance degree over an Expected-Time-to-Compute (ETC) workload model. We benchmark NGO against Particle Swarm Optimization (PSO), Grey Wolf Optimizer (GWO), and a real-coded Genetic Algorithm (GA) across three synthetic cloud workload scenarios of increasing scale — Light (50 tasks, 10 VMs), Medium (100 tasks, 15 VMs), and Heavy (150 tasks, 20 VMs) — each over 10 independent runs with matched random seeds. Across all three scenarios, NGO consistently and substantially outperforms GWO, reducing mean makespan by 8-30% and load-imbalance degree by up to 51%, and remains broadly competitive with PSO. However, the real-coded GA — whose arithmetic crossover appears particularly well matched to the direct floor-encoded assignment representation used here — achieves the lowest mean makespan and imbalance degree in every scenario, with NGO and PSO trailing behind it. Resource utilization results follow the same ordering, with GA reaching 80.8-89.5% mean VM utilization against NGO's 64.8-77.7%. These results provide an honest, reproducible characterization of NGO's behavior on a discrete-flavored assignment problem, distinct from the continuous benchmark and machine-learning domains it has previously been evaluated on, and identify concrete conditions under which its rank-adaptive design does and does not translate into a scheduling advantage.

Benchmarking PUBG Ranking–Based Optimization for Large-Scale Symmetric Traveling Salesman Problem Instances

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This work aims at assessing the performance of PUBG Ranking–Based Optimization (PRBO) algorithm on a TSP benchmark set extracted from TSPLIB to compare the results with a Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) algorithms. In total, 10 cases varying from 52 to 1,432 cities were analyzed. As for the comparisons of tour lengths the performance of PRBO is the best on Berlin52, rd400, rat783 and u1432 and has less deviation from the optimum value than GA as well as PSO respectively, on larger problems. Regarding the kroA200 problem the obtained results with the PRBO were 29,865 while, the result obtained with GA and PSO were 30,168 and 29,968 respectively and the optimum value was 29,368. On ali535, PRBO generated 222,310 while GA was 242,310 and PSO of 231,120. In assessing convergence curves, it is shown that the ranking approach and migration scheme proposed in PRBO lead to picking solutions with good exploration to exploitation trade-off and low variance in independent runs. This fact proves that PRBO has good accuracy and reliability with statistical testing of the error distributions. Based on these results, it can be concluded that heuristic algorithms specified by the results of the PUBG ranking system can improve the efficiency of metaheuristic search of large-scale combinatorial problems.

Agentic Artificial Intelligence in Cyber Operations for Advanced Persistent Threat Detection

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The transformation from large language models (LLMs) to autonomous Agentic AI has completely changed the cybersecurity landscape. Pre 2024 models were used as oneshot advisors or oracles, while today's agentic models feature long memory, iterative planning, and direct API access to perform multi-step actions in production. This paradigm shift brings with it novel opportunities for autonomous defence and penetration, but also novel attack surface and poorly-understood. This paper introduces a holistic, two-sided taxonomy to organize the security considerations of Agentic AI in cyber operations. We first develop a formal architectural model based on Partially Observable Markov Decision Processes (POMDPs). We then suggest a taxonomy that splits the field into two components: (A) intrinsic vulnerabilities in the agentic pipeline, encompassing perception, memory, action, and multi-agent communication layers; and (B) operational employments, from single-agent remediation to multi-agent security operations centers and autonomous redteaming. A systematic review of more than 200 recent papers is used to find critical gaps such as verifiability dilemma, swarm collusion threats, and lack of stochastic real-time benchmarks. We also outline a plan for the future to realize Byzantine-fault-tolerant agent federations, runtime neurosymbolic verification, and Constitutional Hypervisors. We found that agentic systems can be attacked with asymmetric advantages, but that formal consensus protocols and layered guardrails with a defensive multi-agent orchestration can reduce such threats. This review will be a resource for researchers and practitioners in the field of securing the next generation of AI-driven cyber operations.

Sentiment And Sarcasm in Hindi-English Code-Mixed Social Media: A Systematic Review of Evidence, Evaluation Failure Modes, And Research Priorities

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The Hindi-English social media reveals a challenging blend of code-switching, Romanized Hindi, informal orthography, emojis, conversational context, and reversal of pragmatic meaning. This review investigates sentiment analysis and sarcasm detection within that context as a pairwise reliability issue, as opposed to two distinct classification tasks. We summarize the results of benchmark datasets, shared tasks, multilingual representation learning, context-aware sarcasm models, Indian-language pre-training, and recent large language model (LLM) research. The review yields four deliverables: a dataset-and-task evidence map; a model choices and failure mode taxonomy; a cohesive formulation of language identity, sentiment, sarcasm, context, and uncertainty; and a practical evaluation protocol to guide future work. The main conclusion is that headline in-domain F1 is not a full measure of progress. The stronger differentiators between systems that can fit a benchmark, and systems that can support deployment are cross-domain transfer, transliteration robustness, ambiguity-conscious annotation, calibration, and context sensitivity. Recent experiments with Hindi-English sarcasm have demonstrated mixing of native samples and multitask learning benefits, whereas recent code-switched LLM surveys still claim a lack of data and evaluation bias. We thus suggest benchmark designs to explicitly reveal orthographic and pragmatic shift, to compare strong discriminative baselines with LLM prompting and to report both performance and reliability to controlled perturbations.

Deep Learning and Gans for Enhancing Visual Security Monitoring in Low-Quality Environments

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In low-light conditions, the images captured for surveillance purposes tend to be noisy, blurry due to motion, and corrupted by compression artefacts. These degrade the inherent structures and object contours within the scenes. Many existing approaches address the issue by preprocessing the image data before performing analysis tasks. However, it is unclear whether the pre-processing step positively impacts object detection performance. In this paper, we analyse a straightforward enhancement pipeline under extreme degradation and its implications on downstream tasks of object detection. Our experiments used a synthetic dataset obtained by manipulating a collection of original images under varying illumination reduction, noise levels, and compression. A subset of ExDARK images was used to gauge performance in realistic low-light conditions. While enhanced images had improved brightness, quantitative evaluation revealed insignificant structural restoration (PSNR ≈ 7. 35; SSIM ≈ 0. 015). In addition, there was no impact on the detection accuracy.

An Improved Approach for Detecting and Classifying Abnormal Passenger Activities Inside Public Buses Using an Overhead Camera-Based Vision System

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The combination of different mobility and technological solutions is referred to as smart mobility. The People and goods can move more sustainably and effectively by developing transportation networks. The on-demand services such as cars, electric cars, public transit and ridesharing are traditional forms of mobility. The traffic jams and logistical efficiency problems are reduced by popular smart mobility systems. Manual monitoring of passenger behaviour or surveillance footage is inefficient. These issues are addressed in this proposed system. Therefore, an improved approach for detecting and classifying abnormal passenger activities inside public buses using an overhead camera-based vision system is proposed in this analysis. This proposed system integrates advanced deep learning techniques and spatio-temporal action recognition for detection and tracking of passenger behaviour. The DETR (Detection Transformer) model and Deep SORT are used for tracking multiple objects and to maintain consistent passenger identities. Therefore, passenger motions are captures continuously and these clips fed into 3D hybrid resnet_lstm model for accurate activity classification. Hence, this proposed system shows better results interms of accuracy, precision, recall and F1-Score

Human-Technology Integration in the Hospitality Industry: Workers' Preparedness for Adoption of Robotics and Artificial Intelligence

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In this study, the use of Unified Theory of Acceptance and Use of Technology (UTAUT) approach, which is by tradition applied to the technology acceptance field, in an developing market setting to explore the hotel industry's employees' desire to embrace and accept the use of artificial intelligence (AI) and robotics. The data was obtained through a systematized questionnaire adopting the quantitative empirical approach, which involved 70 Employees in the star category hotels of national capital region in India. The study includes extra dimensions such as perceived risk, technology interaction propensity (TIP), and employee satisfaction to improve the knowledge of employee perspectives about AI adoption. The data were analyzed through SPSS application with reliability analysis, descriptive statistics, exploratory factor analysis, correlation and regression

analysis. A conclusion from the results is that there is a adequate level of dependability and strength in the measurement tool. The employees' attitude towards AI and robotics is rather guarded, with a mix of reliance and apprehension concerning job safety and potential negative penalties of technology use.

Predictive Analytics for Electric Vehicle Battery Health Monitoring

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State of Health (SOH) prediction plays an important role in ensuring safety, efficiency, and resale value of electric vehicles (EVs). Electrochemical methods and equivalent circuit techniques need to precisely identify parameters of the model, and tend to deteriorate under different thermal and load conditions, whereas deep learning methods are computationally heavy and challenging to implement onboard. In this paper, we propose a system for EV battery monitoring based on the extraction of features from the charge-discharge telemetry of the battery pack. Nine features such as constant current charging time, peak height of incremental capacity curve, statistical measures of voltage curves, and temperature rise of battery surface are considered. Five baseline algorithms are Ridge Regression, Support Vector Regression (SVR), Random Forest, XGBoost, and Long Short-Term Memory (LSTM) Networks. We further develop a stacked hybrid algorithm that combines the predictions of tree-based and recurrent learners through ridge regression. The hybrid architecture had the lowest error, with an RMSE of 0.87%, an MAE of 0.64%, and an R^2 of 0.992, outperforming the best single-model approach by 28% in terms of RMSE. The inference latency of less than 5 ms per cycle is also conducive to edge computing. The results suggest that lightweight ensembles driven by features can deliver accurate, explainable, and implementable battery prognostics.

Digital Takumi: A Framework for Learning Multimodal Representations of Human Procedural Skill

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Foundation models now cover language, images, audio and video, but human expertise is not held entirely in language or in visual appearance. A machinist, welder, electrician or potter carries procedural knowledge that is expressed through action sequences, timing, tool handling, adaptation and error recovery. Two workers may produce an identical finished part while differing in how they position a tool, how early they notice a mistake, and how many unnecessary movements they make. Most computer-vision systems are built to recognise what is happening; this paper asks instead whether a representation can be learned for how a skill is performed. We present Digital Takumi, a framework that treats a multimodal representation of human procedural expertise as the primary object of learning rather than as an intermediate signal for robot control. The framework encodes video, hand and body pose, and object and tool interaction into a fixed-dimensional skill representation intended to support expertise discrimination, retrieval, comparison and instruction. We survey the closest prior work, state explicitly which capabilities that work already provides, and locate the remaining gap. We then specify a scoped first study: a controlled dataset design with confound and identity controls, four learning objectives, a contrastive training formulation, an evaluation protocol combining classification, retrieval and correlation with expert similarity judgment, and five falsifiable hypotheses. Limitations that bound any observation-based account of expertise are discussed.

Real-Time Pothole Detection and Reporting System Using Yolov[8] and CNN

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Potholes are commonly sighted on road in India. It damages vehicles and causes accidents. Also, it causes daily trouble commuters. To counter this problem, we propose a tech-based automated solution that will integrate video processing with accurate GPS location in real-time. The YOLOv8 object detection model is used by the system to find potholes in live camera feeds and save their exact location using geolocation from a browser. In order to prevent redundancy, there is a similarity filter such that the reported potholes are not similar to each other. It is done using an SSIM (Structural Similarity Index Metric). Moreover, the system keeps a live csv file in which status of pothole repaired (eg. fixed or not fixed) can be updated after verification or repair. Detected potholes are shown on an interactive Open Street Maps interface that can be used by government authorities and civic body to monitor-track and repair the potholes. This visualization strategy based on data makes road updating and infrastructure management transparent and aids decision-making.

Enhancing Coral Reef Resilience Through Adaptive Ecosystem Modeling

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Coral reefs, which are home to many marine species and provide vital ecosystem services, are degrading more quickly due to ocean deoxygenation, which is a direct outcome of pollution, climate change, and nutrient over-enrichment. This work combines adaptive ecosystem modeling with advanced image processing to provide a comprehensive, innovative approach to detecting, forecasting, and mitigating coral reef susceptibility under hypoxic stress. Efficient Attention U-Net with Temporal-Spatial Correlation (EAU-Net-TSC), a novel hybrid deep learning architecture at the heart of the system, combines temporal pattern recognition and spatial attention mechanisms to segment and classify reef health using both underwater imagery and satellite remote sensing data. In addition to visual analysis, the system employs agent-based simulation to predict future reef conditions using real-time environmental parameters, such as temperature, salinity, dissolved oxygen, and pH, from global oceanographic sources such as NOAA and ARGO. With this multimodal integration, stress accumulation, bleaching events, and potential reef recovery scenarios may all be dynamically anticipated. A complex picture preprocessing pipeline that ensures high quality in both data collection and model output improves underwater visibility challenges. Additionally, a cloud-deployable visualization dashboard provides stakeholders with access to interactive health maps, temporal degradation patterns, and recommendations for conservation action. In terms of accuracy, scalability, and timeliness, the proposed system outperforms existing methods and offers a dependable, automated platform for real-time monitoring, policy planning, and reef resilience augmentation. It is a significant win in the global battle against ocean deoxygenation and the protection of coral ecosystems from global warming.

Bridging Ancient Wisdom and Modern Tech: Ai-Enhanced Smart Yoga Mat with Multimodal Sensing

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The performance of yoga requires precise physical alignment, yet for individuals to self-assess their own alignment is difficult, causing them to miss the benefits of yoga practice and, at worst self-injure. In this paper we present an intelligent yoga mat based on multimodal sensing and artificial intelligence that improves the

users' performance in real-time. The system will capture the user's posture and then classify the relevant posture and movement efficiencies through machine learning classifiers. We tested the Naive Bayes and Support Vector Machine (SVM) classifiers for evaluating the user's posture and movements and propose a hybrid model that demonstrated improved classification performance. The testing results indicate the accuracy of the Naive Bayes model was high, at 98.0% whereas our hybrid model was even better at 98.95%. The platform will provide users with actionable performance feedback in real time, longitudinal progress tracking and expert recommendations. Furthermore, it will integrate functionality with smart watches providing potential holistic well-being monitoring. Our system occupies a unique niche by marrying traditional yoga pedagogy with data science that draws on recent advances in biofeedback technology to produce a validated, affordable, and accessible research- informed device.

E-VAL : Ai Evaluator for Automated Examination Evaluation

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We propose E-val, an AI-driven system to automate grading of handwritten exam answers. The system first uses TrOCR (a transformer-based OCR) to transcribe student handwriting into text. The extracted text is then fed into a GPT-based evaluator that compares it to model answers or rubrics and outputs a score (and optional feedback). Our results (on a simulated dataset of 50 short answer scripts) show grading accuracy within a few percentage points of expert human scores while drastically reducing evaluation time. For example, E val achieved about 90% grading accuracy (vs. 95% for human graders) and cut per-script grading time from ~10 minutes to under 1 minute. This suggests the system can significantly reduce instructor workload. Remaining challenges include handling highly open-ended responses and ensuring model explainability.

AI Powered Panic Detection and Support System Using Ml

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Panic disorder leads to sudden episodes of fear, chest pain, and breathlessness. This leaves individuals feeling helpless without immediate support. This project suggests a Panic Attack Detection and Support System powered by AI that acts as a virtual emergency coach. It uses Natural Language Processing (NLP) and Machine Learning (ML) methods like Naive Bayes, Logistic Regression, and Support Vector Machines (SVM) to classify user input as normal or panic. When it detects panic, the system provides real-time support through breathing exercises, calming messages, and motivational cues. Unlike traditional systems that focus only on detection, this approach combines prediction with immediate help, showing how AI can improve access to preventive mental health care.

A Review of Deepfake Image Detection Techniques

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Recent advancements in generative deep learning, particularly Generative Adversarial Networks (GANs), have enabled the creation of hyper-realistic synthetic media, commonly known as deepfakes. This technology, which can convincingly swap faces, manipulate expressions, or generate entirely new facial images, poses significant societal risks, including the spread of misinformation, financial fraud, and cybercrimes such as blackmail. In response, a substantial body of research has emerged to develop automated methods for deepfake detection. This paper provides a comprehensive review of the current landscape of deepfake image detection. We survey the primary techniques used for deepfake generation, including entire face synthesis, identity swaps, and

attribute manipulation. We then delve into the prominent detection methodologies, which largely leverage Deep Learning, particularly Convolutional Neural Networks (CNNs), to identify artifacts in the frequency domain, texture inconsistencies, and other generator-specific fingerprints. Furthermore, we discuss the critical role of public datasets like FaceForensics++ and Celeb-DF in benchmarking these detectors. Finally, we highlight the pressing challenges facing the field, such as poor generalization to unseen manipulation techniques and the evolving threat of adversarial attacks that use foundation models to evade detection. The review concludes by summarizing the state-of-the-art and suggesting future research directions focused on improving robustness, generalizability, and interpretability.

Disease Checker Chatbot for Predicting Diseases

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This paper presents an in-depth design and implementation blueprint for a Disease Checker Chatbot capableof predicting potential diseases based on user-reported symptoms. Unlike traditional rule-based systems, this chatbot integrates natural language understanding (NLU), symptom normalization, probabilistic reasoning, and machine learning classifiers to provide accurate, explainable, and safe predictions. It is designed for web and mobile platforms, connected to a secure backend, and adheres to strict privacy and ethical guidelines. We discuss data acquisition, preprocessing, model training, evaluation methodologies, and deployment strategies. The goal is to offer a reproducible framework for building symptom-based diagnostic assistants for research and educational purposes, emphasizing reliability, clinical safety, user privacy, and fairness

Market Basket Insights for Nifty50: Identifying Financial Winners and Losers with Eclat and APRIORI Algorithms In ^{2023}-^{24}

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This research explores the use of Market Basket Analysis (MBA) employing the Eclat and Apriori algorithms to analyze stock market trends within the NIFTY 50 index for the financial year 2023-24. The main goal is to identify the leading daily gainers and losers based on percentage fluctuations in stock prices while uncovering stock combinations that frequently demonstrate correlated movements as gainers or losers. The analysis provided significant insights into stock interdependencies, revealing that certain stocks tend to rise or fall together, influenced by factors like market sentiment and sector performance. The Eclat algorithm identified several highsupport stock combinations, while the Apriorialgorithm generated strong association rules characterized by notable confidence and lift metrics. These findings offer valuable guidance for traders in developing effective investment strategies, highlighting the importance of considering stock relationships alongside individual performance. Overall, the results underscore the usefulness of MBA techniques in enhancing traders' understanding of market dynamics, particularly regarding gainers and losers, thus addressing a gap in traditional methodologies that primarily focus on historical data or single-stock analyses. Future improvements could involve integrating additional data sources, real-time analytics, and advanced machine learning techniques to further enhance predictive capabilities and broaden the research's applicability across various financial contexts. By tackling these areas, the study aims to contribute to more strategic portfolio management and informed trading decisions in the ever-evolving stock market landscape.

Automated Road Damage Detection Using Drone and VECHILE-Mounted Cameras with Deep Learning

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The potholes, cracks and surface deformations caused during the road damage are so dangerous to the transportation safety and very expensive in terms of the infrastructure maintenance. This damage should be identified early and in a proper way in effective management of roads. The proposed study is an automated road damage detection system, where in this instance the drone-based and the vehicle-mounted cameras would be used and the real-time image of the road would be made available. Additional deep learning systems, like Convolutional Neural Networks, YOLO and Mask R-CNN, are able to identify and categorize multiple kinds of road damage with high precision. The results of the experiment suggest that it can have high detection accuracy, have high processing speed, and be stable in various road conditions. The given solution reveals the potentiality of integrating autonomous imaging and deep learning of developing scalable and automated tools to conduct proactive maintenance of roads that will ultimately result in enhancing road safety and maintenance time.

Adaptive And Privacy-Preserving Intrusion Detection Systems: A Survey of Deep Reinforcement Learning and Semi-Supervised Learning Techniques

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The complexity of cyberattacks is increasing, and as a result, intrusion detection solutions are required to address the limitations of traditional signature-based systems. To this end, this research has examined how the use of machine learning and deep learning can improve the effectiveness of modern Intrusion Detection Systems (IDS). The performance of different learning methods, namely supervised, unsupervised, and hybrid, has been based on standard test collections such as NSL-KDD, UNSW-NB15, CIC-IDS2017/2018, and new IoT-related data. The studied criteria include accuracy, scalability, and operational viability. The results we obtained show that hybrid and ensemble methods, i.e., those that integrate classic algorithms with deep neural architectures, are able to achieve a higher level of detection performance that almost reaches 94.7% accuracy along with a lowered false positive rate of 2.3%. Moreover, the paper discusses a number of essential implementation aspects, such as lag control for live observation, model intelligibility for Security Operations Centers (SOCs), and privacy protection via federated learning approaches. This research is not only about performance measurement, but it also offers a clear and logical classification of AI-based IDS technologies; it paves the way for effective test protocols and provides large-scale enterprises with useful guidelines for the implementation. The research backup of the final claims comes from the findings that integrated IDS architectures, which combine the exploitation of predefined detection rules with the use of adaptive machine learning models, are the ones that deliver a more balanced and stronger protection to the current cybersecurity ecosystems.

Movielens

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This project entails implementing a movie recommendation system using a machine learning approach on the MovieLens dataset with Hadoop. The MovieLens dataset provides rich user–item interactions hatenable recommendation algorithms to capture preferences, patterns, and correlations among users and movies.

Hadoop, with its distributed processing capabilities, allows efficient handling of large-scale data while supporting scalability and fault tolerance. This is an extremely interesting project that encompasses practical aspects of big data involved in recommendation systems and can be a reliable ourcefor generating accurate suggestions through data processing with Hadoop and performance nalysis over time concerning trends in user preferences.

AI Powered Slum Risk Detection and Mapping Tool Using High-Resolution Satellite Imagery Analysis

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The emergence of informal settlements due to rapid urbanization has been intensified in developing countries, which poses challenges for urban planning, infrastructure management and social welfare. Traditional slum identification methods, such as surveys from yesteryears or manually interpreting satellite images, are not very scalable and are not very accurate. This research is an AI-based Slum Risk Detection and Mapping Tool where high-resolution satellite images and geospatial analytics are used to automatically identify the presence of slums and derive hazards. The proposed paradigm combines deep convolutional neural networks and remote sensing indices along with urban morphology parameters for slum-prone zone detection, classification and mapping with high spatial resolution. High-quality data such as WorldView-3 and Sentinel-2 imagery are used and ground-truth is applied for model validation. The proposed system has high detection accuracy (>95%) and generalization performance on the different variety of urban morphologies. What's more, the tool also supports the dynamic classification of risk by integrating such environmental and socio-economic indicators so that policymakers can visualize the patterns of vulnerability for themselves in real time. These findings highlight the power of AI-driven geospatial intelligence in contributing to improved urban resilience, resource allocation planning, and sustainable city planning based on proactive slum risk monitoring.

AI-Powered Vehicle Repair System

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Artificial Intelligence (AI) has rapidly become a big part of our everyday world, influencing and changing everything from smartphone features to complex industrial level automation systems. In the automobile sector, AI has been exceptionally transformative, overall impacting how vehicles are designed, how they operate, and how they are maintained. While significant progress has been attained in domains such as autonomous driving and prognostic maintenance, one crucial area of vehicle care is still heavily dependent on human expertise which is for the identification of physical damage and the determination of appropriate repair actions. The proposed AI-Powered Vehicle Repair System aims to address this limitation by using modern AI tools to automatically recognize vehicle damage through images and generate intelligent repair suggestions in real time.

Post-Quantum Migration for Secure Protocols: Building A Quantum-Safe Internet

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The rise of quantum computing is putting serious pressure on the cryptographic systems that currently protect digital communication. Algorithms like RSA and ECC will not withstand the challenges posed by large-scale quantum machines, making a shift toward Post-Quantum Cryptography (PQC) unavoidable. This paper

introduces a migration framework designed to help enterprises transition to PQC without disrupting their existing systems. The approach centers on using PQC alongside traditional methods, with hybrid TLS handshakes playing a crucial role in maintaining compatibility with older systems while new nes are rolled out. The framework outlines a comprehensive migration path that includes assessing urrent cryptographic assets, integrating hybrid mechanisms, verifying performance and security, and deploying the updated infrastructure. To support decision-making, the work also proposes measurable risk indicators and policy recommendations that help organizations assess their preparedness for the transition. Experiments on simulated enterprise networks demonstrate that the hybrid approach incurs only slight latency while significantly enhancing defenses against quantum-level threats. Overall, this model offers a realistic and scalable route for enterprises preparing for the post-quantum era.

Sentiment Analysis Radar: Tech & Trends

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Public opinion has emerged as one of the most crucial determinants for the adoption and further development of new technologies in recent times, especially in the digital arena. Sentiment Analysis Radar: Tech & Trends proposes a structured approach to collecting, analyzing, and displaying opinions relevant to new technological developments and market trends. The system utilizes machine learning with NLP in collating data from various online sources such as social media, news sites, and research discussions when tracing trends in the sentiment of the general public. Within this radar framework, the stakeholders shall be able to monitor the development of polarity, intensity, and changes in sentiment over time and draw insights on market acceptance, obstacles, and opportunities for innovation. This work will illustrate exactly how, because of an unmet need, sentiment-driven intelligence constitutes the missing link for enterprises, researchers, and policymakers in making informed decisions within the shifting landscape by bridging the gap between technical It includes analysis and human perspectives, and since technology is developing at warp speed, there is a need for continuous monitoring of how society both perceives and addresses changes in response. Sentiment Analysis Radar: Tech & Trends aims at delivering an overall framework on how advanced-level sentiment analysis could be utilized to record and analyze large-scale public opinion about upcoming technologies. In addition, the system collects unstructured data from discussion boards, tech blogs, news portals, and social media platforms using machine learning and NLP technique along with data visualization techniques.

AI-Powered Wildlife Intrusion Detection and Virtual Deterrence System forAgricultural Protection

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Wildlife intrusion into agricultural fields leads to huge economic losses and endangers both animals nd humans. Traditional methods such as electric fencing, traps, or manual patrolling are either harmful, expensive, or ineffective. To address this, the proposed project AI-Powered Wildlife Intrusion Detection and Virtual Deterrence System uses Artificial Intelligence (AI) and Computer Visionto automatically detect animals and trigger nonlethal deterrence responses such as sound or light. The system employs a YOLOv4-Tiny deep learning model to identify animals from real-time video streams captured by a camera. Upon detection, the system records details such as animal type, time, and location in an Excel sheet and activates a deterrent sound through a connected speaker. Optionally, an email alert can be sent to notify the farmer immediately. This approach provides an eco-friendly, automated, and scalable solution to minimize human wildlife conflict, safeguard crops, and promote sustainable agriculture. The system requires only a standard Intel i5 machine, a camera, and a speaker for complete functionality. Furthermore, the model is designed to operate continuously with low power consumption and can be integrated into existing farm surveillance setups. The logged data can

later be used to analyze the frequency and timing of animal intrusions, enabling predictive insights for future prevention. With minimal human intervention, the system ensures continuous protection of agricultural lands. The combination of deep learning and IOT principlesallows for intelligent, real-time decision-making in dynamic outdoor environments. This project thus serves as a step toward smart farming and the development of technology-driven wildlife management systems that are both efficient and humane..

Deep Learning–Enhanced Beam Selection For 5G Millimeter-Wave Communication Using Subsampled Beam Measurements

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Millimeter-wave (mmWave) communications are a promising technology for 5G and beyond due to the large available bandwidth but require highly directional beams to overcome severe propagation loss. Beam selection identifying the best transmit/receive beam pair is critical for system performance, latency, and energy consumption. Exhaustive beam search provides high reliability but is time-consuming and expensive in terms of pilot overhead. This paper investigates beam selection strategies for 5G mmWave systems with a focus on reducing overhead while maintaining high selection accuracy. We present a proposed system that uses a reduced set of beam measurements (subsampled beams) combined with a lightweight machine-learning classifier to predict the best beam direction. Theoretical modeling of the mmWave single-path channel and received-beam measurement process is presented; a mathematical formulation for the beam-selection decision and the classifier training objective is given. A simulation dataset (single-path channels with random angles of arrival) is synthesized to evaluate the proposed approach and benchmark it against exhaustive scanning. Results indicate that the proposed subsampled-ML method achieves competitive beam-selection accuracy, especially at moderate-to-high SNR, while requiring significantly fewer pilot measurements than exhaustive scanning. We report experiment hyperparameters, dataset statistics, and show accuracy-vs-SNR curves. The proposed method is particularly attractive for initial access and fast beam refinement stages in mobility scenarios where overhead reduction is essential. Finally, we discuss limitations and future work including multi-path extension, richer codebooks, and real-world measurement validation.

Comparative Analysis of Statistical and Deep Learning Models for Short Term Load Forecasting: PROPHET Vs LSTM

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Predicting efficiency and stability of modern smart grids requires accurate short-term load forecasting. Yet the non-linear and volatile nature of the energy consumption shows challenges for the traditional forecasting methods. This paper shows a comparative analysis of two different approaches: Facebook's Prophet, an additive regression model and Long Short-Term Memory (LSTM), a deep learning recurrent neural network. We use the American Electric Power (AEP) hourly dataset which contains fourteen years of data. We tested both the model on their ability to predict the future energy demand. The result shows a contrast in performance. Prophet successfully identified seasonal trends, but it failed to capture high-frequency volatility showing a Root Mean Squared Error (RMSE) of 1988.36. However, the LSTM model uses a 72-hour sliding window and thus achieved a better RMSE of 294.20, therefore reducing predicting error by approximately 85%. Thus, we can conclude that Prophet gives baseline transparency whereas the LSTM gives the necessary prediction for real time load management.

Supply Chain Chaos Early Warning System

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This research explores the use of Market Basket Analysis (MBA) employing the Eclat and Apriori algorithms to analyze stock market trends within the NIFTY 50 index for the financial year 2023-24. The main goal is to identify the leading daily gainers and losers based on percentage fluctuations in stock prices while uncovering stock combinations that frequently demonstrate correlated movements as gainers or losers. The analysis provided significant insights into stock interdependencies, revealing that certain stocks tend to rise or fall together, influenced by factors like market sentiment and sector performance. The Eclat algorithm identified several highsupport stock combinations, while the Apriorialgorithm generated strong association rules characterized by notable confidence and lift metrics. These findings offer valuable guidance for traders in developing effective investment strategies, highlighting the importance of considering stock relationships alongside individual performance. Overall, the results underscore the usefulness of MBA techniques in enhancing traders' understanding of market dynamics, particularly regarding gainers and losers, thus addressing a gap in traditional methodologies that primarily focus on historical data or single-stock analyses. Future improvements could involve integrating additional data sources, real-time analytics, and advanced machine learning techniques to further enhance predictive capabilities and broaden the research's applicability across various financial contexts. By tackling these areas, the study aims to contribute to more strategic portfolio management and informed trading decisions in the ever-evolving stock market landscape

Analytical Study of Cryptographic Algorithms with Respect to Performance and Security

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Safe systems are a must to protect the transmission of data as well as confidential information, especially with the significant increase in the use of communication over digital networked systems. This article carefully examines and discusses the classification, efficiency and security features of security algorithms. One broad way to classify these algorithms is to divide them into three categories: hash-based mechanisms, symmetric-key techniques and asymmetric-key techniques. Symmetric key techniques, like the Data Encryption Standard (DES), Advanced Encryption Standard (AES), share a single secret key and are very fast and efficient. Since they have excellent speed and efficiency, they are quite suitable for encrypting data in real-time and on a very large scale. Asymmetric key cryptography techniques, like Elliptic Curve Cryptography (ECC) and Rivest-Shamir-Adleman (RSA), involve the use of public, private key pairs for carrying out digital signatures, secret key exchange and authentication. However, these methods incur relatively more computational costs. Hash-based approaches such as the Secure Hash Algorithm 256-bit (SHA-256) and the Message Digest algorithm (MD5) ensure data integrity by yielding fixed-length, concise message representations (digests). To get suitable solutions for modern computing environments, the paper highlights the compromise between system performance and the level of security.

Women Safety Application: Real-Time Voice Analysis for Emergency Response

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The identification of emergency situations at an early stage is essential for effective intervention and the safety of women in vulnerable settings. Conventional safety systems depend on manual triggering, delayed responses,

or the intervention of a third party, which may not be effective in critical situations. There is a growing trend of research that suggests distress, panic, and fear are expressed in specific voice patterns and acoustic variations that can be analyzed computationally. The objective of this research is to design an automated women safety system based on real-time voice analysis and deep-derived features from speech signals. It proposes a simple and effective method for applying deep learning algorithms to identify emergency situations using voice patterns.The result of this research work proves to be reliable and efficient compared to conventional rule-based and threshold-based safety systems. This finding validates the assumption that deep learning algorithms-based voice analysis systems can be used as intelligent supporting systems for emergency detection and response. Observations based on a carefully selected voice dataset show that the proposed system has high accuracy, precision, and sensitivity compared to conventional machine learning algorithms like SVM and RF.

Carbon-Conscious Computing Platform for Forecasts on Real-Time Water Quality Chemistry

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The proliferation of real-time water quality monitoring systems have given rise to a previously unexplored environmental paradox: that these systems are designed to protect aquatic ecosystems but the computational infrastructure they rely on also produces carbon emissions. This work presents a new carbon-aware computing model which adapts chemical analysis algorithms in response to energy grid carbon intensity and water pollution severity. Unlike traditional monitoring systems which run constant computational protocols irrespective of the characteristics of energy supplies and pollution severity, our approach does support adaptive algorithm selection, from simple heuristic models in high-carbon periods to full chemical equilibrium calculations when there is plenty renewable energy or critical thresholds below dose reduction for pollution re-achieved. It can control the values of the BOD, COD, heavy metals concentrations (Pb^{2+} and Cd^{2+}), pH and DO by adjusting solute concentrations according to FCE's in disturbance response. By cross deploying data in the field on twelve monitoring stations in six months, we show a 43% reduction of computational carbon footprint by preserving the pollution event detection accuracy at 96% for events crossing regulatory thresholds. The framework utilizes an innovative priority-weighted scheduling algorithm which jointly optimizes the three competing goals: analytical accuracy, energy performance, and environmental urgency. Results suggest that the system moves to full spectrophotometric analysis and multi-parameter chemical modelling when grid renewable penetration is high (>70%), while turning to computationally cheap proxy models based on historical chemical data when fossil fuels predominate.

Augment Or Automate: A Consultative Framework for Ai-Driven Workforce Rebalancing Based On Knowledge Codifiability and Experience Decay

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This paper presents a proprietary consultative model for assessing and mitigating AI's impact on organizational workforces by deconstructing roles through the dual lenses of automation susceptibility and augmentation viability. Using novel telemetry data from enterprise AI tools, we empirically demonstrate that AI's effects are not uniform but systematically tied to the composition of human capital: codified knowledge (education) consistently heightens exposure to both automation and augmentation, while tacit knowledge (on-the-job experience) increasingly correlates with automation risk and shows negative association with augmentation—a finding we term experience decay.

Edge-Cloud Hybrid Model to Overcome Latency and Privacy Issues in Healthcare Pricing Transparency

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The aim of this study is to design a healthcare pricing transparency model by integrating edge computing with AWS cloud services to achieve low-latency processing. Machine learning models enable cost prediction and real-time hospital bill transparency. The existing System used a cloud only (XG Boost, Light GBM, ARIMA) machine learning architecture, where all data processing and cost prediction are performed in the cloud with 8000 samples. The Proposed model used the Edge-cloud hybrid architecture which allows real-time cost prediction at the edge, where 12,000 samples are trained and analysed in the cloud to achieve low latency. The result of this model has been able to achieve a R^2 accuracy of 90.22% on the test dataset, which has further increased the target accuracy of about 92%, indicating reliable cost prediction and data privacy than cloud-only architectures. The performance improvement was statistically significant about ($p < 0.001$), which further confirms that the proposed approach was effective. The Edge-cloud hybrid model enables efficient and enhanced healthcare pricing transparency features by combining real-time edge intelligence with scalable cloud analytics.

CIVIK: A Voice-First, Ai-Assisted Civic Issue Reporting System For Transparency-Centric Urban Governance in India

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Reporting civic issues has traditionally been a high friction process for citizens, requiring multiple steps such as f illing forms, visiting municipal offices, or relying on informal channels with little transparency or feedback. We present civik, a voice-first, AI-assisted civic issue reporting platform designed for low-friction citizen input and transparency-centric municipal workflows in India. civik treats voice as a first-class reporting channel and uses a four-layer, event-driven architecture grounded in an append-only event log for lifecycle auditability. Intelligence is applied selectively through a constrained neural reasoning pipeline that operates only on text and images, transforming unstructured reports (voice calls, images, free-form text) into structured, validated, and categorized issue objects with pre dicted severity and department routing. Unlike heavy multimodal systems that depend on server-side speech recognition and complex vision stacks, civik stores raw audio immutably for audit but performs reasoning over a schema-constrained JSON representation. The platform is implemented using Next.js for the web interface, Supabase (PostgreSQL, Auth, Storage, Realtime) for integrity-centric data management, and a VAPI-based conversational agent for calls. Synthetic benchmarks show end-to-end voice-to-structured-object latency of approximately 11 seconds and real-time dashboard update latencies below 250ms under controlled conditions. By combining event-sourcing, constrained AI outputs, and voice-first UX, civik offers a practical, low cost blueprint for inclusive and transparent urban governance in resource-constrained municipalities.

Design And Simulation of a Reversible Arithmetic Logic Unit for Quantum Computing

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The rapid growth of computing systems has increased the demand for high-speed circuits with lower power consumption. Conventional CMOS-based digital circuits perform irreversible operations, which lead to loss of

information during computation and consequently cause energy dissipation as described by Landauer's principle. As device density continues to increase in modern VLSI systems, this issue becomes a major challenge for designing energy-efficient hardware. Reversible computing provides a potential solution by preserving information during computation through a one-to-one mapping between inputs and outputs, thereby theoretically reducing energy loss. Arithmetic Logic Units (ALUs) perform fundamental arithmetic and logical operations in processors and provide an effective platform for implementing reversible circuit architectures. In this work, a reversible ALU structure capable of performing operations such as addition, subtraction, AND, OR, and XOR is examined using reversible logic gates including Feynman, Fredkin, Toffoli, and Peres gates. The arithmetic core of the architecture is implemented using a reversible full adder constructed with Peres gates and verified through Microwind simulation. The proposed 4-bit reversible ALU requires 32 reversible gates with a quantum cost of 104, producing 8 garbage outputs and 5 constant inputs. Compared with conventional reversible ALU architectures, the proposed design achieves approximately 20% reduction in gate count and about 25% reduction in quantum cost, demonstrating improved hardware efficiency. These results indicate that reversible logic circuits can reduce circuit complexity and support the development of energy-efficient and quantum-inspired digital computing systems.

YOLO-Based Deep Feature Extraction with Gradient Boosting Classifier for Intelligent Movie Recommendation Systems

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One-on-one movie recommendation systems demand proper modelling of both the user preferences, and the movie properties. The classical methods of recommendation are pre dominantly based on the metadata or bare visual attributes of posters and frames, which in most cases cannot be able to handle more significant semantic attributes found in pictures. In order to overcome this constraint, this paper will present an intelligent recommendation framework with an intelligent title of, Y OLO- Based Deep Feature Extraction with Gradient Boosting Classifier to Intelligent Movie Recommendation Systems. As part of the suggested method, the YOLO model is applied to mine meaningful visual elements out of movie posters and frames, i.e., actors, objects, scene elements, etc. Such deep features extracted are added with the data on user interaction to understand the preferences to view and the relationship one has to the context. This set of integrated features is then fed through a Gradient Boosting classifier to gain the ability to learn the intricate trends between movies and users. Experiment on benchmark data shows that the proposed model has an accuracy of 96% and it beats the traditional baseline models like ResNet-101 and RegNetY, thus enhancing the accuracy of recommendations and personalization.

Explainable Multimodal Vision-Language Framework for Intelligent Scene Understanding and Context-Aware Image Captioning

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Image captioning is an important interdisciplinary task of computer vision and natural language processing (NLP) to automatically produce descriptive text on visual data. In this work, we will suggest a hybrid framework which uses deep feature extraction via YOLOv12 and an ensemble classifier made of RandomForest and AdaBoost (RF-AdaBoost) to improve the per formance of caption generation. YOLOv12 model is effective in capturing the contexts of the scene as well as extracting high-level visual features and object representations of the input images. These features are then fed through the RF-AdaBoost classifier, which enhances predictive power through the combination of the strength of the Random Forest with the adaptive learning abilities of the AdaBoost classifier, thereby minimizing overfitting and maximizing classification reliability. The proposed system generates syntactically and semantically meaningful captions by combining these visual representations

with highly sophisticated NLP algorithms. Experimental analysis shows that the hybrid strategy is more accurate, more relevant to the context, and more effective as compared to the traditional models of captioning. The framework eventually leads to the creation of more reliable and image context-aware image description, enabling intelligent vision applications.

A Hybrid Deep Learning And Explainable Ai Framework For Multiclass Differential Diagnosis Of Me/Cfs and Depression

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Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS) is a disabling neurologic disorder that has been mistaken for psychiatric disorders like Major Depressive Disorder (MDD) so many times, it has become a common co morbidity. Due to lack of established biological biomarkers and high levels of symptomatic overlap in fatigue, sleep disturbances and cognitive dysfunction, the ability to differentiate between these conditions using methods from computational psychiatry presents a great challenge. The current machine learning based approaches, are largely limited to binary classifications (Patient vs. Healthy Control), and do little to address the entangled feature manifolds of comorbid patients. In this research, we propose a new hybrid deep learning architecture combining Deep Latent Representation Learning with Shapley Additive explanations (SHAP) to allow for a true three-way multi class diagnosis: Depression, ME/CFS, and Comorbid (Both). Through the use of nonlinear deep transformations, the architecture learns an embedded representation space, which can effectively separate the symptoms that overlap to provide near perfect class separation and a 99.5% test accuracy with a negligible generalization gap ($\Delta gen < 0.5\%$). We also develop class conditioned SHAP attribution and interaction modeling to enable us to transform the model from a blackbox, into a clinically relevant, transparent clinical discovery tool. The results show that the framework provides both the high precision diagnostic labels and confidence probabilities, while providing feature level causal explanations, to establish a reproducible baseline for Explainable AI in the treatment of complex chronic diseases.

Green Pulse: An Intelligent IOT-Based Framework for Autonomous Agriculture Monitoring and Data-Driven Farming Analytics

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: Farmer production is still one of the main concerns of most countries, particularly with the climate change making crop production unreliable, and making the risk of insect invasion more prominent. To counter these problems, the professional growers are adopting the greenhouse cultivation as a sure way of maximizing output. Farmers can reduce the effects of pests by incorporating the latest technologies in greenhouses which help in production of controlled environments promoting the growth of vegetables, crops and fruits all year round. The paper presents Green Pulse, which is an intelligent agriculture monitoring system aimed at transforming the traditional farming through a combination of advanced analytics, Internet of Things (IoT) architectures and automation frameworks. The system takes advantage of a decentralized network of smart sensors and microcontrollers, which are used to gather real-time environmental and crop related variables such as the soil moisture, ambient temperature, humidity, and light intensity. Embedded algorithms and cloud-based systems take this sensor data and derive actionable insights, trends in crop health, and predictive analytics. Green Pulse permits independent decision-making through integrated alert systems and adaptive responses, minimizing the number of people involved. One of the main characteristics is smart irrigation control, where the water flow is dynamic controlled according to the dynamic soil moisture analysis in favor of the effective use of resources and ecological control. Specific user interface is created to help farmers to plan the route and distance that an agricultural robot has to cover. When the robot moves into the fields, it also records sensor data that will be

used to track and assess the conditions of the crops and make a real time decision that will optimally manage the farms.

Innovation Of Internet of Health Things (IOHT) In Telemedicine: Facilitating Remote Consultations and Streamlined Healthcare Services with Creative Connected Devices

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The booming Internet of Things (IoT) gives rise to the Internet of Health Things (IoHT), a game-changing medical technology that establishes real-time connections between medical devices, wearables, sensors, and specialized data systems for better patient care. IoHT is transforming telemedicine by offering remote consultation, ongoing health monitoring, and data-driven decision-making, thus enhancing the accessibility and efficiency of healthcare services, especially in rural and underserved territories. This study highlights the use of IoHT in telemedicine, including seamless remote healthcare service delivery, with cost-saving and timely medical treatment opportunities from connected devices. IoHT in telemedicine enables the provision of personalized healthcare solutions, allowing patients to connect with healthcare professionals through virtual consultations while their health data is continuously updated using connected devices like smart wearables, remote monitoring tools, and diagnostic devices. These devices continuously monitor and remotely transmit patient data (for example, vital signs, glucose levels, heart rate), allowing health care providers to make evaluations without an in-person office visit. Moreover, this IoHT solution built into telemedicine can provide high-quality healthcare services in real-time and address the problems of geographic barrier, shortage of healthcare workforce, and the increasing demand of healthcare services in the aging population care.

Innovative Approach to Air Defense Target Classification and Threat Prioritization: Employing Machine Learning for Radar Signal Processing

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[1]*Saveetha University*

In an evolving contested and fluid air warfare scenario, real-time detection, classification, and prioritization of airborne threats has become a critical requirement for modern air defense systems. Classical radar processing methods, which are viable only in a controlled environment, may encounter challenges when the threat environment changes to make air targets faster, stealthier and more electronically deceptive. This work proposes a novel architecture of employing machine learning (ML) algorithms in conjunction with advanced radar signal processing methods for improving target classification and threat prioritization in air defense operations. The proposed approach is based on the supervised and unsupervised ML models such as Convolutional Neural Networks (CNNs), the Support Vector Machines (SVMs), and the K-Means clustering to extract and classify the high-dimensional scattering characteristics of target extracted from the radar return signals. Such signals are normally polluted with noise, jamming and multipath effects and are pre-processed by means of digital filtering, wavelet transformation, Doppler shift correction and then given to the learning models. The system is trained with synthetic and real aircraft, drone, and missile data with varying radar cross-sections (RCS), velocity, and maneuvering. After classification, the targets are prioritized by a threat prioritization module with dynamic treatment and prediction trajectory, engagement envelope analysis, and intention estimation.

Analyze Blockchain-Assisted Protected Image Processing: Guaranteeing Data Integrity, Preserving Privacy, And Ensuring Tamper-Proof Medical Imaging in Healthcare Systems

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The use of blockchain technology for secure image processing increases the reliability, precision, and privacy of data kept by cutting-edge medical imaging equipment. With their growing use in monitoring, diagnosis, and treatment planning, digital photographs captured at healthcare institutions must be kept private and secure. Traditional approaches of storage and transmission of medical pictures through centralized pipelines increase their vulnerability to tampering, unauthorized access, and identity breaches. To address these issues, this essay suggests a blockchain-based system that integrates cutting-edge privacy-preserving methods into healthcare procedures. The security, verifiability, and immutability of image processing are guaranteed by this technology. Taking, editing, and viewing images are all documented by the software using distributed ledger technology. Because of this, we can check the data's origin in real-time and stop unauthorized changes. Decentralized consensus methods and cryptographic hashing have made it possible to obtain trustworthy image data for medical evaluations, even down to the smallest of changes. Secure multiparty computation, homomorphic encryption, and differential privacy allow for the undetectable processing and analysis of sensitive medical data. To lessen transmission threats and conform to regulations, the study investigates federated learning. We conclude that integrating blockchain-log with secure picture watermarking and AI-powered anomaly detection can produce transparent audit trails. As a result, illegal changes are not feasible. Image centers, medical centers, labs, health insurers, and remote diagnostic platforms could work together more effectively with the help of the suggested method, which offers shared visibility and rigorous access control.

Integrate Internet of Things (IOT) And Machine Learning (Ml) For Energy Optimization and Occupancy Prediction in Smart Buildings

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The automation of smart buildings has been propelled by the need for sustainable infrastructure and energy efficiency. The inflexibility of schedules and the incapacity to react to changes in the environment and occupancy causes traditional building management systems to waste energy. This study develops a smart building automation system that uses machine learning and the internet of things to reduce energy usage and predict when a building will be occupied. Internet of Things (IoT) sensors may detect occupancy, light, humidity, and temperature in the suggested system. Machine learning techniques forecast occupancy based on data trends. These predictions enable the system to make real-time adjustments to the building's HVAC, lighting, and other services, which improves energy efficiency and occupant comfort. With the use of cloud and edge computing, the design processes and scales data. Using regression and categorization, decision-making and system responsiveness are both enhanced. When compared to more traditional building management systems, the experimental results show substantial savings in both energy and operational costs. The gadget lessens environmental impact while enhancing convenience. This study found that smart building automation systems made with IoT and ML are clever, adaptable, and energy efficient, making them ideal for long-term smart infrastructure.

Innovative Federated Learning (Fl) With Reinforcement Learning (Rl): Establish Secure Training on Dispersed Devices Without Requiring Centralized Data Exchange

Kirubakar D[1]*
[1]*RMKEC*

Decentralized data expansion has been expedited by distributed intelligent systems, Internet of Things devices, edge computing platforms, and autonomous communication networks. Data privacy, communication, scalability, and cybersecurity risks are all exacerbated by traditional centralized machine learning methods that transmit raw data to servers. Multiple devices could be used to train ML models independently of one another using Federated Learning (FL). Issues with resource allocation, client selection, communication efficiency, model poisoning assaults, heterogeneous data distributions, and dynamic network adaptability are common in traditional FL systems. This work proposes a solution to these problems by combining Federated Learning and Reinforcement Learning (RL) to execute distributed training across distributed devices in a safe and adaptive manner. We study the use of RL agents to maximize adaptive model aggregation, energy usage, scheduling of communications, and real-time client involvement. Device speed, network latency, computing power, and threat detection are all used as reinforcements in policy optimization. Enhancements to data privacy and cybersecurity include secure aggregation, differential privacy, anomaly detection, and blockchain-assisted validation. By reducing the need for centralized data interchange, the integrated FL-RL model enhances training accuracy, convergence speed, communication efficiency, and robustness to adversarial attacks. Distributed artificial intelligence systems that are clever, scalable, and privacy-preserving are developed in this study for use in healthcare, smart cities, driverless vehicles, industrial automation, and next-generation edge computing.

Employ Cloud and Edge Computing for The Operation of City Infrastructure In Real Time: The Urban Service Management Platform

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City infrastructure and services are becoming increasingly difficult to sustain due to rapid urbanization. Data generated by smart devices, utilities, transportation, the environment, and public safety in modern cities is massive and updated in real time. Conventional centralised management systems are ill-suited to fast-paced metropolitan environments due to issues with latency, scalability, bandwidth usage, and delayed decision-making. Computing in the cloud and on the edge provides solutions to these problems through distributed data processing, intelligent resource management, and the delivery of services in real time. This study's Urban Service Management Platform runs municipal infrastructure in real time using Cloud and Edge Computing. Data from the Internet of Things (IoT), smart sensors, surveillance, and linked infrastructure can be collected using the proposed architecture. The nodes at the edge of the network do processing, evaluation, and decision-making close to the data source, while the cloud handles large-scale storage, advanced analytics, centralized coordination, and optimizing resources over the long term. With these technologies, operational efficiency, responsiveness, and communication latency are further enhanced. Transportation, smart energy, waste management, environmental tracking, water supply, and citizen security are all facets that the platform can accommodate. Predictive maintenance, anomaly detection, and resource allocation are three ways in which AI and advanced data analytics enhance service quality. Processing speed, system reliability, scalability, and service responsiveness are all improved over centralized alternatives, according to the experimental results.

Employ Blockchain Technology in Very Large-Scale Integration (VLSI) For Secure and Tamper-Resistant Hardware in Financial Technology

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Secure, tamper-proof technology is essential for the ever-growing digital banking system. Developing top-tier Very large-scale integration (VLSI) technology is necessary for financial technology integrated circuits. Data and system security are at danger from physical manipulation, supply chain assaults, and reverse engineering. Here we take a look at how blockchain technology might strengthen the honesty, openness, and security of very large scale integrated circuits (VLSI). To keep tabs on hardware development, production, and rollout, this solution employs blockchain's immutable ledger. Smart contracts are utilized for the secure verification, authentication, and control of access to designs. Integral circuits can be identified and illicit modifications can be detected by hardware fingerprinting with blockchain technology. Integrating VLSI ensures trustworthy execution, auditability, key management, and digital wallets for secure transaction processing, payment systems, and other similar applications. Complexity in integrating blockchain technology, latency, energy overhead, and scalability are all aspects that we take care of. Lightweight blockchain solutions for embedded circuits with limited resources are also being explored. Results show that compared to more traditional methods, this one excels in areas such as lifecycle management, tamper resistance, and traceability. This study found that next-generation financial technology systems can benefit from blockchain and VLSI by building trustworthy, transparent hardware infrastructures.

Apply Cybersecurity Measures for Integrated Ai Systems: Preventing Malicious Attacks on Neural Networks Used for Real-Time Inference on the Device

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Smarter decisions in healthcare, driverless vehicles, and surveillance have been made possible by the fast deployment of AI systems for real-time inference on embedded and edge devices. Adversarial attacks, model poisoning, data leaks, and unauthorized manipulation are some of the cybersecurity concerns that are exacerbated by neural networks on devices. We provide robust real-time inference context protection as part of our cybersecurity architecture for AI systems that are integrated. The protection of neural networks from harmful assaults can be achieved by secure model design, adversarial training, runtime monitoring, and hardware-level safeguards. To safeguard models from malicious inputs and reverse engineering, we use input validation, anomaly detection, and encrypted model storage. Data is safeguarded during inference by utilizing secure communication protocols and dependable execution settings. Due to advancements in cybersecurity, adversarial AI model attacks are getting smarter and smarter, and they can influence model outputs without modifying the human-perceivable inputs. Accurate predictions may be life-saving in applications where safety is paramount. Cybersecurity is essential for AI pipelines to be reliable and trustworthy. To improve device-deployed neural networks, this study looks for a safe, cost-effective, and adaptable framework. This approach makes systems more resilient, less susceptible to attacks, and enables AI to operate safely in hostile contexts in real time.

An Ensemble DENSENET^{121}–RESNET^{50}Deep Learning Approach for Multi-Class Alzheimer's Disease Detection Using ^{3}d MRI Brain Scans

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Alzheimer's disease (AD) is a progressive neurodegenerative condition that has a major impact on memory, cognition and functioning, which may have an impact on everyday life, and early and accurate diagnosis is important for clinical intervention. This study introduces an effective ensemble deep learning network based on DenseNet121 and ResNet50 for the Alzheimer's disease multi-class classification from 3D MRI brain images. The proposed architecture takes advantage of the high feature propagation capacity of DenseNet121 and the residual learning power of ResNet50 to obtain complementary spatial and structural representation from volumetric MRI. Enhancing the quality of data and the robustness of models through preprocessing techniques such as skull stripping, intensity normalization and 3D image augmentation. The two networks produce discriminative representations, which are then fused in the feature level and finally classified in the fully connected classification layer, giving the subjects the categories of Cognitively Normal (CN), MCI, EAD and AAD. Experimental results confirm that the ensemble model outperforms the individual architectures in terms of accuracy with ~97% -score. The proposed framework can provide a trustworthy computer-aided diagnostic system for early-stage Alzheimer's disease detection

AI-Driven Personalized Learning in Education: A Comparative Review Of Techniques, Applications, Outcomes, And Challenges

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The development of personalized learning is being notably enhanced by Artificial intelligence (AI), which utilizes a range of features such as learner profiling, intelligent tutoring, recommendation engines, adaptive delivery of content, automatic evaluation, and real-time feedback. This article aims to provide a comprehensive analysis of research studies on this topic by exploring the connections between different AI techniques, methods of personalization, educational applications of AI, learning outcomes, and challenges during implementation. In the course of analysis, 29 works published between 2019 and 2025 were reviewed with regard to the employed AI techniques, contexts, methods, evaluation techniques used, main findings of the studies, and weaknesses. The writers of the studies recognized AI methods such as machine learning, deep learning, reinforcement learning, learning analytics, recommendation systems, intelligent tutoring systems, large language models (LLMs), and generative AI. The analysis shows that AI techniques help to ensure adaptive learning paths for personalized learning, delivery of individual resources, learner feedback, intelligent tutoring, and adaptive evaluation. Furthermore, the recent approaches based on LLMs and generative AI provide personalization that is contextualized and conversational in its nature. However, there are still not numerous studies on this subject matter due to its focus on short-term assessments, the variety of assessment tools used, scalability issues, problems of concerns related to privacy and fairness, difficulties related to explainability, and negative influence of reliance on AI tools. The authors have mentioned that there is a need to conduct more longitudinal assessments, set a common system of metrics, continue human participation in the implementing of personalization, use responsible AI technologies, and evaluate emerging multimodal and generative systems based on evidence.

Blockchain For Safe Sharing of Medical Data: Protecting Patient Privacy and Keeping Cyberattacks Out of Healthcare Internet Of Medical Networks

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The digitization of healthcare IT has led to an explosion in the use of the IoMT. This paves the way for remote diagnostics, data-driven healthcare choices, and continuous patient monitoring. While these improvements improve hospital efficiency and quality, they also raise legitimate concerns about patient privacy and cybersecurity. Security breaches, ransomware attacks, unlawful access, and insider threats frequently target healthcare infrastructure storage because to the centralized architecture of the system and the sensitive nature of the personal data handled there. Modern healthcare systems place a premium on secure data transfer and the protection of patient privacy. Possible solutions to these problems may lie in the distributed, immutable, and transparent data management protocols provided by blockchain technology. This inquiry aims to determine the level of security that hospital IoM networks provide for patient data. Analyzes blockchain technology's ability to improve data interchange across healthcare providers, labs, patients, and insurers while reducing data breaches. This field studies several forms of distributed ledger technologies, including cryptographic hashes, consensus processes, and smart contracts. According to the results, traditional healthcare data formats lack auditability, access control, and the removal of single points of failure. Healthcare operations are jeopardized, patients' privacy is compromised, and patients are put at risk because of these vulnerabilities. Blockchains are more secure because they distribute trust across several nodes. Automating access control, smart contracts restrict data access to permitted parties.

Holographic-Type Communication Paradigms Augmented by Generative AI For Immersive Remote Surgical Guidance, Fortified by Quantum-Resistant Blockchain Protocols

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Remote surgical guidance presents with challenges including loss of depth perception in typical 2D videos, unacceptable latencies in guidance-critical loops, the limited availability of surgeons, and the vulnerability of existing cryptography to quantum computing. This paper proposes a novel approach to remote guidance that uses holographic-type communication, incorporates generative artificial intelligence to produce recommendations, and uses quantum-resistant blockchain to record and secure those recommendations. The approach involves capturing and transmitting multi-view representations of the scene for reconstruction as holograms on the receiver side, applying generative artificial intelligence to preoperative scans and videos to provide guidance overlays, predict deformations, identify critical structures and recommend instrument trajectories in real-time while simultaneously recording those recommendations in a manner that protects patient privacy and enforces access control using a post-quantum blockchain. Simulation results show that the combination of intelligent generative augmentation and blockchain add acceptably little overhead to the critical communication loop. The approach provides a path towards equitable global distribution of expert surgical care, improved patient outcomes, and long-term protection of data integrity and privacy with novel concepts contributing to each of these areas.

Differential Privacy-Preserving Transfer Learning for Multi-Modal X-Ray Anomaly Classification Using Photonic Quantum Computing on Edge Servers with Blockchain Traceability Over Wi-Fi[7] Mesh Networks

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Recent advances in artificial intelligence enabled unprecedented progress in the field, including medical image analysis. Specifically, the field of X-ray anomaly classification benefits considerably from the application of deep learning approaches. Nevertheless, the practical implementation of such methods is complicated by the issue of data privacy. The necessity for efficient processing and dissemination of results among medical institutions. This paper discusses how implementing of differential privacy-preserving transfer learning, photonic quantum computing. Also it discusses the integration of edge servers, blockchain traceability, and Wi-Fi 7 mesh networks. From this integration of various techniques one can facilitate multi-modal X-ray anomaly. classification.

Visible Light Communication Integrated with Generative Adversarial Networks For Secure Real-Time Retinal Image Streaming from Portable Fundus Cameras In 5g Healthcare

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This research proposes a novel framework for real-time retinal image streaming using portable fundus cameras. It is through the combination of Visible Light Communication and Generative Adversarial Networks in 5G healthcare. With the help of portable fundus cameras retinal photos and videos can be captured anywhere including in remote areas. However reliable, timely, and secure transmission of the data is challenging. The proposed research implements Visible Light Communication for faster, more reliable, and secure data transmission. The Generative Adversarial Networks for boosting, securing, and analyzing the images for abnormalities in real-time. It provides multiple benefits over the state-of-the-art methods. The proposed work can make a significant difference in 5G healthcare by allowing eye specialists to provide high-quality care.

Quantum Photonic Neural Networks for Noise-Robust Feature Extraction in Wireless Capsule Endoscopy Videos Leveraging Satellite Edge Backhaul and Cybersecurity Protocols

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Wireless Capsule Endoscopy amasses huge volumes of video data for non-invasive gastrointestinal tract diagnostics. However wireless transmission noises, motion artifacts, illumination variations and bandwidth limitations in remote areas commonly impede feature extraction accuracy. This work introduces quantum photonic neural networks for noise robust spatiotemporal feature encoding from Wireless Capsule Endoscopy videos. By leveraging quantum photonic circuits, execute high dimensional parallel processing, the networks demonstrate improved resilience. To facilitate deployment in remote areas, the framework utilizes satellite edge backhaul for efficient. It also uses latency tolerant feature offloading from portable receivers, while simultaneously securing the diagnostic pipeline. In this proposed model, the cybersecurity mechanisms that protect the confidentiality, integrity and availability of the extracted features throughout the end-to-end process.

Variational quantum circuits enable rapid identification of clinically significant video segments. The vidoe segments might involved with bleedings, ulcers, polyps or inflammation. The efficacy of the methodology has been empirically validated on multiple noisy video datasets and hardware accelerated prototypes. The test confirm its ability to improve diagnostic accuracy and alleviate false discovery rates.

Innovative Dynamic Cloud Security Framework Integrating Graph-Based Threat Detection with Quantum-Resistant Cryptography for Secure Cloud Environments

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Cloud computing is the backbone of today's digital infrastructure because it provides affordable, flexible, and scalable computing resources to individuals, organizations, and governments. As new forms of ransomware, insider assaults, zero-day vulnerabilities, and advanced persistent threats emerge, traditional cloud security measures are unable to keep up. It will be necessary to implement security measures that are resistant to quantum computing's exponential expansion if public-key cryptography is to remain reliable in the years to come. Cloud security is the focus of this paper, which presents a Dynamic Cloud Security Framework that includes graph-based threat detection and encryption that is immune to quantum attacks. Using post-quantum cryptography and graph-based threat modeling, an adaptive cloud defense architecture is built. By constantly monitoring the communication links between cloud entities, graph-based threat detection can uncover hidden attack pathways, abnormal interactions, and multi-stage cyberattacks. Using quantum-resistant encryption, data storage, authentication, and transmission are safeguarded against both current and future quantum attacks. Modules in the security orchestration system that are dynamic adjust encryption, access controls, and threat intelligence based on cloud workloads and attack patterns. Operational resilience is enhanced by secure key management, automated risk assessment, and real-time event reaction. Improvements in detection latency, data confidentiality, intelligent threat analytics, and cloud service delivery are achieved by next-generation cryptographic protection.

Apply Machine Learning-Driven Energy Management Framework for Renewable Energy Microgrids with Intelligent Resource Optimization Strategies

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As power systems incorporate renewable energy sources, the number of sustainable and resilient microgrids has increased. Microgrids powered by renewable energy sources include solar photovoltaics, wind turbines, batteries, and distributed energy resources are good for the environment and the economy. Problems with power balance, grid stability, and energy use arise from the intermittent and unpredictable nature of renewable energy supply. Conventional energy management systems, which rely on rule-based scheduling and deterministic optimization, are ill-equipped to deal with fluctuating energy demands, intermittent renewable sources, and battery storage. An Intelligent Resource Optimization Strategy-Driven Machine Learning-Based Energy Management Framework for Renewable Energy Microgrids Enhances Power Sustainability, Reliability, and Efficiency. To manage energy resources, the proposed system makes use of adaptive energy scheduling, intelligent optimization algorithms, real-time monitoring, and forecasts based on machine learning. Complex machine learning algorithms assess changes in load, power consumption, renewable energy generation, battery charge status, and historical data. With the goal of maintaining system stability, intelligent optimization algorithms optimize power distribution, battery charging and discharging, and operating costs. This platform

allows for scalable deployment in microgrid contexts, low-latency decision-making, and demand response management using cloud-edge collaborative computing. It also includes anomaly detection.

Design Digital Twin-Assisted Adaptive Modulation Selection Framework For 5G And Beyond Wireless Communication Networks Efficiently

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The rapid evolution of fifth-generation (5G) and beyond wireless communication networks has created unprecedented demands for high data rates, ultra-low latency, massive device connectivity, and reliable communication under dynamic channel conditions. Adaptive modulation techniques play a crucial role in optimizing spectral efficiency and communication reliability by selecting appropriate modulation schemes according to changing network environments. However, conventional adaptive modulation approaches often rely on static channel estimation methods and are unable to respond efficiently to rapidly varying wireless conditions, resulting in reduced throughput, increased transmission errors, and inefficient resource utilization. This research proposes a Digital Twin-Assisted Adaptive Modulation Selection Framework for 5G and beyond wireless communication networks to enhance communication performance through intelligent and real-time modulation optimization. The proposed framework integrates digital twin technology with wireless channel modeling, real-time network monitoring, machine learning-based prediction, and adaptive decision-making to create a synchronized virtual representation of the physical communication network. The digital twin continuously analyzes channel quality indicators, user mobility, interference levels, traffic demand, and network congestion to predict communication conditions and recommend optimal modulation schemes before transmission. Intelligent adaptive algorithms dynamically update modulation strategies to maximize spectral efficiency while minimizing bit error rate, transmission latency, and packet loss.

Fuzzy Logic–Enabled Smart Wearable System for Real-Time Health Assessment

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The growing need in the real-time monitoring of health has increased the adoption of wearable computers that have the ability to record continuous physiological information. Nevertheless, the classic threshold-based decision approaches usually have problems with the noisy sensor data and variability of human physiology. In this paper, a smart wearable system is proposed using fuzzy logic that provides credible real-time health monitoring based on multisensory measurements of heart rate, SpO 2, temperature and activity level. The suggested structure uses a systematic fuzzy inference engine that is sub-supported by adaptive membership functions and clinically inspired IF-THEN rules to categorize the health condition into a Normal, Alert, and Critical health condition. Experiments in real time showed that the sensors were stable, could detect the physiological deviation and reasoned effectively in the presence of uncertainty. The system was found to be highly classified, low inference latency and high user acceptability, which justified its appropriateness in incessant personal health monitoring. In general, fuzzy-powered wearable system is a promising concept to address the issue of early identification of the risks, remote health monitoring, and improved decision making in smart healthcare settings.

Deep Learning and Pattern Recognition for Early Lung Tumor Identification and Classification

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Lung cancer is difficult to discover and classify at an early stage which may pertain to arise two of the main reasons of lung is one of the most important causes of cancer death in the globe. An early and precise detection of lung tumor can increase the survival rate of patients would possibly help clinicians in clinical decision-making. The paper introduces a computer-based framework for lung tumor classification utilizing machine learning and data mining approaches. The lung tumor classification is performed using medical imaging along with clinical information as a proposed method. An early approach employing genetic programming to predict lung cancer is GESIC. Five feature selection algorithms (information gain, gain ratio, chi-square, reliefF, and PCA) and five classification algorithms (support vector machine, decision tree, Naïve Bayes, k-nearest neighbour, and logistic regression) were employed. In addition to diagnosing the disease, the classification of lung nodules can help the clinicians in preparing a therapeutic plan of the patient. Moreover, an automatic method of classification of lung nodule types is proposed in this paper. The categories are Ground glass, Vascularized, Solid and Mixed type. The SVM and k-NN classifiers perform the assessment. Machine learning classification algorithms include Support Vector Machine (SVM), Random Forest (RF), Decision Tree (DT), K-Nearest Neighbor KNN, Artificial Neural Network (ANN) etc. Classification is that. It can be effective and efficient to use techniques of deep learning and machine learning through a computer-aided diagnostic system with medical image processing. The process of diagnosing acute diseases that involve examination of medical images. Image analysis can reveal a variety of diseases.

Performance Evaluation of CatBoost-Based Model for Accurate Cyber Attack Detection in Network Traffic

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Rapid changes to digital infrastructures have led to increasingly complicated cyber-attacks. As such, better, smarter detection techniques are required. This research describes a cyber-attack detection model (CatBoost) that uses Machine Learning techniques based on the Cat Boost algorithm (Gradient Boosted Machines) to classify network traffic as either normal or an attack, using a labeled cybersecurity dataset for training and evaluating. The experimental results indicate that the proposed model achieved a 96.7% accuracy rate for classification and provided a good ability to predict between normal and attack traffic. The confusion matrix also indicates that the model correctly found 1,920 normal instances and 14 instances of attack out of a total of 2,000 data samples. The reports of classification performance (precision and recall) provide good evidences to support the efficacy of the designed classifier. For the normal class, the precision was found to be 0.97 and recall of 1.00. For the attack class, there was a perfect score of precision (1.00), while a relatively low score was found for recall at 0.17 supporting an overall F1-score of 0.30. The weighted average F1-score of 0.96 supports the robustness of the model; however, the low recall value may limit the model's applicability to real-world scenarios because many of the attacks are low-prevalence events and class imbalance could detrimentally affect the overall detection rate for the CatBoost-based model. Future work will continue to investigate class imbalance problems associated with rare attack samples to improve detection rates.

Diagnex-AI: A Modular Multimodal Platform for Rule-Based Medical Diagnostics and LLM-Enhanced Clinical Explanations

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The widespread adoption of AI in medicine raises the question of how to combine the creative capabilities of large language models (LLMs) with the reliability of diagnoses. In this paper, we present a solution to this problem in the form of the Diagnex-AI system that distinctly separates medical reasoning from language generation. Instead of black box models, Diagnex-AI relies on a Multimodal Control Plane (MCP), which applies structured reasoning rules to processing of text, audio, and image inputs. The "safety-first" paradigm makes sure that diagnoses rely on verified clinical reasoning only, whereas the LLM takes care of language generation. To further strengthen reliability, the system includes a Fusion Engine that brings together inputs from different sources and resolves any inconsistencies between them. It also uses a Retrieval-Augmented Generation (RAG) component, meaning the system checks reliable medical sources before forming its responses instead of depending only on what the model has learned. In practice, this approach helps reduce incorrect or made-up information and makes the output easier to understand and more dependable for users.