

# 13th International Conference on Microelectronics Circuits and Systems.

Abstract Proceedings of

## MICRO2026

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24<sup>th</sup> to 25<sup>th</sup> of April, 2026

**Organizer and Venue:**

**School of Information and Communication Technology,  
Gautam Buddha University, Greater Noida, Uttar Pradesh, India.**

**Joint-Organizers:**

**Applied Computer Technology,  
Kolkata, West Bengal, India.**

and

**Indira Gandhi Delhi Technical University For Women,  
Kashmere Gate, New Delhi, India.**



Abstract Proceedings of

# Micro2026

13<sup>th</sup> International Conference on Microelectronics,  
Circuits & Systems 24<sup>th</sup> and 25<sup>th</sup> April, 2026



*Nanomaterial*



*Optoelectronic*



*Chip Fabrication*

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## Micro2026

13<sup>th</sup> international conference on Microelectronics, Circuits and Systems

24<sup>th</sup> and 25<sup>th</sup> April, 2026

School of Information and Communication Technology, Gautam Buddha University,  
Greater Noida, Uttar Pradesh, India.



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53 Teachers' Colony, Agarpara, Kolkata-700109, India

Inaugural Song:

**Prayer**

Translated in English

By

Hillol Ray

<http://www.iwvpa.net/rayh>

<http://www.iwvpa.net/rayh/index-hra.php>

Desires are all yours,  
You are the universal star-  
You do your own works, mom,  
People say, I do them from a far!!

You stuck elephant into clay,  
And push a handicap to ascend hill-  
To some, you offer "Brahmo" feet,  
And make others descend downhill!!

I am a machine, you are the machinist,  
I am the home; you are the homemaker-

I am the chariot, you are the charioteer,  
You drive as you like, and I am a happy taker!!

"Milestone"

June 25, 2019

Garland, Texas, USA

## Editorial

This abstract Proceedings contain only the abstract of all registered paper of the conference, Micro2026. Some pages contain summary of invited Speakers and some pages contain biodata of the speakers of this conference. Names, Photos and affiliations of all Speakers are available at end of this Proceedings.

About 480 papers are received and around 150 are selected for presentation. Most of the papers are in the areas of MEMS / NEMS & Sensors, Circuits, VLSI, Power Electronics, Microelectronics, CS and IT, Image Sensing and Processing, Micro Materials, Nano Materials & Nano Structures, Optical Fiber, Optoelectronics and Photovoltaics, Silicon and III-V Technology, Bio and Medical Electronics, Other relevant Themes of Micro2026 etc.

All of these presented full versions of papers will be published in different journal/book chapters/ACT Proceedings either print/online or both of the options.

This abstract book will be available online, in this link: <https://actsoft.org/science/proceedings.html>

With due thanks and best wishes to all our team members including the Chief Guest, Keynote Speakers, invited speakers, chair persons, authors, participants etc. for sparing their valuable time in making the event a success.

These abstract proceedings are prepared with the abstracts of all papers for the delegates of the conference

The Editors of Micro2026

Prof. (Dr.) Gunajit Kalita (Professor, HOD, Department of CSE, Assam Engineering College)

Prof. Kanchan Sharma (Department of ECE, Indira Gandhi Delhi Technical University for Women)

Dr. Vivek Chaudhary (Department of ECE, Gautam Buddha University)

Mr. Arup Halder (Scientist, Applied Computer Technology, Kolkata.)



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Message from the Vice Chancellor:

It is a matter of great pleasure to extend my warm greetings to all participants of the 13<sup>th</sup> International Conference on Microelectronics, Circuits and Systems (Micro2026), being organized by the School of Information and Communication Technology, Gautam Buddha University, Greater Noida, on 24–25 April 2026.

The rapid advancements in microelectronics, communication systems, and intelligent technologies continue to play a crucial role in driving innovation and addressing contemporary challenges. Conferences such as Micro2026 provide an important platform for researchers, academicians, industry experts, and students to share knowledge, exchange ideas, and explore emerging trends in these dynamic fields.

I commend the organizing committee for their dedicated efforts in bringing together a diverse and distinguished group of participants. I am confident that the deliberations during the conference will contribute meaningfully to the advancement of research and technological development.

I extend my best wishes for the success of MICRO 2026 and hope that all participants have a productive and enriching experience.

With best wishes,  
**Prof. Rana Pratap Singh**  
Vice Chancellor,  
Gautam Buddha University,  
Chief Patron, Micro2026

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Speech of:

**Prof. Dulal Acharjee,**

Executive Chairman, Micro2026 and  
Director, Applied Computer Technology, Kolkata, WB.

As a part of Organizing committee of the conference of Micro2026, we offer our heart full thanks and welcome to all of you in this inaugural session. The main aim and objective of organizing this conference is to gather better academic resources which would be helpful for furnishing research works in micro and Nano electronic fields.

For a better future, we should think ahead, learn and teach latest technology and modern tools which can provide us comfort and sustainable better means of lives. Technologies are progressing very first. Gradually, we should abandon obsolete technology which causes quality of productions, time and quantities of materials.

Many examples of latest technologies, Blue LED, MEMS (Micro Electro-Mechanical System), SpaceX Crew Dragon which returned back four Astronauts to the Earth, material shield for high temperature, security algorithms implemented in Pegasus, hydrogen fuel for motor engine, Quantum computer, Nano Robot for surgical purpose etc.

Microelectronics has evolved to Nanotechnology with minimum spaces and high sensitivity. Civilization of human beings is due to means of advances of electronics which has applications in all fields of lives. All sensors and devices are the components of a system as elements of a circuit. Nano circuits are used within ATM card, ID card, memory chips, human body interfacing embedded devices, sensors, processors etc.

The objective of design and development of a circuit should be to use minimum power and to yield high performance like less heat dissipation, less induction-leakage of power and should be environment friendly. Circuits should not emit harmful radiations, if so, that should be capsuled by proper shield. All manufacturing concepts should be associated with waste collection and disposal in a safe way. Manufacturing unit must have separate processes for collecting and disposing of waste electronics in proper places and recycling for reproductions.

Hope, by active participation, researchers will be able to make a network with the professionals of same fields which may help them gathering resources required for their research projects. In future, many of these inventions presented in this conference would be patented and applied within different instruments to make the machines more intelligent to understand the requirements of the users. All inventions of science should be used for peace, development and prosperity of the society.

Dated: 15/04/2026, Kolkata

Keynote Speaker  
**Prof. Abhijit Biswas**

Institute of Radio Physics and Electronics, University of Calcutta,  
92, Acharya Prafulla Chandra Road, Kolkata- 700009, India.

**Title of Presentation:**

**Next-Generation Photovoltaics: The Rise of Perovskite Solar Cells**

**Abstract:**

The growing demand for sustainable energy has accelerated the development of next-generation photovoltaic technologies, among which perovskite solar cells (PSCs) have emerged as a viable solution. With a rapid increase in power conversion efficiency (PCE) from below 4% to over 27%, PSCs demonstrate exceptional potential for high-performance and low-cost solar energy conversion. This talk presents an overview of their operating principles, material advantages, fabrication approaches, recent progress, and future prospects.

Perovskite materials, defined by the ABX<sub>3</sub> structure, possess remarkable optoelectronic properties such as strong light absorption, tunable bandgap, long carrier diffusion lengths, and low exciton binding energy. These features enable efficient charge generation and transport. Additionally, their compatibility with solution-based, low-temperature fabrication offers significant advantages for scalable manufacturing. However, challenges such as environmental instability, ion migration, hysteresis effects, and lead toxicity remain critical barriers to commercialization. The operation of perovskite solar cells (PSCs) is governed by the photovoltaic effect, wherein incident photons generate electron-hole pairs that are subsequently separated and transported through electron and hole transport layers to yield electrical power. Device performance is typically quantified by parameters such as short-circuit current density, open-circuit voltage, fill factor, and power conversion efficiency, all of which are strongly influenced by material quality and interface engineering. PSCs are commonly realized in planar architectures, including n-i-p and p-i-n configurations. Their structural versatility also enables seamless integration into tandem configurations—most notably perovskite-silicon solar cells—thereby surpassing the efficiency limits of single-junction devices. Fabrication techniques such as spin coating, blade coating, and vapor deposition play a crucial role in determining film morphology, crystallinity, and device reproducibility. Recent advances have focused on enhancing both efficiency and operational stability through compositional engineering, defect passivation, and advanced encapsulation strategies. In particular, the development of mixed-cation and mixed-halide perovskites, along with 2D/3D hybrid structures, has significantly improved device performance and durability. Notably, two-dimensional (2D) Ruddlesden-Popper perovskites have emerged as promising candidates due to their superior environmental stability. Concurrently, increasing attention is being paid toward the development of lead-free or eco-friendly alternatives. Looking ahead, PSCs hold immense promise for large-scale deployment across diverse applications, including flexible electronics, building-integrated photovoltaics, and tandem solar technologies. Continued progress in materials design and device engineering will be essential to address the remaining challenges related to stability and environmental impact.

In conclusion, perovskite solar cells represent a transformative advancement in next-generation photovoltaics. With sustained research efforts aimed at overcoming existing limitations, PSCs are well-positioned to play a pivotal role in the transition toward efficient, sustainable, and scalable energy systems.

Keynote Speaker

**Dr. Mukku Pavan Kumar**

Associate Professor & RnD Coordinator, Dept. Of ECE, Lendi Institute of Engineering and Technology  
(Autonomous), Vizianagaram, Andhra Pradesh.

**Title of Presentation:**

**Beyond Hardening: Self-Resilient IMC Caches for Energy-Constrained Space Systems**

**Abstract:**

This talk introduces a novel approach to space-grade memory: combining In-Memory Computing (IMC) with self-adaptive resilience. While standard hardening often compromises efficiency, our proposed self-resilient cache leverages the inherent properties of IMC to provide both computational acceleration and robust radiation tolerance. We will showcase how these low-energy architectures maintain data integrity and functional performance in the harshest environments known to man.

Invited Speaker

**Prof. Pankaj Gupta**

Professor, ECE, Indira Gandhi Delhi Technical University for Women,  
New Delhi, India.

**Title of Presentation:**

**Impact of Distributed Generation on Power System Protection**

**Abstract:**

Distributed Generation (DG) refers to small scale generation such as wind and solar introduces bidirectional power flow, challenging traditional protection schemes. It alters fault current levels, causing relay miscoordination and detection issues. Problems like unintentional islanding and voltage fluctuations further complicate system protection. Recent methods include adaptive relays, communication-based protection, and AI-driven fault detection. These advanced techniques improve coordination, accuracy, and overall grid reliability in DG-integrated systems.

Invited Speaker

**Prof. Rishu Chaujar**

Professor, Department of Applied Physics,  
Delhi Technological University, Delhi.

**Title of Presentation:**

**FET: An Effective Biosensor & Gas Sensor**

**Abstract:**

Field Effect Transistors (FETs) have emerged as highly sensitive platforms for biosensing and gas sensing applications due to their excellent charge modulation capability. Their ability to detect minute changes in surface potential enables real-time, label-free detection of biomolecules for biomedical diagnostics and identification of gas species for environmental monitoring applications. Advanced structures such as nanowire, Recessed Channel FET, FinFET, and 2D material-based FETs further enhance sensitivity and selectivity. Owing to their low power consumption, scalability, and compatibility with CMOS technology, FET-based sensors are a promising solution for next-generation sensing systems.

Keynote Speaker  
**Dr. Chandrima Mandal**

Department of ETCE,  
Jadavpur University, Kolkata, WB, India.

**Title of Presentation:**

**2D Semiconductor Devices for In-Memory Computing**

**Abstract:**

The rapid growth of data-intensive applications such as artificial intelligence, machine learning, and edge computing has exposed the fundamental limitations of the conventional von Neumann architecture, primarily due to the excessive energy consumption and latency associated with frequent data transfer between memory and processing units. In-memory computing (IMC) has emerged as a promising paradigm to overcome this bottleneck by enabling computation directly within the memory array. In this context, two-dimensional (2D) semiconductors have gained significant attention as potential building blocks for next-generation in-memory computing devices owing to their atomically thin body, superior electrostatic control, and excellent scalability.

For more than five decades, the extraordinary progress of electronics and computing has been driven by the continuous scaling of silicon-based CMOS technology. This relentless miniaturization has enabled unprecedented improvements in performance, integration density, and cost. However, as modern transistors approach atomic dimensions, further scaling is increasingly constrained by fundamental physical and technological limitations. At ultra-scaled dimensions, silicon devices suffer from severe short-channel effects, increased leakage currents, excessive power dissipation, and degraded electrostatic control. Simultaneously, the rapid growth of data-intensive applications such as artificial intelligence, machine learning, and edge computing has exposed the fundamental limitations of the conventional von Neumann architecture, primarily due to the excessive energy consumption and latency associated with frequent data transfer between memory and processing units. In-memory computing (IMC) has emerged as a promising paradigm to overcome this bottleneck by enabling computation directly within the memory array.

In this context, two-dimensional (2D) semiconductor materials and ferroelectric devices have emerged as key enabling technologies for the post-silicon era and for realizing in-memory computing architectures. The atomically thin nature of 2D semiconductors provides superior gate electrostatics, excellent immunity to short-channel effects, and enhanced scalability compared to bulk materials. Among various 2D material systems, transition metal dichalcogenides (TMDs) are of particular interest due to their intrinsic and tunable bandgaps. Unlike graphene, which lacks a bandgap and therefore fails to satisfy the switching requirements of CMOS logic, TMDs enable low off-state leakage, high on/off current ratio, and reliable digital switching—features that are essential for low-power VLSI and embedded computing platforms.

Molybdenum disulfide (MoS<sub>2</sub>) has emerged as a leading candidate for n-type transistor applications due to its suitable bandgap, favorable electron mobility, environmental stability, and strong current modulation capability. Tungsten diselenide (WSe<sub>2</sub>), on the other hand, exhibits superior hole transport and favorable valence band alignment, making it an excellent p-type counterpart. The complementary integration of MoS<sub>2</sub> and WSe<sub>2</sub> opens pathways toward fully 2D CMOS architectures that can support logic, memory, and computing functions within a unified device framework. Such characteristics make 2D semiconductor devices particularly attractive for in-memory computing, where logic operations are performed directly within memory arrays to minimize data movement and associated energy overhead.

Invited Speaker

**Mr. Nikunj Gajera**

Manager, PCB design and Testing Expert (LabVIEW and Python), SVTronics Inc., USA.

**Title of Presentation:**

**Bridging the Gap: Signal Integrity in Health-Tech**

**Abstract:**

The evolution of biological computing and bioinformatics relies entirely on continuous, passive physiological data collection from edge devices. However, an industry-wide "Bioinformatics Blind Spot" threatens the efficacy of these advanced systems. Hardware-induced noise—stemming from micro-sensor degradation, poor High-Density Interconnect (HDI) signal integrity, and critical data loss during embedded I2C and SPI transmissions—directly corrupts raw algorithms, creating a fundamental "Garbage In, Garbage Out" scenario.

This keynote addresses how automated hardware validation and test engineering safeguard the future of health-tech devices by eliminating these failure modes at the manufacturing level. Drawing from over seven years of experience driving innovation in high-reliability, mission-critical electronic systems, this presentation will detail the critical role of Design-for-Testability (DFT). By integrating validation hooks and methodologies directly into the PCB architecture early in the design lifecycle, engineering teams can ensure mass manufacturability without compromising data integrity.

To illustrate these engineering methodologies in action, the session features a comprehensive case study on scaling the Ultrahuman Ring AIR at the first-of-its-kind US smart ring manufacturing hub, the "UltraFactory" in Plano, TX. Attendees will explore the challenges of extreme miniaturization, specifically the integration of medical-grade temperature, PPG, and 6-axis motion IMU sensors into a flexible PCB within a 2.45mm titanium frame. Meeting the mandate for zero-defect releases at mass-production speeds requires deploying proprietary, automated test architectures engineered entirely on LabVIEW and Python.

Invited Speaker

**Jubin Abhishek Soni**

Senior IEEE Member, San Francisco, CA, USA

**Title of Presentation:**

**Energy-Proportional Big Data Pipelines: Dynamic Scaling Between Performance and Sustainability**

**Abstract:**

As Apache Hadoop and Apache Spark underpin large-scale analytical workloads, the energy footprint of cluster-based big data pipelines is increasingly scrutinized alongside throughput and latency. This motivates energy-proportional computing—systems whose resource consumption scales proportionally to useful work. This study introduces a framework incorporating dynamic auto-scaling driven by renewable energy availability, power-aware YARN extensions, and adaptive degradation for streaming workloads.

Recent carbon-aware scheduling research demonstrates that significant emission reductions are achievable through workload shifting. Lechowicz et al. (2025) showed that precedence-aware carbon scheduling for Spark DAGs on Kubernetes reduces carbon footprint by up to 32.9% with configurable completion-time trade-offs. Miao et al. (2024) proposed a carbon-aware scheme for multi-renewable edge–cloud environments, leveraging complementary wind and solar profiles for measurable carbon reduction. These contributions address task-level scheduling but do not extend to pipeline-level orchestration of heterogeneous batch and streaming workloads under composite service-level agreements.

This study extends existing methodologies by embedding power-aware heuristics into the YARN container allocation lifecycle, evaluating marginal carbon cost against a pipeline-scoped carbon budget. Graceful degradation protocols for Spark Structured Streaming and Kafka pipelines dynamically adjust micro-batch intervals and stage priorities during renewable supply fluctuations while preserving freshness guarantees. A composite SLA model augments latency targets with carbon budget constraints, enabling joint optimization of processing deadlines and cumulative emissions per pipeline run.

Trace-driven simulations indicate 30–40% reductions in operational carbon emissions for batch-dominant workloads with less than 12% increase in median job completion time, while streaming pipelines maintain sub-minute freshness under moderate renewable intermittency. This study advances a pipeline-level approach to energy proportionality, bridging carbon-aware scheduling theory and practical big data infrastructure while providing a principled mechanism for balancing efficiency with environmental responsibility.

**Keywords:**

Energy-Proportional Computing, Big Data Pipelines, Carbon-Aware Scheduling, Apache Spark, Apache Hadoop, YARN Resource Management, Renewable Energy Integration, Graceful Degradation, Streaming Systems, Sustainable Computing, Carbon Budget SLAs, Dynamic Auto-Scaling.

**References**

- [1] A. Lechowicz, N. Christianson, B. Sun, N. Bashir, M. Hajjesmaili, A. Wierman, and C. Delimitrou, “Carbon- and Precedence-Aware Scheduling for Data Processing Clusters,” in *Proc. ACM SIGCOMM 2025*, pp. 1241–1244, 2025. doi: 10.1145/3718958.3750478.
- [2] Z. Miao, L. Liu, H. Nan, W. Li, X. Pan, X. Yang, M. Yu, H. Chen, and Y. Zhao, “Energy and Carbon-Aware Distributed Machine Learning Tasks Scheduling Scheme for the Multi-Renewable Energy-Based Edge-Cloud Continuum,” *Sci. Tech. Energy Transition (STET)*, vol. 79, no. 82, 2024. doi: 10.2516/stet/2024082.

Invited Speaker

**Mr. Balaji Shesharao Ingole**

Project Manager | AI & Data System Engineer | AI Researcher

**Title of Presentation:**

**Agentic AI in Program Management**

**Abstract:**

Program management in complex IT environments — whether governing large-scale government health systems or high-velocity eCommerce platforms — shares a common dysfunction: project managers spend the majority of their time assembling information rather than acting on it. Weekly status decks, manual RAG dashboards, and reactive escalation chains are not management tools. They are symptoms of an intelligence gap.

This talk introduces a practical framework for deploying agentic AI systems that autonomously sense, synthesize, and act across the program management lifecycle — validated across two distinct high-stakes domains: healthcare and ecommerce.

Drawing from 17 years of hands-on experience it presents a concrete architectural shift — from human-as-aggregator to AI-as-signal-engine — with the program manager elevated to decision authority.

Key themes include: multi-agent LLM pipeline design for continuous project monitoring; automated narrative risk summarization replacing manual reporting cycles; predictive escalation triggers derived from artifact and communication pattern analysis; cross-domain applicability of agentic workflows between regulated government IT and agile eCommerce environments; and feedback loop architectures that improve signal quality over successive project cycles.

Keynote Speaker

**Prof. Abhijit Biswas**

Institute of Radio Physics and Electronics, University of Calcutta, 92, Acharya  
Prafulla Chandra Road, Kolkata- 700009, India.



**Biography:**

Abhijit Biswas earned his B.Tech., M.Tech., and Ph. D. (Tech.) degrees from the University of Calcutta. He is currently a Professor in the Department of Radio Physics and Electronics at the University of Calcutta, where he also served as Head of the Department from 2020 to 2022. Prior to this, he was a Reader in the Department of Electronics and Telecommunication Engineering at Jadavpur University from 2006 to 2008. Additionally, he worked at the Interuniversity Microelectronics Centre (IMEC) in Belgium in 2007. His research interests include semiconductor physics, as well as the modeling, simulation, and characterization of electronic and optoelectronic devices, including CMOS devices and circuits, LEDs, laser diodes, photovoltaics, and optical fiber communications. He has published 100 technical papers in SCI-indexed journals, contributed a book chapter to Nova Science Publications, USA, and presented over 150 papers at international conferences and workshops. His research excellence has been recognized with seven Best Paper Awards at international conferences. Since 2016, he has served as a Guest Editor for Microsystem Technologies and currently acting as a Lead Guest Editor for the S. I. of IET Circuits, Devices and Systems (U. K.). He is an active reviewer for numerous peer-reviewed journals, including IEEE Transactions on Electron Devices, IEEE Transactions on Nanotechnology, Microelectronics Reliability, Optical Engineering, Solar Energy, and many more. Dr. Biswas has successfully supervised 13 Ph. D. candidates and is currently mentoring six Ph. D. scholars. He is a Fellow of the Institution of Engineers (FIE), India, and a life member of both the Indian Physical Society (IPS) and the Institute of Electronics and Telecommunication Engineers (IETE). His academic contributions have been recognized with several prestigious awards, including the UGC Research Award (2012–2014), the Best Citizen of India Gold Medal Award from the Global Economic Progress & Research Association (August 2019), and the Vidyasagar Award at the International Conference Micro 2024, held at Delhi Technological University (DTU) on May 16–17, 2024.

Invited Speaker

**Dr. Mukku Pavan Kumar**

Ph.D., Post-Doctoral Research Associate | IIT Gandhinagar



**Biography:**

Dr. Mukku Pavan Kumar is a distinguished researcher specializing in radiation-hardened memory circuits and in-memory computing architectures for space, defense, and AI hardware. He earned his Ph.D. from VIT University, where his pioneering work on nanoscale SRAM reliability earned him the Best Researcher Award in both 2023 and 2024. After Ph.D., he joined as Post-Doctoral Research Associate at IIT Gandhinagar (nanoDC Lab). Dr. Kumar is actively involved in MeitY-funded semiconductor research, focusing on self-recoverable radiation-hardened SRAM and digital in-memory computing architectures. His expertise spans circuit-level hardening and architectural resilience, having successfully completed full-custom chip tapeouts using UMC 65 nm and SCL 180 nm technologies. He completed tapeouts and tested successfully, which is shown in "SEMICON-Indian Semiconductor Chips" Dr. Kumar holds an Indian patent for a self-recoverable radiation-resistant memory cell and has published extensively in high-impact journals such as IEEE Transactions, IEEE Access, Microelectronics Reliability, Integration, Microsystem Technologies, International Journal of Circuit Theory (Wiley), Memories-Materials, Devices, Circuits and Systems. A recipient of multiple IEEE Best Paper Awards in ISCAS-2025 (UK), TENCON-2023 (Thailand) his work is instrumental in advancing India's indigenous space-grade electronics and energy-efficient AI accelerators.

Keynote Speaker

**Prof. Rishu Chaujar**

Professor, Department of Applied Physics  
Delhi Technological University, Delhi



**Biography:**

Dr. Rishu Chaujar is a Fellow of NASI, IETE and OSI; and a Senior Member of IEEE. She is presently working as a Professor in Department of Applied Physics and Centre Head, Vinod Dham Centre of Excellence for Semiconductors and Microelectronics; and Associate Dean (Undergraduate Studies), Delhi Technological University, Delhi, India. She is involved in teaching the B.Tech, M.Sc. and M.Tech courses. She was honored with the University Gold Medal in M.Sc. (Electronics) and College Topper in B.Sc. (H) Electronics in Delhi University. Her doctoral research involves modeling, design and simulation of Sub-100nm gate engineered Grooved Gate/Concave MOSFET for RFIC design and wireless applications, FinFETs, Tunnel FETs, Nanowires, HEMT structures modeling for high performance sensing, biomedical and wireless applications; and Solar Cell Modeling and Design. She has authored or co-authored more than 353 papers in various reputed international and national journals and conferences. She has supervised around 20 M.Tech/M.Sc. students, 13 Ph.D scholars; and 8 Ph.D scholars are presently working under her supervision. She has been awarded the PREMIER RESEARCH AWARD in 2018 and 2024.

Invited Speaker

**Prof. Pankaj Gupta**

Professor, ECE, Indira Gandhi Delhi Technical University for Women,  
New Delhi, India.



**Biography:**

Dr. Pankaj Gupta received B. E. degree in Electrical Engineering from BIT, Durg, Raipur, India and M. E. degree in Electrical Engineering from Delhi College of Engineering, Delhi University, Delhi, India. He obtained Ph.D degree in Electrical Engineering from NIT, Kurukshetra, India in 2017. He is conferred with prestigious POSOCO Power System Award-2017 for outstanding PhD research work entitled, "Protection issues of grid connected distributed generation" by the Power System Operation Corporation Limited, a subsidiary of Power Grid Corporation, India in partnership with Foundation for Innovation and Technology Transfer, IIT, Delhi. He is also conferred with prestigious Premier Research Award by IGDTUW, Delhi in 2023.

He is currently working with Indira Gandhi Delhi Technical University for Women, Delhi, India as Assistant Professor. He has many publications in various reputed IEEE transactions/conferences and journals. He is also editor of many books with Elsevier. His research interests include power system protection, microgrid control and protection, smart grid technologies and islanding detection techniques.

Invited Speaker

**Dr. Rajesh Dey**

Adjunct. Professor, ECE, Gopal Narayan Singh University, Bihar, India.  
And Principal, Camellia Institute of Technology & Management, Burdwan, WB.



**Biography:**

His Post-Doctoral Fellow, IIUM Malaysia Associated with ELECTROVENT LLP as Director M. Tech & Ph.D From Kalyani Govt Engineering College Under Maulana Abul Kalam Azad University, 20 years of expertise in Teaching, Entrepreneurship, and 6 years of experience in Industry Guest Editor/ Reviewer- Springer Nature, Wiley, TMH, Elsevier etc. He has around 50 research papers in journals, conferences and book chapters He is co-author of around 12 Nos of edited and text books. His Research Interest Application of Batteries in EV, Sensor Technology, Adaptive Signal Processing, Biomedical Engineering, Embedded System, Robotics, Internet of things.

Invited Speaker

**Mr. Nikunj Gajera**

PCB design and Testing Expert (LabVIEW and Python).  
SVTronics Inc., USA.



**Biography:**

Nikunj Gajera is a Test Engineering Manager & Lead Electrical Engineer at SVTronics Inc., USA, with over seven years of experience in PCB design, validation, and test automation using LabVIEW and Python. He holds a Bachelor's degree in Electrical Engineering from Gujarat Technological University. He has improved test efficiency by 40%, manufacturing throughput by 25%, and reduced downtime by 30% through advanced DFT and root-cause analysis techniques. Nikunj has contributed to five Records of Invention and developed innovative PCB architectures across industries like healthcare and automation. He has also led teams of 20+ engineers, driving productivity and quality improvements while enhancing first-pass yield by 18%.

Invited Speaker

**Jubin Abhishek Soni**

Software Architect  
Senior IEEE Member  
San Francisco, CA, USA



**Biography:**

Jubin Abhishek Soni is a Senior Software Engineer at Yahoo and an independent researcher based in San Francisco, USA, with over 14 years of experience in distributed systems, cloud architectures, and AI-driven solutions. He holds a Master's degree in Computer Science from New York University and a Bachelor's degree in Electronics Engineering from NMIMS University. At Yahoo, he leads cloud migration of large-scale data pipelines and builds real-time financial systems for millions of users. He has authored multiple IEEE publications, is a Senior Member of IEEE, and serves as a judge for prestigious awards like the Globee and Stevie Awards. Recognized in Marquis Who's Who in America 2024, he also holds certifications from AWS, Microsoft Azure, and Stanford Online, with research focused on sustainable cloud computing and AI in software engineering.

Keynote Speaker

**Mr. Balaji Shesharao Ingole**

Project Manager | AI & Data System Engineer | AI Researcher



**Biography:**

Balaji Shesharao Ingole is a Project Manager at Amla Commerce, USA, with over 16 years of experience in data engineering, government health IT, and eCommerce transformation. He has led large-scale Medicaid systems at Gainwell Technologies and currently drives AI-enabled platform initiatives combining data architecture and product operations. His academic achievements include 40+ research publications (including IEEE and Springer), over 440 citations, along with 2 UK patents and 3 Indian patents in AI and healthcare technologies. He is a Fellow of British Computer Society (FBCS), Institution of Electronics and Telecommunication Engineers (FIETE), and a Senior Member of IEEE. His expertise spans AI in healthcare, IoT-based monitoring, cloud platforms, and agentic AI systems, reflecting strong contributions to both industry and research.

Paper ID: 116

### **A Nano-Power Cascoded $\beta$ -multiplier CMOS Voltage Reference with -90 dB PSRR 0.00085%/V Line Sensitivity**

Sarah Raees, Ishita Gupta, Bhavya Taneja,  
Komal Duggal, Vandana Niranjana  
Department of Electronics and Communication Engineering,  
Indira Gandhi Delhi Technical University for Women, New Delhi 110006, India

**Abstract:** This paper presents a nano-power cascoded  $\beta$ -multiplier CMOS Voltage Reference without the use of passive filters. The circuit includes a start-up, output stage,  $\beta$ -multiplier circuit, bias current generator, and operational amplifier to achieve a high-power supply rejection ratio and low line sensitivity. The cascoded  $\beta$ -multiplier CMOS Voltage Reference is implemented on 180 nm of technology. The reference voltage is 430.23 mV operating from a wide supply range of 0.9 V to 3.0 V. The Power Supply Rejection Ratio is -90.86 dB at 1 kHz, and the line Sensitivity is 0.0008 %/V. Furthermore, the design achieves an ultra-diminished power consumption of only 379.16 nW, with a total output noise of 27.17 nV/ $\sqrt{\text{Hz}}$ .

**Keywords:** Beta-Multiplier, Power Supply Rejection Ratio, Line Sensitivity, ultra-low power consumption, Temperature Coefficient.

Paper ID: 135

### **Enhancing Service Interoperation through Natural Language Processing for Intelligent Systems**

Amar Chandra, Dr.Rakesh Kumar  
Department of Electronics and Communication,  
Indira Gandhi Delhi Technical University for Women, New Delhi, India.

**Abstract:** This research introduces a novel framework utilizing Natural Language Processing (NLP) technologies to enhance service interaction and mutual understanding in smart service ecosystems. The framework through the integration of semantic parsing, named entity recognition, and intent detection, enables different service systems to communicate dynamically and in real, time. The experiments in the healthcare and finance sectors demonstrated a significant level of improvement: accuracy (92.5% in healthcare, 91.8% in finance), precision (94.3% in healthcare, 92.5% in finance), recall (90.1% in healthcare, 89.7% in finance), and response time (320 ms in healthcare, 305 ms in finance). Such results highlight the framework's potential to adjust and outperform in real, time the conventional methods of service interaction. The upcoming work of researchers will be to broaden the framework over more service areas, enhance scalability, and address ethical concerns such as privacy and fairness. This research serves as a steppingstone in the development of more flexible and efficient intelligent service systems in diverse industries.

**Keywords:** Natural Language Processing, Service Interoperation, Intelligent Systems, Real-time Adaptation, Healthcare, Finance.

Paper ID: 196

## **Detect-Then-Clarify: A Hybrid Approach for Identifying and Resolving Ambiguous User Queries**

Shefali Kaushal, Tanvi Saroha, Saie Pawar,  
Shikha Bharadwaj, Vandana Niranjana  
Department of Electronics and Communication Engineering,  
Indira Gandhi Delhi Technical University for Women Kashmere Gate, Delhi, India

**Abstract:** Ambiguity in natural language queries continues to be a significant barrier to accurate question answering and conversational systems, resulting in many incorrect or unreliable answers. The prevailing methods, ranging from AmbigQA style LLM pipelines to rule-based systems such as TaskLint, generally rely on large models which require powerful GPU capabilities or rigid taxonomy-based structures; therefore, usability and real-world practicality are inhibited by these limitations. Detect-Then-Clarify is an agile and lightweight system for detecting and clarifying ambiguities via the detection, classification, and clarification processes, reducing the reliance on large language models or expensive computational resources. Experimental evaluation demonstrates that this system effectively distinguishes between ambiguous requests, resolves ambiguities through detailed exchanges, and builds user trust efficiently while minimizing unnecessary communication between parties.

**Keywords:** Ambiguity Detection, Conversational AI, Clarification Dialogue, BERT-based Classification, Question Answering Systems, AmbigQA Dataset.

Paper ID: 209

## **An Industrial IOT Monitoring System to detect anomaly with the help of some Machine Learning Algorithms**

Pratick Kumar Choudhury, Priyanshi Kashyap, Dr. Gunajit Kalita  
Computer Science and Engineering,  
Assam Engineering College (AEC), Jalukbari, Guwahati, India

**Abstract:** Predicting maintenance needs and detecting issues before equipment fails are important challenges in industrial monitoring. Traditional threshold methods often overlook early warning signs, leading to operational and financial losses. This paper presents an IIoT monitoring platform that combines real-time multi-sensor monitoring with machine learning. The system monitors seven parameters using five models: Support Vector Machine (SVM), Random Forest, Gradient Boosting, Logistic Regression, and Isolation Forest. Tests on synthetic data show high performance, with SVM, Random Forest, and Logistic Regression providing the best accuracy. Key contributions include a unified real-time architecture, a study comparing ML algorithms, identification of the best sensor-model combinations, and a visualization dashboard. The proposed approach improves predictive maintenance by enabling proactive anomaly prevention.

**Keywords:** Anomaly Detection, Gradient Boosting, IIoT, Isolation Forest, Logistic Regression, Machine Learning Comparison, Random Forest, Real-time Monitoring, SVM.

Paper ID: 215

## An Efficient Real Time Steel Defect Detection using YOLOv12

Prof. Vandana Niranjana,  
Head of Department- ECE  
Muskan Garg, Nishu Kumari, Anushka Gupta  
Indira Gandhi Delhi Technical University for Women, Delhi, India

**Abstract:** In this paper an optimized deep learning model has been proposed for automated Steel Surface Defect Detection [1] to mark the disadvantages of manual inspection methods and baseline object detection models. Steel surface has so many defects which can seriously attack safety and integrity of the product if it's not detected early. The YOLO family models offer fast and reliable object detection [2], but their performance in the market is often restricted by many limitations. To overcome those limitations, this work proposes a multi-phase growing training method which is combined with adaptive augmentation scheduling, systematic hyperparameter optimization, and transfer learning-based initialization on enhanced YOLO V12 [3]. When the model is tested on the NEU Surface Defect Database, the proposed model shows better detection accuracy, progressive stability, increased generalization ability with a mAP50 of 0.863. The presented model gives an efficient real time solution which is needed for industrial deployment and also having quality observation systems.

**Keywords:** Deep Learning, Steel Surface Defect Detection, YOLO, Transfer Learning.

Paper ID: 219

## Human Fall Detection in Healthcare Using YOLOv8

Priyanka Goel  
Dept. of ECE, Gautam Buddha University, Greater Noida, India,  
Neha Goel, Surbhi Chauhan, Lakshya Sharma, Rohit Kumar, Anubhav Singh  
Dept. of ECE, Raj Kumar Goel Institute of Technology, Ghaziabad, India

**Abstract:** Fall detection is a critical challenge in healthcare monitoring, elder care, and public safety. This paper presents a real-time fall detection system leveraging YOLOv8n pose estimation to analyze human skeletal keypoints through a novel multi-criterion biomechanical scoring framework. The system supports four configurable video input modalities: webcam, IP/USB camera, pre-recorded video files, and RTSP/HTTP online streams. Fall events are detected by simultaneously evaluating five indicators: bounding box aspect ratio deviation, torso inclination angle, head-to-hip relative positioning, knee-to-shoulder proximity, and ankle elevation. A confidence-weighted scoring mechanism triggers alerts only when cumulative evidence exceeds a threshold of  $S \geq 4$ , substantially reducing false positives. Deployed as a Flask-based localhost web application, the system provides live MJPEG streaming, skeleton overlay visualization, real-time alert signaling, and session-level statistics. Evaluation on the UR Fall Detection Dataset (URFD) and the Multiple Cameras Fall Dataset (MCFD) demonstrates 94.3% sensitivity and 96.9% specificity with an overall accuracy of 95.4% and a false positive rate of 3.1%, outperforming single-feature baselines. The YOLOv8n-pose backbone achieves 28–32 FPS on a standard consumer CPU, enabling practical edge deployment without GPU infrastructure.

**Keywords:** Fall Detection, YOLOv8, Pose Estimation, Skeletal Key points, Human Activity Recognition, Flask, Edge Computing, Real-Time Monitoring.

Paper ID: 234

## Efficient Energy Management for IoT Based Systems Using Multi-Server In Edge Computing

Payal Kavadia, Zaineb Naaz  
Department of Computer Science and Engineering  
Vidushi Sharma  
Department of Electronics and Communication Engineering,  
Gautam Buddha University, Greater Noida, India.

**Abstract:** The expansion of Internet of Things (IoT) has reshaped the daily life by connecting wide range of smart devices, that work intelligently and autonomously. The large volumes of data, requires high computational power and extensive storage, which is provided typically by cloud platforms. However, depending solely on Cloud for timesensitive or mission critical applications can pose challenges, as they require minimal service latency and immediate responses. Thus, Edge computing has emerged as a layer that enables real time and localized processing of the tasks. With fluctuations in data load, the performance of edge nodes may vary depending on their resources and capacity. So, it is essential to schedule tasks based on the priority and available resources, which enhances the Quality of Service (QoS) and the performance of edge nodes. Queuing Theory, which is based on task arrival and service patterns, provides a structured framework for modelling such systems with either single server or multiple servers. The Queuing theory presents different models such as, single-server and multi-server models which can be employed to schedule tasks based on the available resources at the servers and improve overall performance of the system. This study provides an analytical approach by comparing these two models at the Edge Computing layer, which is based on time taken for executing all the data packets in the system, average waiting time or average length of the system.

**Keywords:** IOT, Edge Computing, Queuing Models, Load Balancing.

Paper ID: 261

## Beyond the Visual: The Integration of Artificial Intelligence and Spatial Transcriptomics in Psoriasis

Virat Raghuvanshi, Daksh Yadav, Dr. Annu Singh  
Department of Electronics and Communication Engineering,  
Gautam Buddha University, Yamuna Expressway, Greater Noida, Gautam Buddha Nagar, India

**Abstract:** Psoriasis is a chronic inflammatory disease which happens due to the immune system and affects multiple organs of the body. Around 125 million people worldwide live with this disease. This disease not only affects multiple organs of the body, but also impacts time, financial cost, and mental health. Due to targeted biological treatments, the treatment landscape also improved, but clinical management is still a challenge, mainly due to the shortage of dermatologists and subjectivity of visual assessment methods. This review analyzes the massive shift from traditional machine learning to multimodal foundation models and deep learning architectures that enables the standardized and reproducible Psoriasis Area and Severity Index (PASI) scoring. We carefully analyze the role of molecular AI, specifically spatial transcriptomics (ST) and single-cell resolution which helps in reversing the effect of convolution on localized inflammatory niches, and also the emerging “digital twins” for predictive modeling of treatment response. Additionally, we address the computational frameworks which enable algorithmic precision medicine, including generative data augmentation, privacy- preserving federated learning, and explainable AI(XAI) frameworks. In the end, we conclude that the successful clinical translation of these technologies requires a “human-in-the-loop” approach so that we can navigate through the social and regulatory challenges with ethical obligations.

**Keywords:** Psoriasis; Deep Learning; Multimodal Foundation Models; Psoriasis Area and Severity Index (PASI); Spatial Transcriptomics; Digital Twins; Federated Learning; Explainable AI (XAI).

Paper ID: 262

## **From Foundation Paradigms to Multimodal Models: Two Decades of Alzheimer's Disease Forecasting**

Daksh Yadav, Virat Raghuvanshi, Dr. Annu Singh  
Department of Electronics and Communication Engineering,  
Gautam Buddha University, Yamuna Expressway, Gautam Buddha Nagar, Greater Noida, India.

**Abstract:** This review traces the evolution of the last two decades of computational forecasting models for Alzheimer's disease progression, where the field has evolved from early linear methods to advanced multimodal and foundation models. Therefore, the paper highlights the computational importance of early disease prediction through longitudinal cohorts (e.g. ADNI, OASIS-3) and multimodal data architectures, which include structural, functional, clinical, biofluid, and genomic biomarkers. Review discusses the trajectory of predictive modelling from initial cognitive and structural pairing techniques to the deep learning era, where automated feature extraction and temporal tracking were introduced. Importantly, this review addresses a significant "Credibility gap" in recent deep learning research, which happened due to data leakage and improper data-splitting techniques. So the paper advocates a strict "Methodological Triad", in which subject-level data separation and external validation are essential. Furthermore, this review analyses the state-of-art paradigms of 2024-2026, where Transformer-based architectures, tabular foundation models, Agentic AI frameworks are integrating, which are shifting the field from black-box prediction to explainable clinical intelligence. This review examines XAI techniques such as SHAP, Grad-CAM, LIME and LRP. Along with this Graph Neural Networks(GNNs) are discussed as a framework of brain connectivity model, where cortical regions are nodes and their anatomical and functional connections are edges, because of this network-level disruptions can be captured that cannot detect scalar biomarkers.

**Keywords:** Alzheimer's Disease Forecasting; Multimodal Deep Learning; Longitudinal Cohorts; Foundation Models; Data Leakage; Methodological Triad; Agentic AI; Neuroinformatics; Decentralized Learning; Explainable AI (XAI); Graph Neural Networks; Brain Connectivity.

Paper ID: 269

## **Analysis of Seizure-Associated Brain Structural Patterns in MRI Using Visibility Graphs and Graph Transformers**

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**Abstract:** Epilepsy is a major disorder in the nervous system, in which people have frequent seizures due to irregular electrical activity in the brain, which afflicts millions of people in the world. Early detection of structural brain atrophy of seizure conditions can be useful in enhancing the diagnosis and treatment preparation. Electroencephalography (EEG) is popularly applied in real-time detection of seizures but Magnetic Resonance Imaging (MRI) offers some structural view which can be used to detect abnormalities related to seizure disorders. In the given paper, a brand new model of analyzing the brain structural patterns related to the seizure phenomenon on MRI images is proposed, which combines Convolutional Neural Networks (CNN) with the Horizontal Visibility Graph (HVG) construction and classification based on the Graph Transferer. Preprocessing pipeline consists of the grayscale conversion, noise elimination and normalization of intensity. A simplified region-based signal is calculated based on spatial averaging of pixel intensities to obtain ROI-based signals. These signals are converted to HVGs in which a data point is a node and horizontal visibility criteria are used to create edges to provide the structure of graph representation. To construct a space structural feature set, graph-theoretic properties of the node similarity (degree, clustering coefficient, and the shortest path length) are being taken out. A Graph Transformer classifier which is based on attention is then used to classify binary in terms of abnormal and normal cases of seizures. The core innovation of this paper is that CNN based spatial feature extractions and HVG based graph modeling followed by Graph Transformer classification are merged, such that they are organized into a hybrid architecture that is used to analyze the MRI data. Experiments have shown that the suggested framework has an overall classification accuracy of 96.08, a seizure-related abnormal class (Class 1) recall of 1.00, a precision of 0.94, and F1-score of 0.97, which is better than traditional machine learning, CNN-only, RNN-based, and a regular Graph Neural Network framework. The results are that graphical structural representation of MRI acquired signals can provide reasonable accuracy of seizure related patterns, which offers computational strength of tool to support the neurological diagnostic process.

**Keywords:** Seizure-Associated Abnormalities, MRI, Visibility Graph, Horizontal Visibility Graph (HVG), CNN, Graph Transformer, Structural Representation, Deep Learning.

Paper ID: 270

## **AdapHaze: Fog Density-Aware Adaptive Image Dehazing Using Lightweight CNNs with Perceptual Loss**

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**Abstract:** Fog and haze degrade the performance of visual systems in autonomous vehicles, surveillance, and aerial imaging. Existing lightweight dehazing methods apply a fixed restoration strength regardless of fog density causing systematic overdehazing of lightly hazy images and under-restoration of densely fogged scenes. This paper presents AdapHaze, a two-stage adaptive dehazing framework. Using a balanced training set taken from the RESIDE OTS dataset, Stage 1 achieves strong validation accuracy by classifying each hazy input as Light, Medium, or Dense using a MobileNetV3-Small fog density classifier. Stage 2 uses an AOD-Net dehazing backbone that was trained using a combined MSE and VGG-based perceptual loss. The dehazing intensity is controlled based on the predicted fog class at inference using a density-conditioned lambda parameter. Evaluated on the RESIDE SOTS-Outdoor benchmark, AdapHaze produces competitive fidelity scores and significantly outperforms both the MSE-only baseline and a fixed-lambda perceptual model. The density stratified evaluation confirms consistent improvements over all classes of fog density, thus validating the proposed adaptive lambda mechanism.

**Keywords:** Image dehazing, fog density estimation, MobileNetV3, AOD-Net, perceptual loss, adaptive processing, atmospheric scattering.

Paper ID: 271

## **Comparing Vision Transformers and CNNs for Fine-Grained Animal Classification Across Multiple Dimensions**

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**Abstract:** Vision Transformers (ViTs) have emerged as a powerful alternative to Convolutional Neural Networks (CNNs) for image classification; however, their practical trade-offs in accuracy, efficiency, and interpretability across tasks of varying complexity remain underexplored. This study presents a multi-dimensional comparative analysis of four deep learning architectures — ViT-Patch16, ViT-Patch32, ResNet-50, and EfficientNet-B0 — on two animal classification benchmarks: Animals-10 (coarsegrained, 10 classes) and Oxford-IIIT Pet (fine-grained, 37 breeds). All models were fine-tuned under identical training conditions using ImageNet-pretrained weights to ensure a fair comparison. Experimental results reveal an architectural rank reversal between datasets: while all models achieve near-saturating accuracy on Animals-10 (98.91%–99.41%), clear stratification emerges on the fine-grained benchmark, where ViT-Patch16 achieves the highest accuracy of 92.12%, outperforming ResNet-50 (88.75%) and EfficientNet-B0 (87.92%). Critically, EfficientNet-B0 demonstrates the largest accuracy degradation (11.29 percentage points) when moving from coarse to fine-grained classification, despite ranking second on the easier dataset. Computational analysis shows EfficientNet-B0 is 16× smaller and 6× faster than ViT-Patch16, highlighting a significant efficiency trade-off. Explainability analysis using Grad-CAM [1] and Attention Rollout [2] reveals that ViTs attend to semantically precise image regions, providing mechanistic insight into the observed performance gap. These findings offer practical guidelines for architecture selection based on task granularity and deployment constraints.

Paper ID: 274

## Temporal Graph Attention Networks with Knowledge Distillation for Multi-Center SEEG Surgical Outcome Prediction in Drug-Resistant Epilepsy

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**Abstract:** Predicting whether epilepsy surgery will actually stop seizures remains frustratingly difficult. Current methods—mostly based on static graph convolutional networks (GCNs) or older statistical approaches—fail because they can't capture how epileptic brain networks change over time. We developed a Temporal Graph Attention Network (T-GAT) that combines spatial graph attention layers with LSTM networks to track how seizure patterns evolve across time. Our approach divides each SEEG recording into 10 time windows, building a separate brain connectivity graph for each window using adaptive top-15% Pearson correlation thresholding. Each graph node contains hub centrality features plus Delta and Gamma band power— features that clinicians actually use. Since we had limited labeled data, we used Knowledge Distillation (KD): a teacher network trained on 35 labeled patients guides a student network to learn from 500 additional unlabeled patients, giving us 535 total patients from three different hospitals. The model achieved 96.16% accuracy with 5-fold cross-validation, beating previous GCN methods by 3.7 percentage points. This shows that combining temporal modeling, attention mechanisms, and knowledge distillation can provide a practical tool for predicting epilepsy surgery outcomes across different medical centers.

**Keywords:** stereoelectroencephalography (SEEG), graph attention networks, temporal graph neural networks, epilepsy surgical outcome, knowledge distillation, brain connectivity, drug-resistant epilepsy, spatio-temporal modelling.

Paper ID: 282

## AI-Powered Personal Assistant for Daily Life Automation and Smart Decision Support

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Pradeep Kumar Kushwaha, Amardeep Gupta  
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**Abstract:** This paper presents the design, development, and deployment of a Python-based AI personal assistant engineered to automate routine daily tasks and provide intelligent decision support. Built over a nine-week agile sprint cycle, the system evolved from a command-line prototype into a fully featured GUI-enabled desktop application. Three contributions define the work: a purpose-built Natural Language Processing (NLP) engine for intent classification, a modular task automation engine for scheduling and system control, and a recommendation module driven by historical interaction patterns. Experimental evaluation yielded 88% intent recognition accuracy, and backend caching reduced response latency by approximately 40%. Operating entirely offline, the system constitutes a privacy-preserving alternative to mainstream cloud-based assistants.

**Keywords:** Artificial Intelligence, Personal Assistant, Natural Language Processing, Task Automation, Python, Intent Recognition, Human-Computer Interaction, Desktop Automation.

Paper ID: 290

## **Design and Analysis of Reliable Energy-Efficient CNT-8T SRAM Array for High Speed In-Memory Computing Applications**

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**Abstract:** Advance technology in memories below 10nm faces various issues like stability, leakage power, and access time which limits the future memory applications, especially in energy-efficient computing-in-memory applications. Even the developments of Non-Volatile memories, SRAM plays a vital role in recent in-memory computing applications due to its unique data retention speed, and simple to fabrication. The Carbon Nanotube FET's (CNTFET) superior properties over MOS transistors in nano scale circuits, which benefits advanced memory applications. This paper shows a read reliable 8 transistor SRAM architecture using conventional MOS and CNT technologies at 45nm and 32nm nodes, respectively. We measured the major performance metrics like static current and voltage noise margins, write trip voltage, read, write access times, read, write switching powers, power delay product, and trade-off performance metrics. The proposed 8T-CNT SRAM shows 2.29x, and 3.2x times higher read stability than 8T-MOS SRAM and 6T-MOS SRAM, respectively. Further, static current noise margin of proposed 8T-CNT shows 8.4x, 10.6x times higher than 8T and 6T- CMOS SRAM array. Moreover, complete array with memory peripherals consuming pico-watt for CNT memory, whereas MOS SRAM exhibits few-mico watt power. These results shows that proposed 8T-CNT SRAM is reliable and energy-efficient for advanced In-memory computing applications.

**Keywords:** Carbon nano tubes, static random access memory, static noise margin, Non-Volatile memories, trip voltage, power delay product.

Paper ID: 294

## **AI-Powered Personal Assistant for Daily Life Automation and Smart Decision Support**

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Pradeep Kumar Kushwaha, Amardeep Gupta  
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**Abstract:** This paper presents the design, development, and deployment of a Python-based AI personal assistant engineered to automate routine daily tasks and provide intelligent decision support. Built over a nine- week agile sprint cycle, the system evolved from a command-line prototype into a fully featured GUIenabled desktop application. Three contributions define the work: a purpose-built Natural Language Processing (NLP) engine for intent classification, a modular task automation engine for scheduling and system control, and a recommendation module driven by historical interaction patterns. Experimental evaluation yielded 88% intent recognition accuracy, and backend caching reduced response latency by approximately 40%. Operating entirely offline, the system constitutes a privacy-preserving alternative to mainstream cloud-based assistants.

**Keywords:** Artificial Intelligence, Personal Assistant, Natural Language Processing, Task Automation, Python, Intent Recognition, Human-Computer Interaction, Desktop Automation.

Paper ID: 298

## **Study and Performance Analysis of Smart Vacuum Cleaning Robot using Arduino Uno**

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**Abstract:** In this work, a smart vacuum cleaning robot based on Arduino Uno microcontroller with an aim of achieving efficient, low cost and autonomous cleaning of floor is studied. The designed system was combination of ultrasonic sensors, which is used to detect the presence of the obstacles, the motor drivers which are used to control the navigation system, and the suction mechanism which is used to remove the dust. The algorithm on which the robot was built features a preprogrammed moving, allowing to move in a system herself without colliding, thus performs optimally in the area coverage. The hardware architecture was adjusted with caution to maintain a balance between the efficiency of the performance and the energy consumption of the hardware and the embedded C programming was used to implement the software logic in the arduino actual IDE environment. The system architecture depicted a smooth flow of interaction between sensing, processing and actuation units. The cleaning efficiency, navigation accuracy and obstacle avoidance capabilities were calculated by experimental testing in the held indoor environments. The results demonstrated that the suggested robot is reasonable outcomes in relation to improved cleaning space as well as restricted hand control compared to conventional cleaning plans. Besides this, the system has been found out to be cost effective, scalable and hence suitable in both the domestic and small scale industry. The research will have an impact on creating easy implementation automation solution and other possible bright opportunities of microcontroller robotics in daily life.

**Keywords:** Arduino Uno, Vacuum Cleaning Robot, Autonomous Navigation, Ultrasonic Sensor, Embedded Systems, Robotics Automation.

Paper ID: 310

## Defect-Engineered Topological Light Transport in 2D Photonic Crystals at MidIR Wavelengths

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**Abstract:** Topological band structure engineering enables the development of robust light propagation states known as topological interface states, across a variety of media. These light states emerge at the interface between two topologically distinct lattices and are characterized by their remarkable robustness against structural imperfections. We present a systematic study of light transport in twodimensional photonic crystal (PhC) waveguides, progressing from conventional defect-engineered designs to topologically robust architectures. Initially, a topologically trivial 2D square unit cell is designed and its photonic band structure is computed. Based on this unit cell, a line-defect waveguide of width  $d=2a$  is introduced. Further, a tapered 2D waveguide is realized using point defects, with the defect width gradually reduced from  $d=4a$  at the input to  $d=2a$  at the output. In both configurations, comparable input and output field intensities confirm efficient light transmission. However, these conventional PhC structures lack robustness against structural perturbations and fail to support bent light propagation. To address this, a topologically non-trivial 2D unit cell is designed, and the associated topological phase transition is verified via parity analysis of eigenmodes obtained from eigenfrequency simulations in COMSOL Multiphysics®. By integrating trivial and non-trivial unit cells, a topological defect-guided waveguide is demonstrated, enabling robust light transport through topological interface states along a  $15^\circ$  bend.

**Keywords:** Band structure engineering, Defect-engineered light transport, Photonic crystal waveguides, Topological photonics, Topological interface state (TIS).

Paper ID: 319

## **OFDM-Based Target Detection in Integrated Sensing and Communication (ISAC) Systems: A CFAR Analysis with Optimal Resource Allocation via the Alpha ( $\alpha$ ) Parameter**

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**Abstract:** This work investigates how OFDM waveforms can simultaneously serve radar and data communication functions within a shared spectral and hardware resource pool. A scalar allocation parameter  $\alpha \in [0,1]$  controls the fraction of subcarriers devoted to radar pilot tones versus QPSK payload data, giving continuous and reversible control over the sensing-communication balance. We ran thousands of Python-based Monte Carlo trials to characterize how this trade-off actually behaves in terms of detection probability (PD), bit error rate (BER), and throughput. The data surprised us: you only need to dedicate 5% of your subcarriers to pilots ( $\alpha = 0.05$ ) to achieve a perfect detection rate (PD = 1.0) at SNR  $\geq 0$  dB. Crucially, this subcarrier-splitting approach does not degrade the BER for the remaining data symbols, meaning radar capability can be added without making the communication link "noisier". While 5% is the mathematical optimum in our simulations, real world deployments face unpredictable channel uncertainty. Therefore, we recommend  $\alpha = 0.10$  as a safer, more "defensible" operating point for emerging 5G/6G hardware. It represents a low-overhead pathway to giving networks "eyes" without sacrificing the high-speed data throughput we rely on.

**Keywords:** OFDM, ISAC, CFAR detection, Range-Doppler map, alpha parameter, subcarrier allocation, BER, detection probability, 5G/6G.

Paper ID: 320

## **32% Efficient Thickness Optimized Lead-Free CsSnI<sub>3</sub> Perovskite Solar Cells With TiO<sub>2</sub> Electron Transport Layer**

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**Abstract:** This paper proposes an ITO/TiO<sub>2</sub>/CsSnI<sub>3</sub>/PEDOT:PSS/Albased planar solar cell designed for efficient capture of the solar radiation. CsSnI<sub>3</sub> acts as the narrow-bandgap active absorber layer, enabling effective photon absorption and generation of electron-hole pairs. The front electrode and electron transport layer (ETL) materials are selected based on favorable band alignment with the absorber, allowing them to function as window layers for incident solar energy. The energy band diagram is also presented to illustrate carrier transport and reduced recombination losses across the ETL and hole transport layer (HTL). Simulation results suggest that a perovskite layer thickness of 300 nm yields the optimal performance, achieving a power conversion efficiency (PCE) of 32.1%, along with a short-circuit current density of 42.71 mA/cm<sup>2</sup>, an open-circuit voltage of 0.91 V, and a fill factor of 82.4%. The obtained PCE is among the highest values reported recently for perovskite lead-free planar solar cells.

**Keywords:** ETL, HTL, PCE, Perovskite based solar cells.

Paper ID: 342

## Predictive Beam Management in 5G mmWave using NMS-Hosted AI with Smart Contract-Based Policy Enforcement

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**Abstract:** Millimeter-wave 5G networks rely on directional beamforming to overcome severe path loss and maintain reliable high-data-rate communication. Managing beams reliably is a challenge. This is because mobility, blockages and rapid changes in channels can often misalign beams and degrade links in dense deployments [1][2]. Conventional methods for beam sweeping and measurement help keep connectivity, but they create a signaling overhead and don't scale well as beam codebooks and deployment density increase [3]. This paper presents a framework for beam management driven by Network Management Systems (NMS). It uses Simu5G to create traces that are then sent to an external NMS. These traces are refined using AI to predict beams. The proposed architecture relies on a quantized graph neural network for predicting the top K beams. This approach does not require changes to the existing RAN control system. To address concerns of trust, policy compliance, and multistakeholder interoperability, a blockchain-based smart contract layer is introduced as a non-real-time governance mechanism. Rather than participating in latency-critical beam selection, the smart contract selectively validates and enforces policy constraints on a subset of AI-generated decisions, ensuring auditability and secure control without impacting real-time performance. In a stadium scenario, with 7 gNBs, 500 UEs, 64-beam codebooks and 28 GHz operation, this framework aims to reduce beam failures, CSI-RS overhead and boost spectral efficiency compared to regular sweeping.

**Keywords:** 5G, beam management, Simu5G, network management system, smart contracts, artificial intelligence. Blockchain, Radio Access Network, decentralized RAN automation, Key Performance Indicators, Configuration Management, Graph Neural Network, Radio Intelligent Controller, INET Framework, OMNeT++.

Paper ID: 350

## Energy-Aware Priority-Based Task Scheduling in IoT-Network

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**Abstract:** The rapid emergence of Internet of Things (IoT) applications has made it even more imperative to schedule tasks efficiently. The conventional scheduling algorithms such as First-Come-First-Serve (FCFS) and Earliest Deadline First (EDF) primarily focus on the time ordering of tasks and do not consider the energy constraints and varying load conditions in hierarchical systems. This paper presents an energy-efficient and priority-based task scheduling framework for IoT-Network, which targets minimizing the response time, energy consumption, and improving Service Level Agreement (SLA) satisfaction. The proposed approach integrates load balancing based on queue, task processing based on priority, and edge processing based on energy constraints. We have a mathematical model of the queueing system based on M/M/1 and M/M/c models that we use to describe the process. Monte Carlo simulations are used to validate its performance. The experimental results show that the waiting time, response time, throughput, and energy efficiency are substantially better than the existing FCFS and EDF algorithms. The proposed framework demonstrates improved SLA satisfaction and overall system performance under moderate load conditions. Furthermore, the proposed framework shows that hierarchical IoT task management systems can be significantly improved by integrating energy efficiency and adaptive priority schemes.

**Keywords:** Internet of Things (IoT), Energy-aware scheduling, Priority-based task scheduling, Load balancing, Service Level Agreement (SLA).

Paper ID: 363

## Coverage-Driven and Assertion-Based Verification of I2C and SPI Protocols using SystemVerilog and UVM for Scalable VLSI Systems

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**Abstract:** As VLSI systems continue to grow in complexity, there is increasing demand for verification methodologies that are both efficient and scalable. Functional verification of widely used communication protocols, such as I2C and SPI, is particularly problematic because traditional verification methods often do not provide complete coverage or identify defects or errors early during the design phase. This delay in identifying defects or errors leads to an increase in the overall time and cost of the manufacturing process. This work presented a Coverage-Driven Verification (CDV) and Assertion-Based Verification (ABV) methodology that combined Constrained Random and Directed Testing, System Verilog assertions, and functional coverage models to provide a comprehensive verification process for VLSI systems. A reusable testbench environment based on the Universal Verification Methodology (UVM) is developed to provide verification of the functionality of the protocol, the timing constraints associated with the protocol, and corner case scenarios. The proposed CDV/ABV methodology achieved 98.75% functional coverage, 97.90% code coverage and 100% assertion coverage. Through fault injection analysis, a 100% detection rate for all fault conditions was achieved, while regression testing produced a 98.33% efficiency rating. In addition, the simulation time was reduced from 120 minutes to 85 minutes, which has improved the overall verification efficiency. The results demonstrated that the proposed methodology improves reliability, scalability and performance in the verification of VLSI systems.

**Keywords:** Coverage-Driven Verification (CDV), Assertion-Based Verification (ABV), System Verilog, Universal Verification Methodology (UVM), I2C and SPI Protocols.

Paper ID: 367

## Neuromorphic Computing and Futuristic Processor

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**Abstract:** Neuromorphic computing represents a transformative shift in computer architecture, moving away from the traditional Von Neumann model to mimic the neural and synaptic structures of the human brain. As Moore's Law reaches its physical limits, conventional microprocessors face the "memory wall" and unsustainable power demands. This review paper synthesizes the evolution of computing from vacuum tubes to modern AI-driven systems, highlighting the critical limitations of conventional microprocessors, such as the "Von Neumann bottleneck." By exploring the fundamental differences between biological and artificial neurons, the study details how neuromorphic hardware achieves massive parallelism and ultra-low energy efficiency through event-driven Spiking Neural Networks (SNNs). We examine the architecture of the "Silicon Brain," including synapses and plasticity, and evaluate modern hardware implementations including Intel's Loihi and Loihi 2, IBM's TrueNorth, and the SpiNNaker2 platform. We further discuss emerging device technologies such as memristors and their role in enabling in-memory computing. Finally, the paper explores real-world applications in autonomous vehicles, cybersecurity, Edge AI, and healthcare, and addresses the key challenges of scalability, programming frameworks, and accuracy gaps that must be overcome for widespread adoption. Neuromorphic processors are positioned as the cornerstone for the next generation of high-performance, energy-aware computing.

**Keywords:** Neuromorphic Engineering, Spiking Neural Networks (SNN), Von Neumann Bottleneck, CMOS, Silicon Brain, Edge AI, Event-driven processing, Loihi, Loihi 2, TrueNorth, SpiNNaker2, Memristor, Spike-Timing-Dependent Plasticity (STDP), In-Memory Computing.

Paper ID: 378

## **Few-Shot Facial Recognition: A Practical Implementation Using Quality-Aware Prototypes and Multi-View Embeddings**

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**Abstract:** The problem that I am going to address in this paper is a real-life issue of how to create a face recognition system with only a couple of handful of images of individuals? Majority of studies presuppose that we possess hundreds of photos, yet that is not the case in the real-life deployments. We have developed a system that operates with 3 or less to 10 enrolment photos to identity. This is not us developing a new neural architecture but approximately to have the existing facial embeddings significantly more effective with thorough engineering. We present four techniques that use test-time augmentation to minimize noise, quality-based weighting to deal with bad photos, k-means clustering to make use of pose diversity, and a hybrid similarity measure that, as a combination of cosine and Euclidean distances. Comparison with standard ImageNet models (VGG-16, ResNet-50, etc.) demonstrates that our method achieves 98.7% accuracy, within 0.3 points of VGG- 16 with an incredibly low number of samples. The system is real-time and uses standard hardware and an automatic threshold calibration technique which eliminates manual tuning. We've also addressed the very often ignored problem of cross-device enrolment. When a person signs in using the phone, but is not identified by a web camera. The full implementation is modular so you can replace more desirable embedding models as they are developed.

**Keywords:** few-shot learning, face recognition, prototype networks, quality assessment, test-time augmentation, domain adaptation.

Paper ID: 391

## **When Augmentation Hurts: Analyzing the Limits of Contrastive Learning on Noisy Augmented Twitter Data for Multi-Domain Sentiment Analysis**

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**Abstract:** The paradigm of contrastive learning has become an effective representation learning method in natural language processing, using semantic similarity of the augmented data pairs to enhance model robustness. This paper presents an empirical research on the use of contrastive learning- namely the NT-Xent (Normalized Cross Entropy) loss-scaled by temperature-to a large scale multidomestic twitter sentiment dataset of 74,682 tweets in 32 brand and game categories and four sentiments. One of the distinguishing characteristics of this dataset is its 6x augmentation, where a single original tweet is paraphrased six times with the same paraphrase exists. identifier, which has been shown to give rich positive pairs on which to train contrastively. Our hypothesis is that we will suggest a dual-objective BERTweet. based architecture which consists of cross- entropy classification and NT-Xent contrastive regularization ( $\tau=0.5$ ,  $\tau=0.07$ ), and make a systematic comparison with a powerful non-augmented baseline. Our, contrary to expectation, is as follows: contrastive model has a Macro- F1 of 0.6026 in terms of Test as against the baseline of 0.6496- a decrease of 4.70 points. We prove this degradation not to be uniform, showing, by detailed per-class analysis, that it is the Irrelevant class that is harmed. the most significant decrease (F1: 0.49 to 0.36), whereas classes that carry sentiments are not very volatile. And we ascribe this to three. compounding factors: (1) augmentation faithfulness violations in the dataset which add label incompatible variants, (2) lack of batch diversity in optimizing NT-Xent on CPU hardware that has a bottleneck on in-batch negative richness, and (3) the irrelevance of the Irrelevant class as a contrastive target. The first is our findings. formal investigation of contrastive learning with augmentation support on this popular benchmark, and our analysis of failure. offers practical principles on how practitioners can use contrastive goals when using noisy, multi-class Twitter corpora. We also are able to show that contrastive objective is selectively detrimental to underrepresented and semantically ambiguous. classes, which have a direct consequence on fairness-conscious NLP systems. Index Terms used- Sentiment analysis, contrastive learning, Twitter NLP, data augmentation, BERTweet, NT-Xent, multi-domain classification, representation learning.

**Keywords:** Sentiment analysis, contrastive learning, Twitter NLP, data augmentation, BERTweet, NT-Xent, multi-domain classification, representation learning.

Paper ID: 394

## Facial Emotion Detection Using CNN: A Real-Time Implementation Approach

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**Abstract:** Human facial expressions convey a wealth of information that can be leveraged to train machines for automated recognition. The accuracy of such cues has become a dynamic area of study in affective computing and human-computer interaction. This paper presents the design and implementation of a real-time facial emotion recognition system using Convolutional Neural Networks (CNNs). The system can detect seven different emotional states—anger, disgust, fear, happiness, neutrality, sadness, and surprise—directly from a live webcam feed. It achieves 80.2% accuracy on the FER2013 benchmark. Model training was conducted using TensorFlow and Keras, while face localization and frame acquisition were performed with OpenCV. In addition to reporting performance metrics, this work details critical design decisions—from preprocessing to architectural trade-offs—and provides a candid assessment of the system's limitations. Concerns such as class imbalance in training data, susceptibility to ambient lighting, and the ethical implications of deploying emotion-aware systems are explored with the same rigor as the technical results.

**Keywords:** Facial Emotion Recognition, Convolutional Neural Networks, Computer Vision, Deep Learning, Real-Time Detection, Human-Computer Interaction, Affective Computing.

Paper ID: 395

## Evolution of AI Towards Electronics Industry

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**Abstract:** In this paper we reviews the evolution of Artificial Intelligence (AI), covering its origins starting from Turing Machines, early advancements like Expert Systems (ES), modern advances and future advancements. Future AI Advancements, including man-machine coexistence, cyborgs, hybrid intelligence, mind uploading, and biological programming, are explored in the context of technological singularity. AI has significantly transformed the electronic industry by improving automation, design efficiency, and intelligent device capabilities. This paper explores the integration of AI in electronic systems including semiconductor design, manufacturing automation, and Internet of Things applications. Based on the through study we identify five coherent thematic area ie. i) AI-driven quality inspection, ii) IoT-enabled predictive maintenance, iii) AI- native electronic design automation (EDA), iv) nanoscale materials modelling, and v) Industry 4.0/5.0 systems integration [i]. The benefits, challenges, and future trends of AI adoption in electronics are discussed.

Paper ID: 399

## Energy Efficient ALU Design using Adaptive Clock Gating Techniques for Low-Power VLSI Architectures

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**Abstract:** The demand to spare energy while creating efficient Very Large- Scale Integration (VLSI) systems continues to increase due to the rise in use of portable devices like cell phones that access Internet of Things (IoT). This means that there is a need for designing a low-power computation unit. As a main component of digital processors, Arithmetic Logic Units (ALU) account for a major portion of system power consumption because they operate continuously throughout their operational life cycle. In addition to those reasons, this study proposed an energy efficient ALU as an example of an adaptive clock gating based on reducing switching activity that is not needed, therefore minimizing the amount of dynamic power consumption. The proposed design is developed in Verilog HDL at Register Transfer Level (RTL) and evaluated using standard Electronic Design Automation (EDA) tools via simulation. The fine grained adaptive clock gating concept allows for selective activation of ALU modules where operational requirement dictates. Performance metrics include power, delay, Power Delay Product (PDP), and energy measurements. Based on our results, the proposed adaptive ALU reduces the power from 52.30  $\mu$ W to 24.10  $\mu$ W for a 53.92% reduction of power, while the PDP has decreased from 109.83 pJ to 55.43 pJ. The delay increased slightly from 2.10 ns to 2.30 ns, however, the overall energy efficiency increased considerably demonstrating the effectiveness of the proposed solution.

**Keywords:** Adaptive Clock Gating, Low-Power VLSI Design, Arithmetic Logic Unit (ALU), Power Delay Product (PDP), Energy-Efficient Architectures.

Paper ID: 410

## Automated Forest Fire Detection And Alert System Using Smart IOT Technology

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**Abstract:** Forest fire leave lasting damage, altering ecosystems and disrupting communities. While satellites monitor rising heat from above, warnings often come too late, and on-site assessments remain slow. This account outlines the development, testing, and implementation of an early warning network designed to detect fires earlier, relay alerts faster, and initiate responses immediately. At the core component is an Arduino Uno R3, Combined with a three sensors for accurate detection: the DHT11 for humidity and temperature, the MQ2 sensor detect smoke particles, and an infrared sensor to spot flame presence. During operation, collected data passes through a two-step verification process that requires agreement among sensor signals before an alert is triggered. Once confirmed, warnings are sent instantly via SMS and automated voice calls, each including real-time accurate GPS location using a GSM 900A hardware module. Simultaneously, water pumps activate through relay circuits, helping suppress flames without delay. Data streams continuously to cloud storage using the ThingSpeak platform, enabling remote monitoring. All ten system tests were fully successful under integrated conditions. Alerts arrived in an average of under seven seconds, and cloud uploads succeeded 98.8% of the time. The response time from detection to pump activation was just 150 milliseconds. Constructing a single device costs around 2500 and 3,000 Indian rupees. Its low cost and modular design support broad deployment across farmland, forests, and other vulnerable natural areas.

**Keywords:** Forest Fire Detection; IoT-Based Monitoring System; Arduino Uno R3; Multi-Sensor Integration (DHT11, MQ2, IR Sensor); Real-Time Alert System (SMS & Voice Call); GSM Module (SIM900A) with GPS Tracking; Automated Fire Suppression System.

Paper ID: 411

## **A Study on Machine Learning and Explainable AI in Diabetes Prediction and Management**

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**Abstract:** Diabetes mellitus (DM) is a widespread metabolic illness. The International Diabetes Federation has predicted that the disease will affect 700 million individuals globally by 2045. The clinical burden of the disease is growing at an unsustainable rate with multiple AI-based predictive models demonstrating clinical promise, but few are actually being implemented in clinical practice. Machine learning has changed the landscape of diabetes prediction, and it is now possible to analyse heterogeneous clinical datasets at a scale that was previously not possible. This review summarizes data on datasets, algorithms, training protocols, and measures of evaluation to characterize the structural constraints to clinical translation. A Gradient-boosted model, Extreme Gradient Boosting (XGBoost) and an Adaptive Boosting model (AdaBoost), were found to work better on structured tabular data on the Pima Indians Diabetes Database (PIDD) and the Behavioural Risk Factor Surveillance System (BRFSS), whereas transformer architectures and Convolutional Neural Networks (CNNs) have become essential for Continuous Glucose Monitoring (CGM) timeseries analysis. Although the Sylhet EMR dataset was included only for context purposes and not evaluated with respect to the cross-dataset architectural conclusions. Taken together, these results affirm that the bottleneck in algorithmic performance is no longer the dominant one. The other obstacles are structural, and federated learning, structural causal modelling, and model distillation must take the forefront in the future to decrease the burden of this widespread disease in the world.

**Keywords:** Diabetes, Machine Learning, Explainable AI, Diabetes Prediction, Diabetes Management.

Paper ID: 421

## **A Comprehensive Review of Twitter-Based Sentiment Analysis During the COVID-19 Pandemic**

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**Abstract:** The COVID-19 pandemic is the catalyst that led to the greatest activity on social media, making Twitter an important source of information about the opinion of the masses, emotional reactions and the trends in behavior under the influence of the global crisis. With over 500 million tweets being posted every day, during the most critical stages of the pandemic, researchers had access to new corpus of real-world sentiment information never before. Lexicon-based, machine learning, deep learning, and transformer-based methods have been applied in the past to analyze COVID-19-related tweets in locations and languages. The paper provides a systematic review that synthesizes the data collection processes, pre-processing pipelines, sentiment classification processes, nation-specific sentiment trends, emotion and topic modelling insights, model performance comparisons, research limitations, and research gaps in Twitter-based COVID-19 sentiment analysis. Our review of over 30 peer-reviewed papers shows that transformer models, and more so BERT variants are never worse than traditional methods, and it has still much to offer in terms of multi-lingual analysis, real-time tracking, and epidemiological integration. The article is a well-structured information reservoir of the researchers and practitioners who intend to work on the domain of crisis-based social media analytics.

**Keywords:** Sentiment Analysis, Twitter, COVID-19, NLP, Machine Learning, Deep Learning, Transformers, BERT, Emo- tion Detection, Topic Modeling, Social Media Analytics.

Paper ID: 425

## Reliability-Aware Circuit Techniques

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**Abstract:** Memory has become an important part of modern computation. With increasing complexity of VLSI-based circuits, reliability, power efficiency and testability have become major issues. As semiconductor memories are scaled in density and speed, they become increasingly susceptible to stuck-at faults, transition faults, delay faults, address decoding, parity, read and write faults, and radiation-induced soft errors or single event upsets (SEUs). External memory testing methods are costly and time-consuming and cannot be fast enough for power-saving applications. Testing has become increasingly difficult as a result. In this work, a reliability-aware low-power memory testing architecture is proposed. The architecture consists of a Hamming Code and Clock Splitting Built-In Self-Test scheme (HCS-BIST). It is expected to include a clock-splitting logic based LFSR to reduce the switching activity, Hamming encoder and decoder to detect and correct errors, a BIST controller to enable synchronized operation and a memory under test framework to automatically diagnose and recover. The motivation of this architecture is to detect, locate the source of an error, and repair it automatically without any external intervention unlike conventional BIST architectures. The experimental results show that the HCS-BIST architecture achieves 99% fault coverage which is higher than the conventional LFSR and BS-LFSR BIST schemes. In addition, dynamic power, average test power, and area overhead are considerably reduced. Consequently the architecture can be used to build reliable, low-power and area efficient memories in modern VLSI.

**Keywords:** VLSI memory testing, HCS-BIST, low-power design, reliability-aware circuits, linear feedback shift register, Hamming code, single event upset, fault coverage.

Paper ID: 428

## An Explainable Artificial Intelligence Framework for Anomaly Detection in IoT Network Traffic

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**Abstract:** This work presents an end-to-end, reproducible framework for detection and interpretation of anomalous or malicious traffic in IoT networks using supervised machine learning combined with explainable artificial intelligence (XAI) techniques. We assemble a large partitioned CSV dataset containing 500,000 network flow records from the CICIOT23 benchmark, preprocess raw network flows, apply stratified sampling and synthetic minority over-sampling technique (SMOTE), and train a set of classical and ensemble classifiers including logistic regression, k-nearest neighbors (KNN), random forest, and XGBoost. The implementation emphasizes reproducibility through configurable presets, fixed random seeds, saved artifacts, and versioned experiment outputs. Feature selection is performed using recursive feature elimination (RFE), and both global and local explanations are produced using Shapley additive explanations (SHAP). We use standard classification metrics—accuracy, precision, recall, and F1-score—to evaluate the held-out test splits. Results demonstrate that XGBoost and Random Forest both achieve over 99.8% accuracy, while SHAP analysis identifies `rst_count` as the dominant discriminating feature with 83.8% importance. The 190-fold training-speed advantage of XGBoost over Random Forest and the ability to reduce features by 54.5% via RFE collectively establish this framework as a deployable, interpretable solution for heterogeneous IoT network security.

**Keywords:** Internet of Things, explainable AI, network security, machine learning, traffic classification, SHAP, anomaly detection.

Paper ID: 434

## Multimodal Meme Classification via Fusion of Visual and Textual Features

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**Abstract:** Multimodal meme understanding involves the joint modeling of visual information and text. This is particularly challenging in the presence of dataset shift, limited data and labeled data. In this paper, we introduce a simple framework for classifying memes that uses both visual and text information learned from a compact CNN image encoder and a bidirectional GRU-based text encoder. The experiments are carried out on a corpus of 15,492 samples aggregated from the Facebook Hateful Memes dataset and the Memotion dataset, which has been turned into a binary classification task. To improve the generalization capabilities, the training pipeline employs aggressive image augmentation, class weighting, and early stopping. Our model reaches a test accuracy of 84.81% with an AUC of 0.9047 while consuming only 222,657 parameters, showing that efficient fusion architectures can deliver high performance without resorting to large multimodal transformers. This paper is formatted according to IEEE conference paper guidelines, which include the absence of symbols and math in the abstract.

**Keywords:** Multimodal learning, meme classification, feature fusion, visual and textual features, convolutional neural networks, gated recurrent units.

Paper ID: 435

## Deep Learning Based Mobile Application for Plant Leaf Disease Detection and Classification

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**Abstract:** A Deep Learning method is proposed in this study to detect plant leaf disease using automation is possible. The automation is realized by the methods of deep learning with a multi-class scenario of classification. The base of the lightweight classification head is the application of EfficientNet-B0 in plant leaf image classification. The model trains end to end on 38 healthy and diseased leave types. The analysis is performed along the PlantVillage dataset that has 54,305 images split into train (70%), validation (15%), and test (15%). The use of class-weighted loss and a WeightedRandomSampler reduce the imbalance of classes. Strong performance is obtained through strong image augmentation based on Albumentations and efficiency is obtained through mixed-precision training. On 8,146 test images, the model achieved 99.59% of test accuracy and 0.9951 of macro-F1. Grad-CAM visualizations are used to increase interpretability.

**Keywords:** Plant disease detection, plant leaf classification, deep learning, convolutional neural networks, transfer learning, EfficientNet, class imbalance, Grad-CAM, PlantVillage.

Paper ID: 436

## Multi-Dataset YOLOv8 Framework for Object Detection in Autonomous Driving Scenarios

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**Abstract:** Object detection in autonomous vehicles requires high accuracy, efficiency, and robustness even in the presence of extreme variations in lighting conditions, weather, and complexity of the scene. This work introduces a multi-dataset YOLOv8 framework to enhance the generalization capability of traffic scene understanding by exploiting the complementary nature of available driving and traffic sign datasets. Our proposed framework includes dataset preparation, joint class mapping, data augmentation, and an efficient training strategy for the resource-limited GPU environment. The experiments are performed on a joint training setting constructed from the BDD100K and TT100K datasets to assess the detection performance on typical road users and traffic infrastructure entities. The performance of the model was estimated using standard detection metrics, achieving a high mean Average Precision (mAP), with a balanced F1-score resulting from strong precision and recall, as well as runtime performance. The proposed framework is intended to serve as a useful baseline for multi-dataset YOLOv8 training with a balance between accuracy and efficiency for autonomous driving applications.

**Keywords:** Object detection, small object detection, autonomous driving, multi-dataset learning, YOLOv8, traffic scenes.

Paper ID: 437

## Development of Energy Efficient and High Speed Vedic Multiplier using Enhanced Adder Structure for Next Generation Arithmetic Logic Unit Design

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**Abstract:** The need for optimized arithmetic units has been underscored by the escalating demand for high-speed and energy-efficient digital systems, particularly in the design of Arithmetic Logic Units (ALUs). This study presented a high-speed and low-power Vedic multiplier using an enhanced adder structure suitable for next-generation ALU applications. The proposed design is based on the Urdhva Tiryakbhyam algorithm, which allows parallel generation of partial products and thus reduces computational delay. A modular Vedic multiplier architecture is realized and merged with a hybrid enhanced adder to minimize carry propagation delay as well as switching activity. The entire design is described using Verilog HDL and synthesized in Xilinx Vivado for performance evaluation. Results show that the proposed design attains a delay of 24.8 ns at an operating power of 190 mW, which is better than conventional multipliers by about 45% in delay, 40% in power consumption, and up to 67% improvement in Power Delay Product (PDP). The enhanced hybrid adder reduces this further to 6.1 ns with lower power consumption; hence such an architecture becomes more appropriate when looking for high-performance energy-efficient ALU systems.

**Keywords:** Vedic Multiplier, Urdhva Tiryakbhyam, Enhanced Adder Structure, Low Power VLSI Design, Arithmetic Logic Unit (ALU).

Paper ID: 438

## **A Smart-Contract-Driven Framework for Secure Personal Banking on the Ethereum Blockchain**

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**Abstract:** Traditional banking infrastructures continue to rely on centralized servers and institutional control, resulting in operational limitations such as high fees, slow processing times, account restrictions, and vulnerability to single points of failure. This research proposes a decentralized banking system implemented using Ethereum smart contracts that allows individuals to perform core financial operations without intermediaries. The proposed system supports secure deposits, withdrawals, and balance inquiries using transparent, immutable, and autonomous blockchain mechanisms. Implemented in Solidity using the Hardhat development framework, the system undergoes extensive functional, performance, and security testing across more than one hundred simulated transactions. The system is designed not only for security and transparency but also to address financial inclusion challenges by reducing transaction costs and enabling access for underbanked users. Results confirm that the system achieves high reliability, strong attack resistance, low operational cost, and near-instant transaction finality. The study demonstrates that decentralized personal banking is feasible, efficient, and capable of addressing the shortcomings of traditional financial systems.

**Keywords:** Blockchain, Decentralized Banking, Smart Contracts, Ethereum, Security, Financial Inclusion.

Paper ID: 441

## **Review Paper on Drone detection using Acoustic signals**

Neelam Sharma, Mangal Das  
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**Abstract:** Wind turbines are a keystone of the global shift toward low carbon electricity though; wind turbines grow in size and move further offshore. To address these problems which introduce industry 4.0 utilizing drones (UAV) advanced sensors, and digital twins is transforming maintenance into a safer, data driven process. The main idea is simple: identifying deep defects by observing heat differences with an infrared camera. Detecting deep defects can be difficult, Interpreting thermography images can be tricky. Using LiDAR instead of a camera to create a 3D model of wind turbine blades + conducting safe autonomous inspection is possible (human control less), This is called a data-driven maintenance system. A virtual model of every turbine is created (real-time updated), Inspection data is continuously updated, Because of this: high-risk blades are identified, maintenance planning improves, future damage can be predicted. Long-term benefit Over time: huge data is collected. Digital twins of turbines integrate inspection data + SCADA + load + environment predict structural health + remaining useful life.

**Keywords:** component, formatting, style, styling, insert.

Paper ID: 442

## **A Machine Learning Framework for Stampede Prediction and Crowd Behavior Analysis with Explainable AI**

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**Abstract:** In environments with high density such as religious events, transport hubs and large gatherings, stampede events can cause many deaths. If stampede events could be predicted and analyzed early on, there could be less fatalities and better capability to respond to emergencies. This paper describes a proposal for using machine learning methods to detect the risk of a stampede using CSV structured data (from historical stampede incidents) for analysis. In particular, this study used the Human Stampedes dataset which contains information on stampedes in world history dating from 1800 to 2021. The study applied three different supervised machine learning models including Random Forest, XGBoost and Logistic Regression to classify the risk (or hazard) level of a crowd as part of the stampede detection process. In order to improve the interpretability and trust in the model results, the study also used Explainable Artificial Intelligence (XAI) techniques (SHAP, LIME) to develop an explanation for each model's prediction. The combination of predictive accuracy and transparency improves the success of the overall proposed model, and thus allows it to be used in smart surveillance systems.

**Keywords:** Stampede detection, crowd analysis, machine learning, explainable AI, SHAP, LIME, CSV dataset, public safety.

Paper ID: 443

## **DHRISHTI (Directional Hostile Reconnaissance & Interdiction)**

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**Abstract:** Smart homes and intelligent security systems have gradually emerged as a result of increasing risk of intrusion, damage, or unauthorized access to the residential as well as institutional environments. To overcome the challenges, this paper proposes a smart automation security system using ESP32 that combines motion sensors, environmental, real-time connectivity, as well as automatic notification for a holistic, economical, and effective surveillance system. The system applies PIR sensors, ultrasonic sensors, magnetic door sensors, as well as ESP32-CAM for smart movement detection, as well as image capture, that too only when required, significantly lowering energy as well as network costs. Since it operates with the microcontroller as its main part, decision-making, as well as sensor data integration, is locally performed, as well as it securely communicates with cloud services. Automated notification messages have been implemented for smartphones, allowing for immediate user action regardless of physical presence within the secure locations. Results have confirmed high accuracy, decreased false alarms, as well as significantly fast notification times. This research establishes the importance as well as importance of effective integration of IoT connectivity with affordable micro-controllers for developing a trustworthy, adaptable, as well as autonomous surveillance system for smart homes/offices for the coming years.

**Keywords:** ESP32-CAM; Microcontroller; Ultrasonic Sensors; PIR Sensors.

Paper ID: 445

**Study the characteristics of HgCdTe/PbS superlattice structure based infrared pin photodetector using machine learning-driven framework embedded with quantum phenomenon based drift diffusion framework**

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**Abstract:** In this paper, HgCdTe/PbS superlattice structure based infrared pin photo-detector has been reported with excellent photo-responsivity, detectivity efficiency. The quantum phenomenon based drift diffusion framework has been developed and validated for analysis the electrical as well as optical characteristics of the HgCdTe/PbS superlattice structure based infrared pin photo-detector. The impact of alternatively incorporated HgCdTe and PbS layers in the intrinsic or low doped n region has not been investigated previously in depth. In addition, the performance of the HgCdTe/PbS infrared pin photo-detector has been analyzed by using machine learning-driven framework embedded with quantum phenomenon based drift diffusion framework. The machine learning framework has been developed based on the regression model in Which test data set obtained from quantum phenomenon based drift diffusion framework and training data set obtained from the reported experimental result to calculate the performance of the HgCdTe/PbS super-lattice photodetector. The performance of the designed HgCdTe/PbS superlattice photo-detector has been compared with its flat structure based Si pin photo-detector. It has been observed that the performance of HgCdTe/PbS super-lattice photo- detector is significantly highly compared to flat structure based Si pin photo-detector in infrared wavelength region.

**Keywords:** HgCdTe/PbS superlattice structure; machine learning-driven framework; quantum phenomenon based drift diffusion framework; Machine Learning Approach (M-L-A), regression model; Noise-factor; detectivity.

Paper ID: 448

## Fingerprint Scanner Recognition System using Arduino

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**Abstract:** Biometric recognition has emerged as a reliable method for enhancing security in modern digital and physical systems. Authentication using fingerprints has emerged as a reliable method for enhancing security in modern digital and physical systems. The Arduino Uno microcontroller, Arduino IDE, and GT521-F32 fingerprint sensor module were used to create fingerprint recognition system presented in this paper. The design architecture, system workflow, and hardware as well as software integration were all reviewed in this paper. Additionally reviewed were the system's accuracy, cost-efficiency, and real-time performance. The review also discusses major challenges, such as insufficient storage capacity, sensitivity to the environment and security vulnerabilities. Additionally, the most recent developments in the field—such as IoT-based authentication and intelligent biometric systems—are discussed to outline the advancements that will be made in the future. The findings suggest that Arduino-based fingerprint recognition systems are a feasible and cost-effective option for small to medium-scale security systems, with potential for improvements in scalability and robustness.

**Keywords:** Fingerprint Recognition, Biometric Authentication, Arduino Uno, GT521-F32 Sensor, Embedded Systems and IoT-Based Authentication.

Paper ID: 454

## Design and Implementation of a TinyML-Based Assistive Communication System

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**Abstract:** Effective communication can be difficult for those with hearing or speech impairments, especially when speaking to people who can hear. Previous gesture-based communication systems have only allowed for one-way communication and did not provide intelligent gesture interpretation. This project proposes a low-cost, portable bidirectional assistive communication system that can provide both sides of the conversation between a user who can hear and a user with impairments using a glove-based controller (with Flex Sensor MPU6050 sensor) that tracks finger motion and direction. An ESP32 microcontroller will process the Flex and MPU6050 sensor data in real-time to provide gesture recognition using a lightweight TinyML-based model. The system will also use vibration motors and LED lights to provide tactile as well as visual feedback to users with impairments. Overall, this portable and low-power system can be used for everyday activities. Based on experimental results from the TinyML model, we expect the gesture recognition accuracy to 93.5% demonstrating that this is a viable solution to the stated problem.

**Keywords:** Assistive Communication, Smart Glove, Gesture Recognition, TinyML, ESP32, Hearing and Speech Impairment, Wearable System.

Paper ID: 309

## **A Microstrip Patch Antenna for Breast Cancer Detection using Confocal Microwaves Imaging**

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**Abstract:** In this paper, UWB band microstrip patch antenna has been designed to detect an early stage of breast cancer detection by using confocal microwaves imaging technique. A patch antenna should be fabricated over FR-4 substrate, with dimensions of 22× 30 mm, having hexagonal circular patch with defected ground structure. The antenna has designed to achieved a moderate peak gain of 2.6 dBi with average depth of -55 dB return loss at resonating frequency of 4.4 GHz. Antenna resonating at sharp 4.4 GHz with proper matching impedance with high efficiency of 90% to penetrate the waves deep inside the breast to detect the correct location of cancer cell with high accuracy while maintaining low system complexity and cost. The UWB microstrip antenna are placed Infront of the breast model to transmit the EM waves and receive the scattered waves from tumour cell which having high dielectric property to absorbed the more energy than healthy cell. Finally, the scattered waves collected and proceed to Confocal Microwaves Imaging technique in MATLAB to regenerate the high resolution 2D image by using Delay-and-Sum Beamforming algorithm which represent the tumour position deep inside the breast. The regenerated image shows the high intensity of energy showing the more absorption of energy by tumour cell.

**Keywords:** Microstrip Patch Antenna, Breast phantom model, Confocal Microwave Imaging, MATLAB, -CST.

Paper ID: 446

## **A Secure and Communication-Efficient IoT Data Aggregation Scheme Using BLS Aggregate Signatures and Paillier Encryption**

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**Abstract:** The rapid expansion of Internet of Things (IoT) networks demands efficient data processing mechanisms. Security-based data aggregation is one of the effective mechanisms for processing and aggregating IoT data. Existing data aggregation mechanisms have their own merits and demerits. This paper proposes a security-based data aggregation scheme by integrating the Paillier cryptosystem and BLS (Boneh–Lynn–Shacham) aggregate signatures, along with nonce-based replay protection. The proposed scheme aims to minimize communication cost in IoT networks. Simulation results show that the proposed scheme outperforms existing approaches and improves the efficiency and performance of the security-based aggregation mechanism.

**Keywords:** IoT Security, BLS Signature, Paillier Encryption, Data aggregation.

Paper ID: 447

## **Automated Tic-Tac-Toe Board State Recognition Using Ensemble Transfer Learning on Synthetically Generated Image Data**

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**Abstract:** Automated recognition of game board states from visual images is a structured multi-label classification problem that involves simultaneous identification of multiple spatial regions in a single image. This paper proposes a deep learning model architecture for the automated recognition of Tic-Tac-Toe game board states, where each cell of a 3x3 grid needs to be classified independently as either containing an X mark, an O mark, or being empty. A high-fidelity synthetic dataset of 16,000 images at 224x224 pixel resolution was procedurally generated from 4,000 distinct game board states, simulating realistic visual variations such as perspective distortion, radial lighting gradients, handwritten stroke simulation, and Gaussian noise to reduce the domain gap between real-world and synthetic visual data. Three pre-trained convolutional neural networks, namely EfficientNet-B2, ResNet50, and DenseNet121, were fine-tuned independently using transfer learning with a custom multi-layer classification head to predict the probabilities of per-cell states. A performance-weighted ensemble method was used, assigning weights of 0.631, 0.091, and 0.278 to EfficientNet-B2, ResNet50, and DenseNet121 models respectively, based on validation board accuracy. Training was performed using mixed-precision optimization, label smoothing, and early stopping to prevent overfitting. Experimental results on a test set of 2,000 examples showed a cell accuracy of 94.26 percent and board accuracy of 70.20 percent without Test-Time Augmentation. EfficientNet-B2 showed the best individual cell accuracy of 94.81 percent and board accuracy of 75.10 percent. The results show that light-weight efficient models with synthetic augmentation pipelines are appropriate for structured game board recognition problems, but the board accuracy of ensembles is limited by the multiplicative effect of per-cell error propagation.

**Keywords:** Transfer learning, convolutional neural network, board state recognition, ensemble learning, synthetic dataset generation, EfficientNet, image classification, computer vision.

## **Online Papers**

Paper ID: 33

### **Intelligent Password Strength Prediction and Enhancement using AI**

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**Abstract:** Password authentication is among the simplest and mostly insecure methods of user data protection in the digital age. Conventional password strength meters are based on the fixed rule based heuristics like length or combination of characters which in most cases do not reflect the actual password security and user behaviors in the real world. The proposed study presents a smart password strength estimation and improvement system based on Artificial Intelligence (AI) and Machine Learning (ML). The suggested system uses data-based models that have been trained on vast password samples to acquire multifaceted patterns that affect password strength such as semantic and contextual information. Using a hybrid AI model with features based classification and deep learning, the system actively assesses password strength and anticipates weaknesses to attacks, including brute force and dictionary based attacks. Moreover, another adaptive enhancement module proposes more robust alternatives by coming up with human-generated alternatives. Accessible but safe passwords with the principles of generative AI. The experiment shows a substantial change in the accuracy of prediction and compliance under the use of the traditional strength meters. The proposed research will add to the development of smart cybersecurity, as it combines the explainable AI method of evaluating passwords explicitly and encourages a preventive attitude toward online safety. The flexibility of the proposed model makes it applicable in terms of integration to the current authentication systems to improve user experience and system resiliency.

Paper ID: 34

### **Intelligent Detection And Prevention Of Brute-Force Attacks Using Machine Learning**

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**Abstract:** Brute-force attacks are the most common type of attacks to gain unauthorized access. The use of some of the most common brute-forcing tools include “Hydra”, “John the Ripper”, “Hashcat” and “Aircrack-ng”. These are some automated tools that are used nowadays to crack username and password through continuous attempt to guess the credentials using a file which is called a wordlist. A wordlist contains all the possible list of words and combination of letters, numbers or characters that could be the username or password. The traditional way of rate-limiting or account lockout policy are mostly futile against new technological advancements of Brute Force attacks that closely imitate legitimate user conduct. This research proposes a Brute-force Prevention Framework that uses intelligent Machine-Learning to learn from mistakes. It uses authentication logs and typical user conduct to differentiate between a legitimate user and an intruder who is trying to brute-force credentials to gain unauthorized access. It uses the mechanism of differentiating through different factors that include number of failed attempts, time interval between attempts, IP address and session behaviour. After experimental analysis, we found out that machine learning models keep improving their detection accuracy to the point where the chances of trespassing become minimal. This project provides an intelligent and adaptive solution for securing systems against these types of attack.

**Keywords:** Brute-force attacks, Machine Learning, Authentication Security, Intrusion Detection.

Paper ID: 43

### **Web App for Personalized News Recommendation**

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**Abstract:** The sheer amount of digital news that is generated on a daily basis has presented a consistent dilemma to the readers: how to sort out the really relevant content amongst the wastage that the randomly generated headline conveys. Traditional platforms usually tend to use fixed categories or trends around the world and neglect the fact that the interest of individuals may change through time. This study reports on the design of a high-performance web application that is based on a hybrid recommendation architecture to eliminate this gap. What we have built is a hybrid approach of content based filtering with in-the-moment behavioral analytics using implicit measures like click patterns and time to read in order to keep user profiling up to date dynamically. Technically, the engine uses TF-IDF to create semantic associations between article metadata and individual user queries as well as Cosine Similarity. We have deployed the platform with a current full-stack solution, including a React/Next.js frontend, which will be responsive, and a data processing back-end based on the Django framework, which will be scalable and secure. According to experimental studies, this multilayered approach supports more than 90 percent in the content relevance which is much higher in comparison to the traditional and inert delivery methods and the problem of cold start is fairly reduced with new users of the system.

Paper ID: 47

### **AI-Powered Freshwater Fish Disease Detection Using MobileNetV2 and Grad-CAM**

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**Abstract:** Aquaculture is significantly contributing to the food security of many nations, but is facing a number of challenges, of which timely identification and diagnosis of fish diseases are of primary importance. The main goal of this paper is to develop an easy-to-use, deep learning-based automatic system for the detection of fish diseases and provide recommendations based on AI-driven intelligence. We present a health-detection framework using the MobileNetV2 architecture with transfer learning to classify freshwater fish from images. The results can also be visually interpreted by Grad-CAM to find the image regions that are most affected by disease and drive the model's predictions, making it more explainable and reliable. A carefully curated dataset for freshwater fish diseases is utilized for training and evaluation, striking a balance between state-of-the-art classification performance and computation efficiency.. To enable practical deployment for both image- based and real-time camera-based disease detection, the model is deployed with TensorFlow Lite and integrated into a web application. Experimental results show that the proposed system provides accurate predictions along with interpretable visual explanations and low-latency inference that is suitable for real-world aquaculture. In summary, this work presents a scalable, interpretable, intelligent, and deployable fish health monitoring system.

**Keywords:** Fish Disease Detection, Aquaculture Monitoring, Deep Learning, MobileNetV2, Transfer Learning, Explainable Artificial Intelligence, Grad-CAM, Computer Vision, Real-Time Image Analysis, Web-Based Deployment.

Paper ID: 48

## **Agentic AI System for Integrated Tax Planning, Portfolio Optimization, and IPO Forecasting**

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**Abstract:** The financial technology sector is characterized by rapid changes and the application of artificial intelligence (AI) in taxation and investment planning becomes one of the inevitable requirements for data-driven decision-making. The present work introduces a Multi-AI Agent System with an ambition to completely automate and also optimize the four interlinked applications: tax computation, portfolio management, IPO forecasting, and mutual fund analytics. The system's nucleus is a Tax Optimization Agent that employs a convex optimization technique to extract the maximum portfolio returns after tax to the fullest allowed by the rules and regulations. The other agents through reinforcement learning construct the evolving portfolios, apply the hybrid LSTM-Transformer models for the IPO profit estimation, and utilize the time-series forecasting and clustering techniques for mutual funds evaluation. For interaction among the agents, a common knowledge base is available and a Bayesian fusion mechanism is employed to coordinate them which integrates the forecasts and maintains the uniformity of the financial strategies. In addition, Explainable AI (XAI) techniques, such as SHAP-based interpretability, assist in the transparency and accountability of the automated decisions. The architecture is implemented using Dockerized microservices on Kubernetes and Grafana dashboards are serving for real-time visualization. The experimental evaluation demonstrates the ability of the system to reduce effective tax rates, improve risk-adjusted returns, and provide clear insights to both investors and financial advisors. Consequently, this structure proves to be a scalable, explainable, and regulation-compliant framework for the next-generation financial advisory systems.

**Keywords:** Tax Optimization, Portfolio Management, Convex Optimization, Reinforcement Learning, IPO Forecasting, Grey Market Premium, Mutual Fund Analytics, Explainable AI, Fin-Tech, SEBI Regulations.

Paper ID: 53

## **Implementation of XAI for Object Detection in Pre-Trained ML Models for Traffic Management System**

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**Abstract:** Deep learning-based models particularly YOLOv11 produced tremendous improvements in object detection capabilities however they still face difficulties in realworld applications especially in traffic management systems. Such issues as misclassification together with non-detection remain active challenges for real-world implementations particularly within traffic management systems. These opaque models constitute a barrier for efficient diagnosis and optimization efforts by making them difficult to enhance detection accuracy. Explainable Artificial Intelligence (XAI) establishes itself as the solution to address this issue. The enhanced interpretability of models allows developers to locate sources of errors together with the opportunity to improve feature extraction and refine processes. and enhance dataset quality. A study examines the effects XAI brings to object detection through failure case investigations. XAI focuses on analyzing situations where both vehicle misidentification occurs and instances of non-detection exist. A greater transparency level remains necessary for model applications because it enables improved detection abilities. The model requires better decision-making transparency to enable more efficient debugging operations and better reliability results. Through advanced error XAI allows professionals to connect computer model outcomes to actual field requirements through analytical tools and data processing protocols requirements. AI object detection systems become more reliable when XAI algorithms merge with their framework. trustworthy, ensuring better accuracy and transparency in applications such as traffic management and surveillance. The results highlight ongoing model development as well as alternative architectural examination as vital methods for performance enhancement. The performance of object detection requires additional investigation of alternative architecture types such as Faster RCNN and SSD.

**Keywords:** Explainable Artificial Intelligence (XAI), Traffic Management System, YOLOv11, Deep Learning, CNN.

Paper ID: 94

### **Design and Implementation of consistent Key-Value store based on modified chain replication protocol**

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**Abstract:** Modern distributed applications rely on replicated key-value stores to provide low-latency access, durability, and fault tolerance under failures. Designing such systems requires balancing consistency guarantees with availability and performance, particularly in the presence of node crashes and reconfiguration. This paper presents the design and implementation of a consistent key-value store based on a modified chain replication protocol. The system ensures strong consistency and durability while remaining available as long as a majority of replicas are operational. We describe the client-server protocol, failure handling mechanisms, and persistent storage design, and evaluate the system under a range of workloads. Experimental results demonstrate predictable performance across varying key-value sizes, client counts, and read-write mixes, while preserving correctness under failures.

Paper ID: 125

### **Multi-Modal Phishing Detection System Using Text, URL and Image Analysis with Admin-User Dashboard**

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**Abstract:** Phishing websites are taking the form of multimodal threats which integrate bad URLs, spam email messages, altered images, and hacked attachments hence rendering the traditional one-layered detection a futile exercise. This paper suggests a multi-mode phishing detection system with structural validation, machine learning, and generative AI. The system validates DNS and database before the classification is done using some engineered features of the URLs, email, files, and images which is then done by the random forest. Screenshot-based phishing uses OCR to improve contextual reading and minimize false positives, whereas generative AI can be used to improve the context of phishing. The system has an overall accuracy of 97% of detection modules and is implemented with a MERN architecture and with secure APIs and a monitoring dashboard.

**Keywords:** Phishing Detection, Multi-Modal Security, Random Forest, Natural Language Processing, Optical Character Recognition (OCR), Generative Artificial Intelligence, DNS Validation, Cybersecurity Analytics, Threat Monitoring Dashboard.

Paper ID: 126

## **Analysis and Fault Recovery in Wireless Communication Networks using HSRP Redundancy**

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**Abstract:** In contemporary wireless communication infrastructures, overall network dependability is frequently limited by weaknesses in the wired backbone rather than the wireless access layer itself. One of the most significant challenges in such systems is the presence of a Single Point of Failure (SPOF), where the failure of a gateway router can disrupt connectivity for all connected wireless devices. This work explores the deployment of the Hot Standby Router Protocol (HSRP) in a redundant Diamond topology to mitigate gateway-level failures. A missioncritical wireless-to-cloud access environment is modeled using Cisco Packet Tracer to analyze network behavior under fault conditions. The performance of a conventional single-gateway architecture is compared with an HSRP-enabled high-availability design. Simulation results indicate that the non-redundant configuration suffers complete packet loss during gateway failure, whereas the proposed redundant architecture maintains connectivity through rapid failover with negligible convergence delay. The study demonstrates that HSRP-based redundancy substantially improves fault tolerance and ensures uninterrupted service in wireless-to-cloud communication networks.

**Keywords:** Single Point of Failure (SPOF), Hot Standby Router Protocol (HSRP), High Availability, Network Resilience, Wireless Communication Systems, Redundant Gateway Architecture.

Paper ID: 151

## **A Machine Learning-Based Weather Forecasting Integrated with AI Chatbot for Smart Agriculture**

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**Abstract:** The demand of agriculture has high province on weather prediction which embosses challenges to yield production. This research proposes a machine learning-based weather forecasting integrated with AI chatbot for smart agriculture using XGBoost and Long Short-Term Memory (LSTM) models. XGBoost is a nonlinear gradient boosting technique which reduces the complexity of nonlinear relationships in historical climatic data. This also provides a highly accurate short-term and mid-term weather predictions. LSTM Model Networks helps to understand the model temporal sequences which are mainly applied to find the long-term dependencies in collecting weather data which includes rainfall, temperature, humidity, etc.. The Integrated AI chatbot will deliver the best actionable insights practices to farmers which helps them as a real-time personalized supports to increase their crop productivity. This System includes irrigation scheduling, crop management, harvesting plans minimizing yield losses, fertilizer usage and resource utilization. The research proposed framework not only provides the weather prediction result along with it will suggest the best practices to farmers for their crop yield production. Experimental Analysis striates that the hybrid XGBoost-LSTM model has high proficiency in the outperforms traditional statistical approaches and single-model approaches, also helps in achieving higher prediction accuracy, weather determination and reduced climate forecasting error.

**Keywords:** Plant Disease Detection, Precision Agriculture, Chatbot Integration, Deep Learning, Sustainable Farming.

Paper ID: 161

## Progressive Web App For Online Learning

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**Abstract:** To create a different online learning experience, I created an AI-based Progressive Web Application instead of using an LMS, which is Traditional Learning Management Systems. Combining these two aspects, an AI powered Progressive Web Application could revolutionize the way people learn on the internet. Because it has the ability to send push notifications, as well as running machine learning continua through the application itself, it has improved the way a user is able to search for information. I built this system using several tools and frameworks, including React.js, Node.js, Firebase, and Gemini API for real time, AI driven, voice activated searching of information, and machine learning elements built into the program based on user interactions with the program and presenting educational content based on user interest. A user study I conducted demonstrated that the combination of AI with PWA technology increases the accessibility of learning experiences while providing a user experience that is more engaging with users quickly becoming addicted to it, and exponential growth of interest from users in the content they are looking for based on responses and effectiveness of the application. My voice query responses are at a very good accuracy rate.

**Keywords:** Artificial Intelligence, Progressive Web Application (PWA), Voiced Based Searching, E-Learning.

Paper ID: 162

## Blockchain-Based Decentralized File Sharing System

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**Abstract:** The digital platforms have brought a revolution to the way information is stored and shared. But the websites have revealed the weaknesses which it possesses in the old traditional, centralised kind of storage. All the recent news about privacy invasion, manipulations of data, server failures, and a single source of control over the key data to a user has raised the possibility of more demands towards other alternatives that resulted in the emergence of Blockchain and the Inter Planetary File System (IPFS). These technologies are decentralising trust and storage, which is to allocate the trust and storage in multiple nodes. Blockchain is intended to ensure a standardized path of the impartial history of transactions that cannot be changed; whereas the IPFS offers a more prosperous procedure of allocating files by offering the user the capability to relate the files through content addressing. Consequently, this paper is the proposal of the synergistic model of Blockchain and IPFS deploying Smart Contracts to be able to verify the level of user access, control the Metadata affixed to files, and also make interactions super-resistant to tampering. The proposed Hybrid framework is better in terms of integrating the data integrity, less dependency on centralised servers or more resilience in relation to unauthorised entry to the data store of vital information or system malfunction. Whereas latency when using decentralised peer-to-peer networks may be a bit higher than when making use of the conventional centralised servers, the decentralised networks are more transparent, verifiable and secure when storing data over the long run. The Hybrid Blockchain-IPFS model proves that new emerging modern applications that need reliable censorship-resistant and secure sharing of files can use the decentralised storage.

**Keywords:** Blockchain, InterPlanetary File System (IPFS), Decentralized Storage, Censorship-Resistant Storage, Decentralized Applications (DApps).

Paper ID: 165

## **Enhanced AutoGen-Driven Intelligent Agent architecture with MCP Tooling based on Google Gemini 1.5**

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**Abstract:** The given paper was dedicated to the design, implementation and evaluation of the AutoGen-driven intelligent agent framework based on Google Gemini 1.5 Pro as the backbone, and the use of 5 Model Context Protocol (MCP) tools, i.e., Tavily web search, Gmail automation, Google Sheets data access, a weather API and a dictionary tool. The suggested system exploits the multi-agent orchestration in AutoGen to plan group, delegate and perform complex user activities that entangle the interaction of multi-tool in the real world. It takes the intellectual computer capable of receiving one-million-token context windows and complex multi-modal reasoning to achieve something coherent and contextual, Google Gemini 1.5. The framework also offers the assistance of the automated delivery of emails to contacts established in Google sheets that allows the end-to-end communication process to be automated. The 950 various user queries are experimentally tested and demonstrate the mean task completion rate of 96.4 percent and an average response time of 1.8 seconds, which is superior to LangChain+GPT-4, CrewAI, BabyAGI or AutoGPT. MCP integration methodology and benchmarks, as well as architecture is provided in a fine detail.

**Keywords:** Google Gemini 1.5; Multiagent Systems; Model context Protocol; Agentic AI; LLM Tool Integration; Gmail Automation.

Paper ID: 170

## **Comparative Power–Delay–HSNM Analysis of a 7T SRAM Cell at 45 nm, 32 nm, and 22 nm**

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**Abstract:** This paper described the performance analysis of a low-power 7T single ended SRAM cell at the technology nodes of 45 nm, 32 nm, and 22 nm. The best result of power dissipation is obtained at the technology node of the 32 nm process for the single ended 7T SRAM cell, where the powers of Write-1, Write0, Read-1, and Read-0 operations are measured as 0.4523, 0.778, 0.259, and 0.418, respectively. Additionally, this cell shows better delay performance at the technology node of the 32 nm process, where the Write-1, Write-0, and Read-0 delay times are measured as 18.13 ps, 14.7 ps, and 15.6 ps, respectively, to enable the memory access process faster. Moreover, the single ended 7T SRAM cell shows the highest noise margin at the technology node of the 32 nm process compared to the other two processes, where the highest noise margin value measured at the technology node of the process is 0.32807 V, as opposed to values of 0.30184 V and 0.26861 V at the technology nodes of the other two processes, respectively.

**Keywords:** Single ended, SRAM, low power.

Paper ID: 177

## Process Corner Analysis Of A Single-Ended 7T SRAM Cell At 32 Nm Technology Node

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**Abstract:** The Static Random Access Memory (SRAM) forms a crucial integrant in embedded systems. Demand for reduced power consumption has made single-ended SRAM bit-cells extremely popular. For enhanced performance of the SRAM bit-cells, the technology node scaling is prevalent to obtain increased transistor density. However, as a consequence the bit-cell undergoes various process-voltage-temperature variations are introduced during the fabrications process. Therefore, the paper studies a single-ended 7 transistor SRAM bit-cell that undergoes Monte Carlo simulations at 0.5V VDD at various process corners to measure its read and write stability and to conclude the best and worst performing corner of the bit-cell.

**Keywords:** SRAM cell, process corner, Monte Carlo.

Paper ID: 178

## Explainable Machine Learning Framework for Breast Cancer Diagnosis Using SHAP-Based Feature Attribution

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**Abstract:** Breast cancer continues to be among the leading causes of death for women; thus, early detection is critical. I applied three machine-learning classification algorithms, Logistic Regression, Support Vector Machine (SVM), and Random Forest, to classify tumors as either benign or malignant using a common dataset for breast cancer, the Breast Cancer Wisconsin (Diagnostic) dataset. All three algorithms performed remarkably well, demonstrating how effective classic machine-learning methods can be when used to analyze structured biomedical data. The goal is not only to predict correctly, but to also gain insight into why each algorithm provided its prediction. By using SHAP (SHapley Additive exPlanations), we can analyze the reasons for classification both globally and for particular patients. When examining global SHAP results, features associated with tumor boundary irregularity (e.g., concave points, concavity, worst radius, and worst area), were among the best predictor features across every model. At the patient level, local explanation showed how each feature impacted the overall predicted outcome either positively or negatively. Significantly, the features identified via the model were consistent with what pathologists look for in a malignant tumor and align with actual medical knowledge. The bottom line here is that combining highly effective Machine Learning(ML) algorithms with Explainable Artificial Intelligence (XAI) tools like SHAP provides more accurate predictions and enables physicians to make more informed decisions based on transparent and reliable XAI tools. This type of methodology will create more trustworthy AI systems related to clinical diagnosis.

**Keywords:** Artificial Intelligence, Machine Learning, Explainable AI, Support Vector Machine.

Paper ID: 181

## **Impact of Phase Jitter on the Design and Reliability of Mixed THz–RF Systems for 6G Networks**

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**Abstract:** A majority of experts agree that THz (terahertz) communication will be a primary enabler for 6G (sixth generation) wireless networks due to both its ample spectrum resources and enormous capacity potential. Nevertheless, reliable performance evaluations of THz systems require precise modelling of both channel fading and phase-based uncertainties. In general, traditional methods for deriving symbol error rates (SERs) assume either that there is perfect phase alignment or use simple approximations that ignore the statistical fluctuations of phase. Recent studies have found that including a probability density function of the phase jitter into the derivation of the SER results in substantially better analytical accuracy and more reliable predictions. In this paper, a general theoretical analysis of phase-jitter- based SER modelling for THz and mixed THz/RF communication systems will be outlined. This effort adds to the analytical framework presented by [1], extends the previous modelling to include THz-related issues, and provides a general discussion on phase-aware detection, enhanced statistical reliability by making use of phase-based measures, and performance scaling with respect to the SNR (signal-to-noise ratio). Additionally, we will include comparison tables illustrating that the use of phase-jitter- based modelling provides a consistent SER improvement over traditional methods. Results indicate that incorporating statistical phase-aware modelling will yield improved analytical accuracy, enable a lower SNR to meet target reliability levels, and provide a basis for optimising future 6G networks.

**Keywords:** Terahertz communication, Phase Jitter, SNR, SER.

Paper ID: 186

## **A Comprehensive Review of Deep Learning Techniques for Tracking and Nowcasting Severe Convective Storms**

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**Abstract:** Meteorologists are faced with the challenges of rapid changes in space and time, interactions across different scales, and the uncertainty of observations when predicting and tracking severe convective storms. This review is a synthesis of advances in classical machine learning and cutting-edge deep learning approaches to the use of radar, satellite, lightning, and reanalysis data for storm detection, tracking, and nowcasting. We outline the methodological families that are being used, from spatiotemporal recurrent networks and ConvLSTM variants that map the movement of storms and their intricate local structures to encoder-decoder and U-Net frameworks that learn to predict pixel-by-pixel changes. PredRNN, self-attention, and transformer variants improve long-range spatio-temporal coherence; generative adversarial and diffusion methods give a sharper and more realistic image; and Fourier and graph methods allow for extremely high-speed, high-resolution global forecasts. We discuss how fusing multiple types of sensors, physical information loss functions, and hybrid systems overcomes real-world problems. When it comes to testing, we cover the evaluation methods, test data, and scorecards CSI, ROC, MSSIM, and object-based metrics and are seeing new uses of climate-shift resilient tests. A problem that still needs to be addressed is calibrating, explaining the results, guaranteeing accuracy for extreme events and managing computing requirements. We call for the top priority of research to be uncertainty quantification, real-time fusion of various sensors, universal test scores and humans being involved in the decision-making process. Deep learning has given a huge boost to short-term storm predictions and tracking, but if we want to have 100% confidence in the accuracy of our nowcasts, we'll need to focus on physical plausibility, monitoring of rare events, and a team effort between AI experts and forecasters.

**Keywords:** Deep learning, Machine learning, Convective storms, Severe weather forecasting, Storm tracking, Nowcasting, Radar echo extrapolation, Satellite-based prediction, Spatiotemporal modeling, ConvLSTM, PredRNN, Transformer models, Diffusion models, Multi-sensor fusion, meteorology.

Paper ID: 197

## **Real-Time Assistive Navigation Using an Edge-Optimized Transformer-Based Detection Framework**

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**Abstract:** Reliable perception capabilities are essential for assistive navigation systems for the visually impaired, which must operate within the constraints of computing and energy limits of edge devices. On low-power embedded platforms, the proposed study aims to implement an object identification framework that is based on edge optimization of transformers. This framework would allow for real-time navigation aid. This study proposes an architecture that efficiently captures local characteristics and global contextual information by integrating a reduced transformer encoder with a lightweight convolutional backbone. Structured pruning and low-precision inference are examples of model-level optimization that drastically cut down on memory usage and computational overhead, allowing for steady real-time performance. To improve domain relevance, training was carried out utilizing a two-stage approach that mixed a task-specific assistive navigation dataset with largescale benchmark data (MS COCO dataset). Further enhancement in visual conditions, a multimodal sensing using ultrasonic distance estimation is needed to include. The final result of the work shows the optimized transformer framework with good comparison between the latency, detection accuracy, and resource consumption, which shows a suitable model for deployment on the continuous edge. Moreover, considering efficiency aware transformer models shows scalable assisted navigation systems which also boosts autonomous movement.

**Keywords:** Edge Computing, Transformer-Based Object, Detection, Assistive Navigation, Real-Time Inference, Embedded Systems

Paper ID: 203

## **Machine Learning-Based Leak Detection and Modeling for Intelligent Water Distribution Networks**

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**Abstract:** The pipe leakages are a major challenge for utilities worldwide, leading to significant economic losses and water scarcity. With increasing demand for freshwater, it becomes essential to monitor and manage the water supply network for anomalies such as leaks or contamination during water transmission to different areas or zones. Traditional approaches include using thermal infrared (IR) cameras to analyze leaky zones, using ultrasonic sensors at both ends, or using a Geophone to measure ground-motion sound. With advances in AI and IoT, water monitoring can be made manageable, innovative, and smart. In this paper, a real-time leak-detection framework for a water pipe network is presented for the future with the use of the Internet of Things. Previous researchers have applied Support Vector Machines, Random Forests, Decision Trees, and XGBoost, as well as Artificial Neural Networks and Convolutional Neural Networks [1], [2], achieving accuracies of 97-99%. We also evaluated leak-detection performance using Regression, achieving 99.25% accuracy. With a Convolutional neural network, the results are 99.7%. The dataset is applied to the water leak dataset to investigate the effects of various parameters on water supply pipelines. In this paper, the leak model is analyzed, and the results are compared with those of the previous model.

**Keywords:** Leak Detection, leak localization, Water distribution networks (WDN), Artificial intelligence, Support vector machine, Convolution Neural network, Random Forest, Linear and logistic regression.

Paper ID: 204

## Law Enforcement Digital Evidence Tamper Detector

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**Abstract:** In criminal investigation, today, digital images are significant; however, they are manipulable by using sophisticated editing software, and it is challenging to detect the manipulation. Traditional forensic methods mainly rely on hash algorithms to check for tampering. However, these tools are not able to detect advanced tampering techniques such as copy-move attacks and metadata manipulation. This research proposes a hybrid model that combines different techniques to detect tampering, including cryptographic verification, error level analysis, metadata analysis, and deep learning classification. The system combines the results from all these methods using a Weighted Confidence Scoring System, which calculates a final tampering probability score. Moreover, it includes an immutable Chain-of-Custody Logging System to provide forensic traceability, addressing important gaps in modern judicial documentation requirements.

**Keywords:** Digital Forensics, Image Tampering, Law Enforcement, Deep Learning, Chain-of-Custody, Cryptography.

Paper ID: 223

## A Multi-Modal Semantic Similarity Approach for Automated Assessment

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Kuntal Roy, Pritam Das, Sudipta Basu Pal  
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**Abstract:** In the continually evolving landscape of higher education, the integration of artificial intelligence (AI) into assessment methodologies presents a promising solution for grading systems. But the increasing need to create an effective assessment measure free from bias has identified challenges with traditional manual marking methodologies, particularly with subjective questions with open-ended replies. The current research aims at creating A generative AI-based framework that could efficiently automate the process of assessment while providing valuable feedback to students. This method uses various sophisticated natural language processing technologies. Other language processing methods, along with GPT-4, can be used in conjunction with semantic similarity analysis approaches like SBERT to analyse student replies, assign grades, and provide feedback appropriately. Moreover, for students using the system through hand-written replies, an Optical Character Recognition (OCR) facility would be added to convert the student reply in an easily readable form for further analysis as required. It has been identified through experimental analysis that this approach has been successful in achieving an over 90% agreement with expert-grade replies. It has also been successful in reducing processing time, which indicates potential efficiency using this method. By introducing advanced machine learning algorithms and natural language processing techniques, the authors' proposed methodology automates the grading process with high objectivity, reliability, and scalability in assessments.

**Keywords:** Automated Answer Grading, Natural Language Processing (NLP), Artificial Intelligence, Automated Essay Scoring, Optical Character Recognition (OCR), Explainable AI in Assessment, Feedback Generation Systems, Machine Learning in Education, Semantic Similarity Modeling, Transformer-based Models, Sentence-BERT (SBERT), CodeBERT, Educational Assessment Automation

Paper ID: 224

## Luminary X- A Skill Based Career Growth Platform

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**Abstract:** Luminary X is created on a scaled up web architecture using Next js, React js, Tailwind CSS, and to make the page eye catching and make users involved, the interface is powered by animations to be responsive. This system systematically manages all kinds of information such as profile data, user's daily improvement data and statistics, project work, alumni interactions and the activity made by users. The platform shows smooth navigation, clear integration, progress monitored. It totally justifies the strategy made into practical approach. The issue that we tried to solve by doing a practical approach that will make students and early professionals to take responsibility, and do not think that only high powered names jobs are the only jobs. They get a clear transparent vision of their goals and can monitor their progress for their professional growth. The world where we are currently living in is growing very fast, as everything has started to shift online. But this has its own cons, as the career preparation environments have its own extremely discontinuous methods where skills do not match with interests, project building, proper mentorship for chosen career path, and job listings are used by isolated and uncoordinated systems. This environment presentation is difficult to the learners' because it is hard to keep track of their progress, time to time career guidance by mentors who are already in that position and can guide from their own mistakes so the new comers do not get stuck in a loop. The rat race that we are currently in, where everyone is going in the same direction and almost none are following their own interests as they do not even know what career would they pursue with their set of skills, they do not know if there is any career path with their match of interest. The important part is interest creates efficiency. The solution to this dilemma presents this paper Luminary X, which is a single web based system that has it all. This platform has a section to choose the skills that match with the learners' interests. After that they will get AI powered assistance to start a career that uses those skills. They will get guidance from alumni who's has done great in their chosen career. Users can upload their projects and get help in building it to an advanced level. This platform enables an AI powered guide, who will help them to reach their desired goals. This makes the model from traditional linear learning environment to a structured in order platform. To plan project work that can turn into portfolio ready projects. Luminary X is created on a scaled up web architecture using Next js, React js, Tailwind CSS, and to make the page eye catching and make users involved, the interface is powered by animations to be responsive. This system systematically manages all kinds of information such as profile data, user's daily improvement data and statistics, project work, alumni interactions and the activity made by users. The platform shows smooth navigation, clear integration, progress monitored. It totally justifies the strategy made into practical approach. The issue that we tried to solve by doing a practical approach that will make students and early professionals to take responsibility, and do not think that only high powered names jobs are the only jobs. They get a clear transparent vision of their goals and can monitor their progress for their professional growth.

**Keywords:** Interest matching skills, alumini advice, goals tracking, project into professional work, web-based systems.

Paper ID: 229

### **BLISION : AI Voice Assistive Technology for BLInd Peoples non ViSION**

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**Abstract:** Visually Impaired people are struggling in their daily life activities which is quite difficult for navigating without someone help. They always need to be monitored, to over come this problem previous researchers have been developed white canes with those they can detect the objects by sticks. Later on it is developed through using some sensors and some digital cameras.so with these smart sticks they have been enabled some sensors and location tracking through some Gps & Gsm modules. But the existing systems are have been used to detect only nearby obstacles but cannot provide the detailed information.to overcome this difficulty, this system is work on an smart mobile based assistive system. where it is using default mobile phone camera and converting image to text and then the text to speech. Thus blind people can understand their surroundings easily. Also the audio feedback gives the current location of the blind people.

**Keywords:** Visual Impairment, smart Assist Technology, object recognition(OCR), Image processing, Voice output.

Paper ID: 233

### **A Category-Aware Multi-Head Attention Framework with RoBERTa for Aspect-Level Sentiment Analysis of Consumer Reviews**

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**Abstract:** Aspect-Based Sentiment Analysis (ABSA) is an important task in the natural language processing, and enables businesses to gain detailed insights into customer opinion available in the reviews. However, existing methods are often prone to fail due to difficulties in capturing dynamic classes of sentiment, a useful model in aspects-context interactions, and the issue of class imbalance. Even though the use of pre-trained models like BERT has been shown to be encouraging, these models are frequently unable to offer explicit category-based mechanisms and strong regularization techniques. In order to overcome these challenges, this paper proposes a novel model that integrates RoBERTa and a Category-Aware Multi-Head Attention mechanism, namely RoBERTa-CA-WMA. In contrast to traditional methods, our model incorporates an aspect projection layer between aspect embeddings and contextual features, which ensures deeper semantic interaction. Furthermore, we enhance the training procedure using Contrastive Loss to improve feature separation, Label Smoothing to reduce over-confidence, and multi-dropout to attain improved generalization. Extensive experiments on benchmark datasets (SemEval 2014, 2015, and 2016) demonstrate that RoBERTa-CA-WMA achieves significant improvements in Accuracy and Weighted F1-Score compared to state-of-the-art baselines, including the original BERT-based category-aware models, particularly on neutral sentiments and imbalanced data distributions. This paper confirms that stronger pre-trained transformers combined with category-based attention and sophisticated regularization are effective in developing a more accurate and robust ABSA system.

**Keywords:** Aspect-Based Sentiment Analysis, RoBERTa, Category-Aware Attention, Contrastive Loss, Customer Reviews, Transformer Models, Multi-Head Attention, SemEval Benchmark.

Paper ID: 236

## Hybrid CNN-LSTM Model for Epileptic Seizure Prediction and Classification using Support Vector Machine

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**Abstract:** Detection of epileptic seizures is a clinically important task that requires accurate, effective, and readable automated systems to decrease neurologist workload, and permit early intervention. In this paper, a fully trained machine learning is provided. binary seizure detection in electroencephalographic (EEG) signals pipeline, tested on the established EEG data from Bonn University. The suggested system combines: (i) signal trimming, to eliminate edges recording artifact, to reduce. (ii) every 4097-sample sample to a 3472-sample representation that is uniform; novel segment permutation-based data augmentation strategy that quadruples. the training sample between 500 and 2000 samples through four deterministic generations. temporal rearrangements of each signal; (iii) a global 53 dimensional. time-domain statistics multi-domain handcrafted feature vector. A total of (12 features) and Hjorth parameters (3 features) are used, as well as frequency-domain band powers. computed using Welch's Power Spectral Density technique (14 features), and wavelet domain. extracted features in 5-level Daubechies-4 (db4) Discrete Wavelet. Areas of transformation (24 features). A soft voting is used to do classification. combination of a Support Vector Machine utilizing Radial Basis Function.. RBF-SVM ( $C = 1000$ ,  $\gamma = 0.0001$ ) and an Extra-Trees classifier (1200 estimators), at SVM weight 2:1 probability averaging. On a stratified 80/20 train-test split, the proposed system reaches an accuracy of 99.75% which is equivalent. to the single misclassification of a single sample out of 400- better than that mentioned in the referred paper. observed mean error rate of 99.10% by 0.65% percentage points. The method has no GPU cost, has no deep learning infrastructure cost, and generates. explicable characteristics that can be used in clinical practice.

**Keywords:** Epilepsy, seizure detection, electroencephalography, handcrafted features, ensemble learning, support vector machine, Extra-Trees, wavelet transform, data. augmentation, Bonn dataset

Paper ID: 240

## Performance-Enhanced Carry Look-Ahead Decimal Adder for Next-Generation Computing Applications

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**Abstract:** Decimal computation/calculation playing a major role and gaining attention by scientists and analysts because of their significance in various human-centric applications. Executing these operations in hardware offer better speed than software methods. This is highly beneficial for systems that need quick responses. Decimal addition is most important and basic decimal operation among all remaining operations and also one of the essential one. The Complementary Metal Oxide Semiconductor (CMOS) technology has the benefit of decreasing/lowering the average power consumption and the propagation delay in virtual systems. Decimal adders can be developed as Ripple Carry Addition (RCA) structure or as a Carry Look-Ahead Addition (CLA) structure with more rapid and extra hardware cost. This work proposes two CMOS based carry look-ahead decimal adders (CLDA) and ripple carry decimal adder (RCDA) that can be used in any decimal arithmetic unit. Operands of 1-digit size, 2-digit size, 3-digit size, 4-digit size are examined. The circuits of each of the proposed RCDA and CLDA is simulated with 45nm and 90nm technology libraries using Cadence virtuoso simulation tool. The simulation shows promising results in terms of speed, power and power delay product (PDP).

**Keywords:** Decimal Arithmetic, CMOS technology, CLDA, RCDA, BCD adder, Decimal adder, PDP, EDP, Cadence virtuoso.

Paper ID: 243

## **A Dual Band Microstrip Rectangular Patch Antenna with Slots for 5G and 6G applications**

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**Abstract:** In this paper, a small dual-band rectangular microstrip patch antenna for advanced 5G and 6G communication systems operating at 100GHz and 68GHz is presented. The antenna, which is built on a Rogers RT/Duroid 5880 substrate, employs a modified slot configuration that includes an extra slot to achieve dual-band resonance and a T-shaped slot made up of two rectangular slots. Impedance matching improves gradually over the course of a threestage design evolution; the final structure achieves VSWR values of 1.0301 and 1.0791 and return losses of  $-36.5657$ dB at 100GHz and  $28.3879$ dB at 68GHz. The antenna can be integrated into nextgeneration high-frequency wireless networks and applications because of its compact size, stable radiation patterns, and peak gains of  $9.00441$ dB and  $3.865$ dB.

**Keywords:** Antenna, Communication, VSWR, Gain, S11, reflection coefficient, Slot, Millimeter Wave, 6G.

Paper ID: 245

## **Junctionless FETs: A Comprehensive Review of Device Architectures and Performance Optimization**

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**Abstract:** This paper aims to provide a comprehensive review of the junctionless field-effect transistor (JLFET) technology by compiling the major findings from ten noteworthy research contributions. Ultra-steep source/drain junctions are not necessary for JLFET devices, which have an advantage over other devices because to their bulk conduction-based design, reduced short-channel effects (SCE), and simpler fabrication procedure. Junctionless tunnel field-effect transistors (JL-TFET), gate-allaround nanowire JLFET devices, nanotube JLFET devices, fin body JLFET devices, ferroelectric JLFET devices, compound semiconductor-based double-gate JLFET devices, etc. are just a few of the many types of JLFET devices that are covered in this review. Subthreshold swing (SS), drain-induced barrier lowering (DIBL), ION/IOFF ratio, transconductance, and other performance parameters are compared and examined. Additionally, design optimization techniques such substrate biasing effects and genetic algorithms are covered. The review highlights the critical trade-offs between ON-state current, leakage suppression, and RF characteristics, as well as the exciting possibilities offered by negative capacitance, 2D material channels, and heterostructures. This work will serve as a reference framework for all researchers and engineers involved in the development of the next generation of CMOS-compatible transistors.

**Keywords:** Junctionless FET, nanowire transistor, gate-allaround, tunnel FET, short-channel effects, ferroelectric FET, compound semiconductor, subthreshold slope, band-to-band tunneling, TCAD simulation.

Paper ID: 249

## A Novel Fuzzy MCDM Approach for Hybrid PV Systems Site Selection

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**Abstract:** The current research presents an innovative tool for solving the problem of developing a hybrid approach for the application of Fuzzy Multi-Criteria Decision-Making (MCDM) that considers and deals with the issues related to criteria for selecting PV site selection in uncertain situations. The main purposes and objectives of this study were to evaluate and identify the weights for fifteen vital parameters determined as related to climatic changes, environmental issues, geographical positions, and infrastructure through inferring the expert opinions presented as linguistic variables and transferring the expert opinions into triangular fuzzy numbers as presented by subjective uncertain situations. Then, to solve this issue with greater precision and provide stronger weight values for dealing with uncertain situations in decision-making, the application of the Fuzzy Best-Worst Method for inferring weights is utilized with the help of the application of the Fuzzy Combined Compromise Solution (CoCoSo) tool to determine the most accurate and efficient weights values for decision-making purposes considering both additive and multiplicative dimensions of the decision-making process for handling uncertain situations with greater precision and efficiency by ensuring greater crystallization and explicitness of the decision-making process and accurately dealing with issues related to uncertain situations with greater efficiency and effectiveness.

**Keywords:** Hybrid PV systems, Site selection, Fuzzy multi-criteria decision-making, Hybrid renewable energy systems, Microgrid.

Paper ID: 250

## Fish Disease Detection System

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**Abstract:** Aquaculture is an important process in the world food security, but fish health management is a major challenge as bacterial diseases, viral diseases, fungal diseases, and parasitism are widespread. The conventional methods of diagnostics depend rather on the manual checking of the specialists, which leads to subjective diagnostics, slowness of the intervention, and inability to make the interventions in large or distant farms. To resolve these issues, an AI-based Fish Disease Detection System was built based on a database of fish images taken in aquaculture farms and open repositories in 2020-2024 and comprised more than 45 disease types of both freshwater and marine organisms. The preprocessing image pipeline is using the OpenCV-based resizing, normalization, bilateral filters, and contrast enhancement to standardize visual inputs and enhance features in the visual image. The identification of the disease combines a deep learning layer based on MobileNetV2 which is used to classify the disease, Gemini Vision AI which is an advanced multimodal reasoning tool, and a rule-based fallback system to remain reliable in situations of low confidence. White spots, lesions, texture variation and fin ruinous are key visual attributes that are extracted to aid in the effective learning of features. The system produces real-time, high-accurate diagnosis, which gives the disease severity, recommendations to take, as well as prevention guidelines. This intelligent diagnostic framework would boost the accuracy of detection through the combination of deep learning, computer vision, and rule-based reasoning, help decrease fish mortality, and encourage sustainable practices in the aquaculture industry.

**Keywords:** Fish Disease Detection, Aquaculture, Deep Learning, Computer Vision, Image Processing, RealTime Diagnostics.

Paper ID: 251

## **Granular Diagnosis: An Instance-Level Severity Quantification Framework for Tomato Foliar Diseases Using Enhanced YOLOv8-seg**

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**Abstract:** India is ranking as the second largest Tomato cultivating country around the world, which makes it crucial to look after significant threats from several pathogenic diseases, making precise detection essential to reduce crop losses. This project develops a sophisticated and compact system for identifying tomato leaf diseases which is not just a simple classification but to provide granular severity estimation. In contrast to the base paper, which depended on older feature extraction methods like GLCM and SIFT with SVM classifiers to provide a single classification for an entire leaf image, this project provides instance level severity estimation of the given tomato leaf. The model was trained on a dedicated dataset of 3462 images and around 8677 annotations categorized into 28 different classes, represents nine diseases at three intensity levels (High, Medium, and Low) and one healthy class. Compared to traditional methods which only labels the whole image, this project provides instance-level segmentation that precisely identifies the location and shape of each diseased lesions. In addition to that we developed a mobile interface using Flutter, allows users to capture leaf photos either through camera or upload images from their gallery. The app then provides real-time diagnosis, visually providing the original image with color-coded segmentation masks that point out the diseased area on that leaf image and indicates the disease name and its estimated severity level. This system merges modern deep learning with agricultural needs, allowing farmers to clearly check the crops health through their smart phone and make necessary action to stop the spreading of the disease, effectively managing pathogen progression before it compromises the entire harvest.

**Keywords:** Tomato leaf disease, instance segmentation, severity estimation, deep learning, mobile application, precision agriculture management.

Paper ID: 253

## **Multi-Task Deep Learning System For Early Fire And Smoke Severity Detection**

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Iswariya  
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**Abstract:** Early detection of fire incidents is critical for minimizing loss of life, property damage, and environmental impact. Conventional sensor-based fire detection systems often suffer from delayed response, limited coverage, and high false alarm rates. With the widespread deployment of surveillance cameras, vision-based fire detection using deep learning has emerged as an effective alternative. This paper presents a multi-task deep learning framework that simultaneously performs fire detection, smoke detection as an early warning indicator, and fire severity estimation using a shared convolutional backbone. Fire and smoke detection are formulated as binary classification tasks, while severity estimation is modeled as a multi-class classification problem. Joint learning of these correlated tasks enables efficient feature sharing, improved detection accuracy, and reduced computational overhead. Experimental results on public and real-world datasets demonstrate that the proposed approach outperforms single-task baseline models in terms of precision, recall, and F1-score, while maintaining real-time performance suitable for safety-critical surveillance applications.

**Keywords:** Fire detection, Smoke detection, Multi-task learning, Deep learning, Computer vision.

Paper ID: 255

### **Design and Implementation of an Efficient Booth Multiplier**

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**Abstract:** An approximate hybrid radix-4/radix-8 Booth encoder is used in this study to present a highly energy-efficient Hybrid Floating-Point Multiplier (HFPM). Improving the Power Delay Product (PDP) for high-speed digital signal processing applications is the main goal of the design. Its hybrid encoding technology employs approximate radix-8 logic for lower-order bits to increase operational efficiency and accurate radix-4 encoders for higher-order bits to maintain computational correctness. The design drastically lowers the critical path delay and hardware complexity by using straightforward shifting logic instead of expensive carrypropagation adders. Verilog HDL was used to implement the multiplier on a Kintex 7 FPGA platform, and Xilinx Vivado 2016 was used for verification. A VMware Workstation Pro environment was utilized to guarantee OS stability and effective resource management during synthesis. The Booth encoder logic achieves a critical path delay of 5.118 ns, according to performance analysis. The system's average timing performance of 543.5 ns per operation cycle demonstrates how well the hybrid approach works to achieve high-speed, low-energy performance.

**Keywords:** Booth encoder, Radix-4/Radix-8, Verilog HDL, Xilinx Vivado.

Paper ID: 257

### **Reversible Karatsuba Multipliers: Design Challenges, Optimization Metrics, and Future Directions for Quantum Arithmetic**

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Assam Engineering College

**Abstract:** Reversible logic is a promising approach for energy-efficient and quantum computing as it avoids information loss during computation. Designing efficient reversible multipliers is challenging due to constraints such as no fan-out and the need to minimize garbage outputs and ancilla inputs. Existing architectures, including array, Wallace tree, Booth, and Vedic multipliers, often suffer from scalability limitations. The Karatsuba algorithm provides an efficient alternative by reducing multiplication complexity using a divide-and-conquer approach. This paper presents a concise review of reversible multiplier architectures with emphasis on Karatsuba-based designs, analyses key performance metrics, and highlights challenges in achieving scalable and resource-efficient reversible arithmetic circuits.

**Keywords:** Reversible logic, Karatsuba multiplier, quantum computing, quantum cost, garbage outputs, ancilla input, scalable arithmetic circuits.

Paper ID: 259

### **Density-Aware Redundancy Constant(K) For Optimized Rpl Protocol**

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**Abstract:** The Routing protocol for low power and lossy network (RPL), according to RFC 6206, uses a redundancy constant (k) in Trickle Timer that suppressed redundant control message transmissions which is not useful. standard RPL uses a static value of k (typically 10) which is unable to adapt the varying network densities, due to excessive control traffic overhead in dense networks and slow to response in sparse networks. This paper proposed Density-Aware Dynamic k model, that adjusts the value of Redundancy constant (K) according to the network conditions. Simulations conducted with 10 to 60 sensor nodes using Cooja (Contiki-3.0) simulator. The results shows that, compared to standard RPL proposed approach improves packet delivery ratio, reduced energy consumption and enhances network life time.

**Keywords:** RPL, redundancy constant (K), Trickle Algorithm, IoT, Control traffic Overhead.

Paper ID: 263

### **Compact Slot-Loaded Two-Element MIMO Antenna with Enhanced Isolation for WLAN and IoT Applications**

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**Abstract:** This paper presents the design and analysis of a dual-band multiple-input multiple-output (MIMO) antenna intended for wireless local area network (WLAN) applications. A compact antenna system is proposed to support high data rates, reliable connectivity, and efficient spectrum utilization. The designed MIMO antenna operates in dual frequency bands around 3.2 GHz and 4.8 GHz, making it suitable for modern WLAN communication systems. The antenna structure is optimized to achieve compact size, high isolation between antenna elements, and significantly reduced mutual coupling, achieving values below  $-40\text{dB}$ . The performance of the proposed antenna is evaluated using key parameters such as radiation efficiency, impedance bandwidth, envelope correlation coefficient (ECC), and diversity gain (DG). The ECC is kept below 0.03, suggesting a weak relationship between effective diversity performance and antenna elements. Furthermore, the antenna exhibits a diversity gain that ranges from 9.86 dB to 10.02 dB, guaranteeing enhanced system performance and signal reliability. The suggested architecture is appropriate for small wireless devices that need improved MIMO performance in WLAN applications.

**Keywords:** Dual-Band MIMO Antenna, WLAN Applications, Microstrip Antenna, Mutual Coupling Reduction, Isolation Enhancement, Envelope Correlation Coefficient (ECC), CST Studio Suite.

Paper ID: 264

### Early heart disease prediction using machine learning algorithm

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**Abstract:** The early detection of the problems related to the heart is the key to avoiding the occurrence of serious cardiovascular events and treating the problems in time. This paper has proposed the system of real-time tracking, which predicts the occurrence of heart disease through the use of different physiological sensors. This system includes the sensor of heart rate, which is the heartbeat sensor; the sensor of Galvanic Skin Response (GSR) to sense the change in the heart rate caused by stress; the pulse oximeter sensor to measure the oxygen levels; and the temperature sensor, which is the body temperature sensor, the DS18B20 sensor. The data received from the sensors is converted into digital form through the MCP3008 ADC and analyzed using the Raspberry Pi 4 along with machine learning algorithms to sense the possible abnormalities related to the heart. A display is used to display the real-time data, and the GSM module is utilized to send alerts in case of abnormalities detected. This has been proved through the tests that the system is capable of constantly monitoring the conditions and providing appropriate warnings.

**Keywords:** Heart Disease Detection, Machine Learning, Physiological Sensors, Real-Time Monitoring, Early Warning System.

Paper ID: 265

### An Efficient Bit Parallel In-Memory Computing SRAM Architecture for Edge Devices

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**Abstract:** This paper presents An Efficient Bit Parallel In-Memory Computing Using SRAM Architecture for Edge Devices which re-purposes this structure to perform parallel compute units capable for Edge Devices. Techniques to do in-situ arithmetic in SRAM array, create efficient data mapping and reducing data movement are proposed. This SRAM architecture also supports the PDP (Power Delay Product) and EDP (Energy Delay Product). Our experimental results show that the proposed architecture can improve the read power and write power for the FULL Adder designed by this SRAM Architecture is better than the normal full adder. Its difference is in pW and nW. Like the normal full adder requires 880.9 nW power for read access but the full adder designed by using SRAM architecture requires 108 pW. Here the energy and access time is reduced compared to the normal design.

**Keywords:** In-Memory Computing, PDP, EDP, read access time and write access time.

Paper ID: 266

## FPGA Implementation of 2D SAR Polar Format Algorithm

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**Abstract:** In order to improve the 2D interpolation with high processing efficiency, we developed a polar format algorithm for spot light synthetic aperture radar (SAR) image formation. When the system operating frequency was at 100MHz, the parallel pipelined structure for hardware implementation architecture produced output results with optimal power utilization, thermal, and resource constraints using an FPGA (Field Programmable Gate Array) ZYNQ ZC 706 board. The high-level design tools enable the instantiation of different optimized design variations to meet the hardware and image processing requirements of application designers. The simulation and FPGA approach results show that it is possible to achieve notable improvements in power and resource utilized efficiently without sacrificing SAR image quality.

**Keywords:** SAR, PFA, FPGA, ZYNQ, spot light imaging.

Paper ID: 267

## FPGA Implementation of 2D SPECAN SAR Algorithm

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**Abstract:** In wide swath ScanSAR modes, the Spectral Analysis (SPECAN) algorithm is a fundamental synthetic processing technique for quickly producing medium-resolution Synthetic Aperture Radar (SAR) imagery. In order to map radar echoes into focused SAR images, SPECAN uses effective frequency domain operations like the Fast Fourier Transform (FFT) and Chirp Z-Transform (CZT), utilizing the deramp (dechirp) and spectral analysis method. This framework allows the direct creation of azimuth profiles without the need for explicit interpolation or conventional range cell migration correction (RCMC) by integrating range compression, azimuth deramping, Doppler centroid estimation, and rapid spectral synthesis. The SPECAN technique enables real-time or near-real-time SAR data processing, making it well-suited for implementation on Field Programmable Gate Arrays (FPGAs) and other hardware accelerators, where resource constraints and processing speed are critical considerations for SAR comparative studies.

**Keywords:** Synthetic Aperture Radar (SAR); SPECAN, CZT, RCMC; FPGAs.

Paper ID: 272

### **An Efficient Two Stage CNT Operational Amplifier For High Gain Applications**

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**Abstract:** In Analog and mixed-signal VLSI systems operational amplifiers are widely used in applications like sensor interfaces, data converters, and signal conditioning. In nanoscale technologies designing an op-amp that can provide high gain, good common mode rejection, and stable operation while consuming low power is still a difficult task, even though they are very important. To overcome these challenges a better alternative to conventional CMOS technology is considered as CNFET (Carbon Nanotube Field Effect Transistor) technology. Advantages such as higher carrier mobility and reduced short channel effects are offered by CNFET devices, which help in improving circuit performance. In this work a low-power two-stage operational amplifier based on CNFET technology is designed and simulated using Cadence Virtuoso. In the first stage a differential amplifier is designed to obtain high gain and improved CMRR, and in the second stage the output swing and overall gain are enhanced, and for stability Miller compensation is applied. Using the Cadence Analog Design Environment the circuit is simulated, and parameters like gain, phase margin, and CMRR are analyzed. In the results better gain and improved CMRR are provided by the CNFET based op-amp while maintaining stable operation with low power consumption.

**Keywords:** CNFET, Two stage operational amplifier, Low power design, CMRR, Phase margin, Analog VLSI, Cadence Virtuoso.

Paper ID: 279

### **AI powered automatic toll payment system using Number Plate Recognition**

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**Abstract:** In this paper, the author has suggested a contactless toll collection system, which employs Artificial Intelligence (AI) and Number Plate Recognition (NPR) to enhance efficiency at the toll plazas. The system will be constructed under Raspberry Pi with a USB camera which will capture pictures of the vehicles in real time. A deep learning model based on the YOLO system detects the license plates and the vehicle numbers are recognized through the Optical Character Recognition (OCR). A sensor in the ultrasonic mode detects the coming vehicles and the automatic toll processing and the opening of the gates with the help of a DC motor and a driver. A database stores vehicle-related information and account balances, and the deduction of tolls can be done automatically. Status of transactions is displayed on an LCD screen, and a buzzer is used to notify the user about any errors or confirmations. Experimental findings indicate that the system is reliable to use, highly accurate and lessens congestion, delays and manual work, which is very economical as compared to traditional method of collecting tolls.

**Keywords:** Number Plate Recognition, YOLO, OCR, Raspberry Pi, Automated Toll System.

Paper ID: 286

### **Design and verification of Parameterized FIFO Buffer Using Verilog and SystemVerilog**

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**Abstract:** Our project mainly focuses on designing and testing a reliable synchronous FIFO buffer used for efficient data transfer in the digital system. This Parameterized synchronous FIFO Buffer is developed using Verilog HDL at RTL level, where the data width and storage depth can be adjusted based on requirements. The design contains essential components such as memory storage, read/write pointers and control logic to indicate full and empty conditions. To verify the corrections in the code and in the design, system Verilog based test benches and assertion techniques are used. In this project, both Verilog and system Verilog are used for design and verification. Different operating scenarios are tested to ensure reliable data flow. Simulation results confirm that the FIFO works as expected and successfully avoids issues like overflow and underflow. The design can be implemented in FPGA for real time validation.

**Keywords:** Synchronous FIFO, Verilog HDL, System Verilog, RTL Design, Data Buffering, Overflow, Underflow, Verilog HDL, Xilinx Vivado Software.

Paper ID: 288

### **Skin Cancer Identification using Deep Learning Model on the HAM10000 Dataset**

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**Abstract:** Skin cancer, being a worldwide health problem, creates major physical, mental and emotional stress. Traditional physical finding is majorly time-taking and subjective, depending on much upon dermatologists' knowledge. In our work, an extensive skin cancer disease analysis is proposed for ease in diagnosis by using deep learning models. The HAM10000 dataset is the standard for estimating skin cancer disease by AI detection approaches. It consists of more than 10,015 dermoscopic images labeled with seven different diagnostic categories. We have identified the skin cancer ResNet18 to the HAM10000 dataset. The procedures in detail, experimental setup, results, and conclusions include reviewing findings and potential consequences on the clinical procedure.

**Keywords:** skin cancer, CNN, ResNet, HAM10000 Dataset.

Paper ID: 289

## Design of a High-Gain, High-Speed Double Recycling Folded Cascode OTA in 180nm CMOS

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**Abstract:** This paper presents the design of a Double Recycling Folded Cascode (DRFC) Operational Transconductance Amplifier (OTA) optimized for high-gain and high-speed applications. By implementing a dual-path current recycling strategy, the proposed architecture significantly enhances the effective transconductance without an increase in total power consumption. The circuit, simulated in 180nm CMOS technology with a 1.8 V supply, achieves a DC gain of 78.76 dB, a Unity Gain Bandwidth (UGBW) of 88.77 MHz, and a Phase Margin of 55.3°. With a power dissipation of 1.504 mW and an average slew rate (SR) of 36.75 V/ $\mu$ s.

**Keywords:** DRFC, Folded Cascode, OTA, 180nm CMOS, Current Recycling, Transconductance Enhancement, Low Power.

Paper ID: 291

## Explainable Deep Time-Series Forecasting for Intelligent Systems: Models, Methods, and Applications

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**Abstract:** The prediction of time-series is a pillar of intelligent systems used in areas like energy, finance, medicine, and industrial Internet of Things; accurate predictions are the foundations of automated decision-making, effective resource distribution, and sound mechanisms of identifying anomalies. Archeologies, such as recurrent neural networks (RNNs), long short-term memory (LSTM) networks, temporal convolutional network (TCNs), and Transformers, have significantly surpassed classical statistical models like ARIMA and exponential smoothing models in terms of precision in prediction since the emergence of deep learning. However, the natural incomprehensibility of such deep models the so-called black-box problem limits their application in safety-critical fields where regulatory standards, human trust and explainability cannot be compromised the presented review is an overview of recent developments in the intersection of deep time-series forecasting and explainable artificial intelligence (XAI) along with a specific focus on their application to intelligent systems. We provide a taxonomy of deep forecasting architectures which includes RNN based, CNN/TCN based, Transformer based, hybrid and emergent foundation models. We then summarize a systematic review of XAI methods specific to time-varying data comprising feature attribution, time-sensitive saliency maps, attention-based explanations and intrinsically explainable architectures. Healthcare, energy, and industrial IoT Our synthesis will represent a more general finance, healthcare, energy, and industrial IoT, demonstrating how explanations assist in model debugging, building trust in a model, and human-AI collaboration. Among the open challenges that we address and discourse include scaling XAI to multivariate high-frequency data streams, standardizing measures of quality of explanations, and incorporating domain knowledge into pipelines in forecasting.

**Keywords:** Smart systems, time series prediction, deep learning, explainable AI, XAI, attention, Transformers, feature attribution, anomaly detection.

Paper ID: 292

## Hybrid Quantum-Classical Federated Learning for Privacy-Preserving Anomaly Detection in Secure IoT Networks

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**Abstract:** QFed-Anomaly During this work, we present QFedAnomaly, which is a hybrid quantum-classical federated learning framework that offers a privacy-saving method of data detection of anomalies in a massive Internet-of-Things (IoT) system. The suggested architecture is also concerned with solving three essentially overlapping issues: the bulky and distributed (around the world) character of IoT information streams, high sensitivity to privacy, and limited computational ability of modern Noisy IntermediateScale Quantum (NISQ) devices. Quantum feature maps are trained on the node of the edge, with the model parameters being interpreted using the classical Federated Averaging (FedAvg) protocol. This system is a guarantee that raw data will be stored in the local devices, and difficult data processing will be provided by the global model operation, which will allow applying differential privacy. A quantum feature-mapping pipeline is again enhanced with a Gaussian mechanism that gives formal  $(\epsilon, \delta)$ -differential privacy without any: This is not at all a significant loss in detection performance. Empirical analysis conducted on four most popular intrusion and IoT security datasets, which include NSL-KDD, CICIDS2017, IoT-23, and UNSW-NB15 containing more than four million samples and deployed in a realistic federated environment with heterogeneously partitioned data in a plurality of edge nodes, confirms that QFed-Anomaly achieves an average detection rate of about 95.0%. It performs better than conventional support-vector machines (SVMs), federated SVM baselines, and centrally trained quantum support-vector machines (QSVMs), and has an up to three-fold speed advantage over purely classical methodologies. Also, the model has a high resilience to adversarial perturbation, with more than 90% accuracy to attack by FGSM, PGD, and CarliniWagner (CW), and has practical privacy-utility trade-offs consistent with GDPR-compliant IoT applications. Therefore, the given research provides a workable framework of implementing the implementation of quantum enhanced, privacy preserving network anomaly devices in actual secure IoT settings-confidential network detection devices in the context of real-world secure IoT systems.

**Keywords:** Quantum Machine Learning, Federated Learning, IoT Security, Anomaly Detection, NISQ, Privacy Preservation, Differential Privacy, Adversarial Robustness.

Paper ID: 293

### **A Compact Deep-Resonant Ultra-Wide-band mm-Wave Micro-strip Antenna With Strong 60-GHz Performance for 5G and Multi resonant Operation Across the 40–100 GHz Ka/V/W Band**

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**Abstract:** This paper presents the design and analysis of a compact deep resonant multiband millimeter-wave microstrip antenna intended for 5G and Ka/V/W-band applications. The antenna is implemented on a Rogers RT Duroid 5880 substrate ( $\epsilon_r = 2.2$ ,  $\tan \delta = 0.0009$ ) with dimensions of  $6 \times 7 \times 0.254 \text{ mm}^3$ , and employs a  $4.7 \times 4.5 \text{ mm}$  patch optimized through iterative HFSS simulations and parameter tuning. The proposed structure exhibits multiple resonances across the 37–100 GHz range, demonstrating its suitability for ultra-wideband mm-wave systems. A strong primary resonance is achieved at 60 GHz with a return loss of  $-30.83 \text{ dB}$ , VSWR of 1.25, peak gain of 4.89 dBi, input impedance of  $55.5 - j10.42 \Omega$ , and an impedance bandwidth of 5.75 GHz. Additional deep resonances are observed at 40.75 GHz ( $-32.94 \text{ dB}$ ) with a VSWR of 1.18 and 1.75 GHz bandwidth, and at 95 GHz with a VSWR of 1.44. Multiple peaks at 37 GHz, 53.7 GHz, 72 GHz, 83 GHz, 99.5 GHz, 104–118 GHz further establish the antenna's multiband capability. The combination of compact size, wide operating range, low VSWR, and high return-loss characteristics make the proposed antenna a strong candidate for next-generation high-frequency wireless communication, high-resolution sensing, and mm-wave 5G/6G front-end modules.

**Keywords:** ultra-wideband (UWB), 60 GHz antenna, Ka-band, Vband, W-band, return loss, VSWR, impedance matching, input impedance, optimization, microstrip patch antenna.

Paper ID: 300

### **Development and Verification of a Verilog-Based Digital Vending Machine with Advanced 3D Simulation and User-Centric Visualization Framework**

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**Abstract:** Finite State Machines are commonly used in digital electronics, and vending machines are one of the easiest examples to understand them. But while implementing such systems, handling inputs like money and product selection is not as simple as it looks. It requires proper state transitions and control logic to ensure correct operation. Normally, tools like Vivado are used for simulation, where outputs are seen as waveforms. But honestly, these waveforms are not always easy to follow, especially for beginners or non-technical users. Understanding the exact behaviour from signals alone can sometimes be confusing. While working on this project, we felt that something was missing — there was no proper way to actually “see” the machine working. That is why we tried adding a 3D simulation part, so that the system becomes more interactive and easier to understand. This also helped us relate the logic with real-world behaviour.

**Keywords:** Verilog HDL, Vending Machine, 3D Simulation, Xilinx Vivado, Hardware-Software Interface.

Paper ID: 303

### **Design And Implementation Of Reliable Adder By Using CMOS Technology**

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**Abstract:** Decimal computation/calculation playing a major role and gaining attention by scientists and analysts because of their significance in various human-centric applications. Executing these operations in hardware offer better speed than software methods. This is highly beneficial for systems that need quick responses. Decimal addition is most important and basic decimal operation among all remaining operations and also one of the essential one. The Complementary Metal Oxide Semiconductor (CMOS) technology has the benefit of decreasing/lowering the average power consumption and the propagation delay in virtual systems. Cadence virtuoso simulator is used to simulate and verify the functionality of the proposed circuits. The circuits are simulated using 45nm, 90nm, and 180nm technologies and compared against existing works in the literature. Due to the lack of existing work in literature and for purpose of comparison, this work also designed three different adders using different existing binary adders in literature. The experimental results show that proposed decimal adder achieves better performance comparing to the other works. For example, for 4-digit operands, the proposed adder shows a power delay product (PDP), in percentage (%), of 14.9 comparing to 21.7, 52.49, 54.19, 81.16 and 84.66 PDP for other works.

**Keywords:** Decimal Arithmetic, CMOS technology, BCD adder, Decimal adder, CLA Adder, PDP, Energy-delay power, Cadence virtuoso.

Paper ID: 305

### **A Novel Network-on-Chip Architecture Based on Mesh of Spidergon Topology under TCP and SCTP protocols**

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**Abstract:** The increasing complexity of System-on-Chip (SoC) designs demands scalable and high-performance interconnection architectures. Network-on-Chip (NoC) has emerged as a promising solution to address communication challenges such as latency, throughput, and congestion. In this work, an enhanced Mesh of Spidergon (MoS) topology is analyzed and extended from a 32-node configuration to a larger 128-node architecture to evaluate its scalability and performance efficiency. Initially, the proposed MoS topology demonstrated improved throughput and reduced latency in a 32-node environment. Building on these results, the topology is further expanded to 128 nodes, and its performance is evaluated under both Transmission Control Protocol (TCP) and Stream Control Transmission Protocol (SCTP). The comparative analysis reveals that the MoS topology maintains its efficiency even at higher network scales. Experimental results indicate that SCTP outperforms TCP in terms of throughput while maintaining comparable or lower latency levels across varying traffic conditions. This improvement is attributed to SCTP's multi-streaming and multi-homing capabilities, which enhance data transmission efficiency and reduce congestion.

**Keywords:** Network on Chip (NoC), Mesh of Spidergon (MoS) topology, Stream Control Transmission Protocol (SCTP), Transmission Control Protocol (TCP).

Paper ID: 308

## A Hybrid Machine Learning Approach for Fake Review Detection in E-Commerce

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**Abstract:** Online product reviews play a major role in driving customers towards purchasing or skipping a product which makes it imperative to distinguish between fake and real reviews on ecommerce platforms. Fake reviews are made to either boost the sales of an inferior product or to hinder the sales of a competitive product which in turn reduces the trust in consumers. In this paper we present a hybrid machine learning approach for detecting fake reviews using textual features with sentiment based and behavioural meta features. TF-IDF representations are employed at word and character levels to obtain linguistic and stylistic patterns and the features that include rating-sentiment gap, review length and sentence statistics are used to detect suspiciousness. Linear Support Vector Machine classifier is used because of its effectiveness and high resilience in high-dimensional feature spaces. The experimental findings indicate that text-only models are effective in the single dataset but the proposed hybrid version is much more effective in terms of robustness in cross-dataset evaluation, hence it is applicable to real-life applications. In testing applicability to real-life performance, further evaluation of the proposed hybrid approach is done under cross-dataset evaluation.

**Keywords:** Fake Review Detection, Opinion Spam, TF-IDF, Sentiment Analysis, Hybrid Features, Support Vector Machine.

Paper ID: 314

## A 256-Byte 10T SRAM Design Optimized for Low-Power Portable Electronics

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**Abstract:** This research paper introduces a 256-byte SRAM cell designed for reduced power consumption. The important design parameters of proposed 10T (PROP10T) and others conventional SRAM cells are evaluated using HSPICE Monte Carlo simulations at 22nm technology node. The estimated results are contrasted with those obtained using conventional 6T (CONV6T) SRAM cell, conventional 7T (CONV7T) SRAM cell, conventional 8T (CONV8T) SRAM cell, conventional 9T (CONV9T) SRAM cell, and conventional 10T (CONV10T) SRAM cell. The Read Static Noise Margin (RSNM) of proposed 10T is same as CONV6T, CONV8T, CONV9T, CONV10T and more than 37% as compared to CONV7T. The Write Time of PROP10T is 1.2 times lower as compared to CONV 8T and 1.2/1.19/1.21/1.21 higher as compared to CONV6T/CONV7T/CONV9T/CONV10T. The Read Time of PROP10T is 1.2 times lower as compared to CONV7T and 1.13/1.53/1.14/1.26 higher as compared to CONV6T/CONV8T/CONV9T/CONV10T. The Hold Power of PROP10T is 55/15/55/55/157 lower as compared to CONV6T/CONV7T/CONV8T/CONV9T/CONV10T. The Write Power of PROP 10T is 6.2/1.68/7/4.2/2.1 higher as compared to CONV6T/CONV7T/ CONV8T/CONV9T/CONV10T. Write Static Noise Margin (WSNM) is high for proposed 10T (PROP10T) compared to other conventional SRAM cells.

**Keywords:** Read Access Time, Write Access Time, Write Static Noise Margin (WSNM), Read Static Noise Margin (RSNM), Hold Power, write power.

Paper ID: 318

## Sensor based Battery Life Prediction in Electric Mobility using Multimodal Neural Network

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**Abstract:** This study develops a multimodal neural-network and sensor-based system that will predict the SOC (state-of-charge) and also the range the electric vehicle can travel even when the battery sensors fail to predict the right output due to some noisy data. Today the EVs that use Lithium polymer batteries highly depend on a single sensor that helps measure the current and the voltage values. There can be multiple reasons a sensor can give an inaccurate or noisy output subsequently leaving the vehicle displaying the wrong SOC data on the display. In real life this can cause multiple issues during the travel for the EV users. To overcome this issue, this study introduces a multimodal prediction system that does not completely rely on a single sensor. Rather, this model does the learning/training from the battery behavior from real-world data like charging and discharging trends, distance covered, environmental factors. By integrating these various inputs, the neural network predicts the SOC and the distance the EV could travel with the SOC. The model learns how the battery discharging patterns change under different loads and conditions, by applying this we make the system more robust as it utilizes the predictive ML not just the readings from a single sensor. This also brings advantages for other electric mobility such as drones, delivery-robots, e-bikes as well in which the range prediction and battery SOC plays a vital role in bringing in efficiency, safety and route optimization. This study ultimately demonstrates that multimodal neural networks can help the system to make it more efficient and intelligent as well as robust to all conditions.

**Keywords:** Battery life prediction, multimodal neural network, sensor based battery life, baseline neural network and Adaptive neural network.

Paper ID: 323

## AI-based Anomaly Detection Framework for Insider Threat Mitigation in Industrial IoT Environment

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**Abstract:** Industrial Internet of Things (IIoT) has become one of the primary enablers of Industry 4.0, which helps in smart automation, real-time monitoring, and data-driven decision-making in smart factories. Nonetheless, the growing interconnectivity among industrial devices poses another serious security issue, especially insider threat, which may be caused by a legitimate user or a malicious internal organization. However, unlike external attacks, insider attacks are hard to detect because of the legitimate access privileges and minimal deviations in behavior, which can be a significant threat to the industrial operations and confidentiality of data. This paper presents a smart anomaly detection system that can be used to detect and prevent insider threats on Industrial Internet of Things (IIoT) systems. The suggested solution employs behavioral analysis along with a hybrid deep learning structure to combine Autoencoders and Long Short-Term Memory (LSTM) networks to successfully acquire the structural and temporal features of the industrial data. The model of autoencoders components standardizes the patterns of normal functioning and detects abnormalities based on the difference in reconstruction, and the LSTM network identifies time associations between user actions and interactions with the device. The proposed model is tested on the benchmark datasets that contain TON\_IoT and the results are evaluated with the assistance of such standard metrics as accuracy, precision, recall, F1-score, and detection latency. The experimental findings show that the proposed method attains higher detection performance than the traditional machine learning methods especially in detecting insider anomalies that are subtle. The suggested framework can be used as a scalable and effective approach to improving security in Industry 4.0 systems, and it may find use in smart factories, critical infrastructure, and cyber-physical systems.

**Keywords:** Industrial IoT (IIoT), Insider Threat Detection, Anomaly Detection, Deep Learning, LSTM, Autoencoder, Industry 4.0, Cybersecurity.

Paper ID: 324

## Implementation of an Optimized 16-Bit Vedic Multiplier Using Lilavati Adder on FPGA for High-Speed Digital Applications

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**Abstract:** Multiplication is a basic arithmetic operation used in various digital signal processing systems, image processing systems, cryptographic systems, and high-speed computation systems. The performance of the above systems is highly dependent on the propagation delay of the multiplier architectures. This paper proposes an optimized 16 x 16 multiplier architecture to enhance the computation speed. The computation speed of the proposed multiplier is improved by optimizing the partial product generation. The proposed multiplier architecture is developed by using a hierarchical modular structure and a column-wise accumulation method by using the Lilavati addition method. The proposed design is coded using Verilog HDL and implemented on a Xilinx Artix-7 FPGA platform by using the Vivado design tools. The result obtained by implementing the proposed multiplier architecture on the Xilinx platform shows a propagation delay of 20.81 ns. The maximum frequency of the proposed multiplier is approximately 48 MHz. The propagation delay of the traditional multiplier architectures proposed by various authors using the same implementation platform is within the range of 23 ns to 80 ns. The proposed method outperforms the traditional method by achieving a lower propagation delay.

**Keywords:** Vedic Multiplier, Lilavati Addition (LA), Urdhva-Tiryagbhyam (UT), Population Counter, 16-to-5 Compressor.

Paper ID: 327

## Early Detection of Breast Cancer Using Machine Learning and Deep Learning Techniques

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**Abstract:** Breast cancer is a major health concern in the world, and requiring early and accurate diagnosis in order to be treated. Due to the improved artificial intelligence, deep learning approaches have been used. have demonstrated much potential in medical image analysis through giving automated and reliable diagnostic support. However, single-model processes can easily struggle to locate the complex. patterns that are in medical data. This study proposes a hybrid deep learning model. for breast cancer detection through feature-level fusion of convolutional neural networks. The technique employs DenseNet and EfficientNet along with it to extract various features on input images. This allows the model to learn deep and efficiently scaled. representations. We also created a model, which compares ResNet. and Inception architectures to find out how well various hybrid combinations work. In order to make the system more stable and generalize, it takes advantage of. data augmentation and normalization preprocessing techniques. It is designed to classify pictures into three categories, normal, malignant, and benign. The findings indicate that feature-level fusion. is effective in enhancing model performance and might be used to assist with. early diagnosis. This work stresses how important hybrid architectures are for medical imaging and preconditions the further development of the smart breast cancer detecting systems.

**Keywords:** Breast Cancer, Deep Learning, Convolutional Neural Networks (CNN), Feature-Level Fusion, DenseNet, EfficientNet, Medical Image Analysis.

Paper ID: 329

## Design of Energy Efficient D-Latches for Low Power Applications

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**Abstract:** Energy-efficient D latch design is crucial for low-power VLSI applications, as latches form the core of sequential circuits and memory elements. This paper presents the design and comparative analysis of 7T, 6T, and 5T D latches optimized for low-power operation. The designs are implemented and simulated using Cadence Virtuoso in 45 nm CMOS technology with a supply voltage of 1V. The performance is analyzed based on power dissipation, propagation delay, and Power delay product. Compared to the 6T D-latch, it is observed in 7T D-Latch that there is -99.9978% reduction in power dissipation and increase in delay by 17.704%. Similarly, when compared to the 6T D-latch, it is observed in 5T D-latch that there is -99.9973% reduction in power dissipation and increase in delay by 16.704%. Also, a 4-bit Serial-In Serial-Out (SISO) shift register is implemented using the D latch designs. The shift register performance is analyzed in terms of power, delay, and PDP. Results indicate that the 5T latch-based shift register achieves the minimum PDP of 95.3 fJ, making it highly suitable for low-power VLSI applications.

**Keywords:** VLSI, Low-Power Design, Energy-Efficient Circuits, D Latch, Shift Register, Cadence Virtuoso, Power-Delay Product.

Paper ID: 332

## A Statistical Modelling Framework with Adaptive Multi-Model Switching for Short-Term Load Forecasting

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**Abstract:** Short-term load forecasting (STLF) is still an essential operational necessity in today's electric power system, especially in relation to the increasing variability in electric demand, renewable energy integration, and development of smart grid infrastructure. The application of statistical techniques and machine learning algorithms in STLF has been highly promising. However, most of the techniques used in STLF have been based on fixed model or ensemble strategies that do not account for input-dependent variations in electric demand. Such inflexibility in dealing with electric demand is likely to limit their effectiveness in dealing with non-linear, non-stationary, and peak demand conditions. To fill in this knowledge gap, this paper proposes an adaptive statistical modelling approach with multi-model switching for short-term electric load forecasting. The proposed approach combines seven state-of-the-art models, namely linear regression, ridge regression, Lasso regression, Support Vector Regression (SVR), Random Forest, CatBoost and LightGBM. Furthermore, it proposes an adaptive switching approach that combines model predictions using instance-level model performance. The proposed approach is tested using hourly electric demand data from the New York Independent System Operator (NYISO) dataset. A comprehensive set of preprocessing techniques, including normalization, outlier handling, and feature development, is also used. The experimental results validate that the proposed approach performs better than existing techniques with an accuracy increase of 3-5%. Moreover, the proposed approach also shows improved performance in terms of reduced root mean squared error. Furthermore, statistical validation is also used to confirm the effectiveness of the proposed approach.

**Keywords:** Adaptive Switching Mechanism, Autoregressive Integrated Moving Average (ARIMA), Categorical Boosting (CatBoost), Gradient Boosting Machine (GBM), Short-Term Load Forecasting (STLF).

Paper ID: 333

## Artificial Intelligence for Crop Yield Prediction: A Data-Driven Framework Using Machine Learning and Deep Learning Approaches

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**Abstract:** Accurate crop yield prediction is a cornerstone of sustainable agricultural planning in the face of a global population projected to exceed 9.7 billion by 2050 and a corresponding 60% increase in food demand. Conventional statistical and agronomic simulation models frequently fail to capture the nonlinear, multivariate interactions among weather patterns, soil properties, and management practices that govern crop productivity. This paper investigates the application of artificial intelligence (AI) and machine learning (ML) techniques to predict crop yields with greater accuracy and generalisability. A comprehensive data pipeline is described, integrating heterogeneous inputs including satellite-derived vegetation indices (NDVI, EVI), ERA5 climate reanalysis data, soil physicochemical properties, and socioeconomic records. Four classical ML algorithms—Linear Regression, Decision Tree, Random Forest, and XGBoost—are systematically compared alongside deep learning architectures including Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM) networks, and a CNN-LSTM hybrid model. Experimental results demonstrate that the proposed CNN model achieves a mean absolute error (MAE) of 2,513.33 and an accuracy of 0.95, outperforming baseline models. The CNN-LSTM hybrid further improves temporal generalisation. The study also identifies key challenges, including data heterogeneity, regional transferability, and model interpretability, and outlines future directions integrating IoT sensors, federated learning, and advanced optimisation algorithms for real-time precision agriculture.

**Keywords:** artificial intelligence, crop yield prediction, machine learning, deep learning, precision agriculture, IoT, remote sensing.

Paper ID: 337

## A Droop Based Virtual Synchronous Generator in an Islanded Microgrid

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**Abstract:** With the emergence of renewable energy sources and the decrease in system inertia, islanded microgrids face stability challenges. Grid-following inverters cannot control voltage and frequency independently in such circumstances. In this paper, a droop control based Virtual Synchronous Generators (VSGs) is proposed to simulate synchronous generator's behavior by offering virtual inertia and damping. For the regulation of a three-phase voltage source inverter with an output filter, a dq-frame voltage-current dual-loop controller is used in conjunction with P-f and Q-V droop loops. MATLAB/Simulink was used to assess the model's performance under island operation. A well-damped power response, precise voltage regulation, and balanced sinusoidal waveforms are demonstrated in the simulation results. In low-inertia microgrid applications, the proposed method guarantees stable voltage and frequency.

**Keywords:** Droop control, dq control, Grid-forming inverter, Islanded microgrid, Virtual Synchronous Generator.

Paper ID: 338

### **Assessment of Low Voltage Performance Metrics in Multiple 8T SRAM Architectures**

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**Abstract:** Various 8T SRAM cell designs are comparatively analyzed to determine the most performance-efficient configuration. Monte Carlo simulations were performed at the 22-nm technology node to evaluate key design metrics. The Read Stack 8T (RS8T) and Low Power 8T (LP8T) cells demonstrate the shortest read access time (TRA), whereas the Zigzag 8T (ZZ8T) exhibits the longest. The Differential Data-Aware Power-Supplied 8T (D2AP8T) achieves the fastest write access time (TWA), while the Feedback Control 8T (FCS8T) shows the slowest. Among all designs, D2AP8T also has the lowest hold and write power consumption, making it the most efficient 8T SRAM cell overall, with superior write performance and energy efficiency at the cost of slightly higher read access time.

**Keywords:** Hold Power; Read Access Time; Write Access Time; RSNM; WSNM; Write Power.

Paper ID: 344

### **A Secure Image Steganography System Using LSB Technique with Password-Based Authentication**

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**Abstract:** The increasing use of digital communication, protecting sensitive information has become an important concern. Steganography is one such technique that helps in hiding information within digital media so that the presence of the data is not easily noticed. In this work, an image steganography tool is developed using Java to hide secret text messages inside images by applying the Least Significant Bit technique. The system allows the user to select an image, enter the message, and protect it using a password. A simple graphical user interface is provided to make the encoding and decoding process easy to use. The fact that the visual quality of the image does not really change when the message is embedded in it, and the hidden data can be easily extracted with the help of the appropriate password is the result of the testing.

**Keywords:** Image Steganography, Least Significant Bit (LSB), Data Hiding, Information Security, Java, Password-Based Encryption.

Paper ID: 346

## Plant Disease Diagnosis Using an EfficientNet-B4 Deep Learning Model

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**Abstract:** The threat posed by plant diseases to the global food supply is a persistent problem, causing yield and financial losses. For diagnostics, speed and accuracy are important, but traditional methods tend to be too reliant on manual inspections that are too slow, and too inconsistent to be useful for the farming communities that need them most. This paper describes an automated diagnosis method using transfer learning with the EfficientNet-B4 architecture. Training was done with the Medley Plant Disease dataset with over 100,000 labeled leaf images spanning 39 classes. Data augmentation and model generalization fine-tuning were performed for the final model to achieve a validation accuracy of 98.41% and a test accuracy of 97.02% model, demonstrating an emphasis on the robustness of the model to diverse types of diseases. This paper illustrates the use of deep learning with high accuracy to be deployed on a mobile and cloud-based with the potential for precision farming at scale and improved decision support for farmers.

**Keywords:** Plant disease detection, Deep learning, Transfer learning, EfficientNet-B4, Precision agriculture, CNN.

Paper ID: 348

## Design and Simulation of SAP-1 Architecture Using Logisim-Evolution: A Gate-Level Approach with Structured Module Verification

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**Abstract:** The SAP-1 (Simple-As-Possible) computer, introduced by Malvino in Digital Computer Electronics, is the most widely referenced minimal stored-program architecture to understand register-transfer-level design. While many prior implementations exist — spanning TTL breadboards, FPGA platforms using VHDL or Verilog, and basic Logisim sketches — none documents a fully gate-level, bottom-up construction in Logisim-Evolution with structured per-module verification, explicit bus domain separation, and a ROM-based decimal display interface. This paper presents exactly that. Every subsystem — the 1bit D flip-flop memory cell, 8-bit register, arithmetic logic unit, program counter, instruction register, memory address and buffer registers, RAM interface, decimal decoder, and hardwired control unit — was built from elementary gates and individually verified using structured truth-table-based test suites before system integration. A key design challenge identified and solved is the absence of an output-enable pin in Logisim-Evolution (HolyCross Edition)'s built-in RAM component; an external 8-bit tri-state buffer controlled by a dedicated RAM OE signal was added to faithfully replicate physical SRAM bus-isolation behaviour. A Memory Buffer Register further separates the external data bus from the internal W-bus, preventing contention not addressed in comparable Logisim implementations. The integrated CPU correctly executes a four-instruction program (LDA 8, ADD 5, OUT, HLT), displaying the result 13 on four-digit decimal seven-segment displays, and halting cleanly. A comparison with existing SAP-1 implementations across ten design parameters demonstrates that the present work achieves deeper gate-level transparency and more rigorous verification than any prior simulation-based approach.

**Keywords:** SAP-1, digital computer architecture, Logisim-Evolution, hardwired control unit, fetch-decode-execute cycle, register-transfer level, 8-bit processor, tri-state buffer, ROM-based decoder, bus contention.

Paper ID: 349

## **Real-Time Multi-Modal Traffic Violation Detection System Using Deep Learning and Keypoint-Based Analysis**

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**Abstract:** Traffic offenses continue to be a serious issue affecting road safety, resulting in various accidents and deaths each year. This paper proposes an extensive real-time solution for traffic offense detection that combines several deep learning models for the concurrent identification of helmet offenses, driver monitoring system (DMS) offenses, traffic light following, and car speed computation. In this work, we use keypoints for accurate localizations of both helmet and seatbelt offenses, MobileNetV2 for accurate helmet classification, and custom object tracking strategies for accurate speed computation without the need for camera calibration. This solution supports the analysis of video feeds at 30 FPS rates without compromising accuracy for various traffic offenses. In this study, we validate the effectiveness of the proposed solution against three different sets of traffic data, outperforming other solutions by 98.67% for the helmet detection system, 96.33% for the DMS system, and the solution's capability for less than 5% error rates in the computation of car speed at <100ms per-frame latency. Thus, this solution can be applied for the realization of smart city traffic surveillance systems.

**Keywords:** Traffic violation detection, deep learning, YOLOv8, helmet detection, driver monitoring system, speed estimation, keypoint detection, real-time processing.

Paper ID: 356

## **Proposed Framework for Crop Stress Detection (Wheat, Maize, Rice)**

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**Abstract:** The early detection of crop stress is essential to increase agricultural output but much of the current solution involves using a multispectral sensor or satellite-based applications that are not available to small and medium-scale farmers. This article suggests the application of a cost-effective web-based stress prediction system in wheat, maize and rice using images that are taken using the traditional RGB cameras. The system does not need any specialised hardware, and it is based on the analysis of visible-spectrum images and some simplified user-provided agricultural data. Images of uploaded plants are processed on the pixel level before extracting the RGB values, which are used to approximate an NDVI to determine the health of crops. Other inputs such as the type of crop, month of sowing, and location identify the growth stages and access the current weather information through external APIs. The resulting values are fed into a rule-based decision mechanism to put the degree of crop stress in a category and provide simple actionable recommendations to farmers. The results are all stored and visualised using an interactive dashboard making historical analysis and tracking easier. Empirical evidence shows that the framework is an effective, cost-effective, and resource-accessible approach to crop health tracking through efficient data analysis and visualization of stresses to detect trends in crop health.

**Keywords:** crop stress recognition, NDVI estimation, image processing, smart agriculture, web-based system, crop health monitoring.

Paper ID: 358

## Video Game Recommendation System

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**Abstract:** The gaming industry has seen rapid expansion recently and as such, there are now countless video games to choose from. This is a great issue because it is even more difficult to find video games that resonate with a player's interests. This issue has been resolved with the development of Game Match in this study. Game Match is a custom video game recommender system that is a result of this study. It incorporates a content-based filtering approach that uses game features and user preferences such as ratings and favorites to generate recommendations. The proposed system is designed as a web platform and follows a modular architecture. To ensure the platform is reactive, user-friendly, and aesthetically pleasing, the frontend is developed in React and is designed with Tailwind CSS. In developing the backend with Python, Flask is employed to create RESTful APIs for handling user interactions, data, and recommendation processing. The system leverages MongoDB for data management and storage, which supports flexible handling of different types of user profiles and game metadata. The system uses JWT (JSON Web Tokens) to protect user authentication while managing user sessions through secure access methods. Docker together with Docker Compose enables the system to run completely in containers which simplifies deployment while enabling system expansion between various environments and enhancing system portability. The software generates customized recommendations for users according to the experimental results which confirm its ability to do so. The recommendation algorithm enables system usage to become more straightforward because it continuously monitors user ratings together with their earlier selected recommendations. The research results prove that content-based filtering provides valuable solutions for the gaming industry particularly when collaborative data remains inaccessible. This paper presents a new solution for recommender systems which combines mobile access with scalable features to provide personalized game discovery. The implementation of hybrid recommendation systems together with larger data sets and cloud system deployment for system scalability will enhance the diversity of the system's recommendations.

**Keywords:** Docker, Flask, JWT, React, Tailwind CSS, Personalized Systems, Game Recommendation, Content-Based Filtering.

Paper ID: 362

## Analytical Comparison of Design Parameters in 6T and 10T SRAM Architectures and Memory Array

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**Abstract:** This paper presents the design and analysis of 6T and 10T SRAM cells using Cadence Virtuoso at 180nm technology node. Schematic and post-layout simulations are carried out to evaluate power consumption, speed, and area. The proposed 6T SRAM cell achieves a dynamic power of 11.5  $\mu$ W, leakage power of 120nW, read delay of 0.75ns, and write delay of 0.55ns with an area of 18  $\mu$ m<sup>2</sup>. The 10T SRAM cell offers improved read stability with a read delay of 0.475ns and dynamic power of 6.5  $\mu$ W. Compared to existing works, the proposed design achieves an average power of 11.62  $\mu$ W against 898,300 W, a reduction of over 99.99%, and a write delay of 0.55ns against 0.67ns, an improvement of 17.9%. The results demonstrate that the proposed SRAM cells are highly efficient for low-power embedded applications. Write Delay: 0.55 ns(proposed) vs 0.67 ns (existing)  $\rightarrow$  17.9% faster. Average Power: 11.62  $\mu$ W.(proposed) vs 898,300  $\mu$ W.(existing) $\rightarrow$ 99.99%, less power.

**Keywords:** Area efficiency, CMOS technology, Delay analysis, Low power design, Read stability, SRAM, 6T SRAM, 10T SRAM, 45 nm technology, 180nm technology.

Paper ID: 364

## **AI Powered Digital Examination Ledger (ADEL): A Hardware Agnostic OMR Framework for Unified Assessment Analytics**

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**Abstract:** With the “Software Defined OMR” engine that has the capability to process black and white photocopied forms, The proposed framework removes the reliance on dedicated scanning hardware by enabling answer sheets to be processed using standard smartphone images. The method utilizes a microservices architecture, a Convolutional Recurrent Neural Network (CRNN) for the transcription of handwritten student IDs, bypassing the optical limitations of traditional OMR, and Four Point Perspective Transforms to account for illumination and geometric distortions. A four-tiered Adaptive Intelligence Layer further raises post-OCR identity resolution accuracy from 71.3% (raw CRNN) to 99.1% for enrollment numbers by combining a self-improving corrections log, session memory, fuzzy database matching, and a targeted human-in-the-loop fallback. Based on performance metrics, ADEL establishes a robust, hardware independent solution for educational organizations seeking to merge offline and online performance data, boasting a 99.7% overall bubble detection accuracy, 99.1% enrollment number recognition after adaptive resolution, and a processing rate of 0.7 seconds per sheet.

**Keywords:** Optical Mark Recognition, Computer Vision, Deep Learning, Educational Technology, CRNN, Assessment Analytics, Fuzzy Matching, Adaptive Intelligence.

Paper ID: 365

## **An AI-Driven Disease Prediction System for Major Indian Cash Crops**

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**Abstract:** The early and accurate identification of crop diseases remains a critical challenge in the agricultural sector. Symptoms vary for crops and diseases, making it extremely difficult for farmers to take crucial steps in a timely manner to sustain yields. This work presents a crop disease prediction system for early disease identification using images of plant leaves. Separate deep learning models were trained for several crops, namely - sugarcane, rice, wheat, cotton, and tea, enabling crop specific learning of disease characteristics. On being provided a crop leaf as input, the system predicts the two most probable disease classes along with their associated probability. To demonstrate its practical usability, the trained models are deployed through a graphical user interface developed using PyQt5. A user can select a crop type and upload an image of the leaf to generate the probability of the leaf to be diseased and its Gradient-weighted Class Activation Mapping (Grad-CAM) for explainability. This work expects to improve upon existing research by presenting a multi-crop, and explainable framework for image-based plant disease prediction. The proposed system demonstrates the potential of integrating deep learning and explainable AI to support reliable decision-making in agriculture.

**Keywords:** Crop Disease Prediction, Deep Learning, Plant Leaf Image Analysis, Crop-Specific Models, Convolutional Neural Networks (CNN), Explainable AI, Gradient-weighted Class Activation Mapping (Grad-CAM).

Paper ID: 368

## **An Explainable AI Framework for Brain Tumor Classification from MRI Using EfficientNetV2 and Swin Transformer**

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**Abstract:** Classification of brain tumors through MRI (Magnetic Resonance Imaging) is very important in the field of medical diagnosis as early and correct identification plays an important role in successful treatment. Interpretation of MRI images by hand is laborious, and the process depends on the variability of the radiologists reading the images, which makes intelligent and automated systems necessary. In this research paper, we propose an efficient approach to classify brain tumors in four classes: pituitary tumor, meningioma tumor, glioma tumor, and normal brain. This work uses two novel networks, EfficientNetV2, and Swin Transformer. These models have been trained via transfer learning, data augmentation, and optimization in the training process to enhance generalization performance. Experiment results indicate that the EfficientNetV2 model has an accuracy rate of 96% and an F1-score of 0.96, surpassing the Swin Transformer model which records an accuracy rate of 94% and an F1-score of 0.94. Although EfficientNetV2 is very efficient in capturing local feature information from the image, the Swin Transformer model is efficient in understanding the context thanks to its ability to capture spatial relationships using self-attention techniques.

**Keywords:** Brain Tumor Classification, MRI, EfficientNetV2, Swin Transformer, Deep Learning, Explainable AI, Eigen-CAM.

Paper ID: 370

## **FinVision AI: An Intelligent Personal Finance Management System Using AI-Based Predictive Analytics**

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**Abstract:** Good management of personal finances is a necessity in the name of financial stability; however, a large percentage of the population is faced with challenges in breaking down their spending habits and how to structure an effective budget. The current financial software has a significant focus on solid transaction monitoring and lack of deep intelligent analytical and predictive features. FinVision –, an artificial intelligence (AI) based personal finance management software, is created to provide real-time finances, analyze patterns about expenses, intercept irregularities, provide personalized budget suggestions, and forecast costs. The system is built on the basis of the modern web technologies and the microservices-based architecture to be scaled, secure, and perform. Historical transaction data is analyzed using machine-learn methods and anomalous spending patterns are detected and future expenses are predicted. To protect the privacy of the users, secure authentication protocol and practices on data-protection are in place. Experimental analysis confirms that FinVision AI can identify anomalies (with an F1-score of 0.83) as well as forecast future costs (with a Mean Absolute Error of ₹345) and therefore generate actionable financial information. The system promotes awareness of the financial behavior of the users and allows making more informed decisions. FinVision is an AI that serves as an example of how AI can be used to make traditional systems of tracking finances smarter and more predictive financial assistants.

**Keywords:** Personal Finance Management, Artificial Intelligence, Machine Learning, Predictive Analytics, Web Application.

Paper ID: 371

## **Car\_Valuate: Car Valuation Made Easy Using Machine Learning**

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**Abstract:** The swift growth of online used-car market places has raised the pressure on proper, transparent, and automated systems of valuation of car prices. Pricing of used cars is a complicated fact, because it is related to several variables which are interconnected including age of the vehicle, miles covered, type of fuel used, transmission, ownership record, and market demand. Traditional valuation techniques founded on subjective appraisal or rudimentary statistical models may be subjective as well as weak in predictive ability particularly when non-linear depreciation patterns are dealt with. In this paper, Car-Valuate is proposed, a car valuation system that works based on machine learning and uses historical data to predict real used car prices. First, a Linear Regression model is used as a baseline because they are not complex and easy to interpret but in the actual experiment, it is shown that it has significant mistakes in prediction because it assumes linear relations between variables. In order to address these shortcomings a Random Forest Regressor is used which uses ensemble learning to learn the intricate non-linear interactions of features. The systematic data preprocessing steps to be included in the proposed system are the processing of missing values, encoding categorical features, feature selection, and the logarithmic transformation of the price values. The trained model will be implemented with the help of the Flask-based backend and combined with a web-based frontend written in HTML, CSS, and Bootstrap, which will allow interacting with the user in real time. The evaluation of the results of the performance shows that the predictions made by the Random Forest model are in close correlation with the real prices in the market, and they are far more effective and robust as compared to the Linear Regression. Evidence proves that Car-Valuate is a powerful system.

**Keywords:** Car price prediction, Machine learning, Regression techniques, Linear regression, Random Forest Regressor.

Paper ID: 372

## **Design And Implementation of A Java-Based Bug Tracker with Enhanced User Role**

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**Abstract:** An efficient bug tracking solution gives all members of the software development team (testers, coders, managers, administrators, etc.) a means to locate, submit, distribute and solve software bugs quickly and accurately. The purpose of this bug tracking solution is to provide a quick, accurate and reliable means for these individuals to work together with each other. The design of the bug tracking solution is based upon an established process for reporting bugs, secure user logins, and the ability to view real-time status updates of both software bugs and bug reports. Please note that the two primary views of the software for the bug tracking solution are: The back-end (software logic), and the end-user's experience managing and tracking bugs in the solution. The back-end logic of the solution is designed using Object-Oriented Programming (OOP), allowing for the creation of reusable, modular components and customized to each user-type. When a user (any user type) submits the status of their bug report, the user's request will first check that enough information on the bug being reported exists, that it has been validated as correct, and that this information can be stored in a manner that can track that bug in the future. Additionally, the bug tracking solution allows the insertion of bug severity and bug urgency levels, which enables users to determine how they should proceed in resolving a bug. In the user face thing, a Java Swing based GUI that gives users a place that's pretty easy to use. Where, users can put in bugs, update how far along they are, look over what they've been given to do, and take care of system data. Future stuff to hook it up with MySQL will make sure the data is safe, and Maven project management will help it grow and handle what it needs to work. These parts work together, to make a user-friendly tool that is definitely going to improve software quality and help the teams work together better.

Paper ID: 373

### **Design of Energy Efficient high speed Vedic multiplier for squaring operation**

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**Abstract:** A low-power, high-performance Vedic multiplier for squaring operations is presented in this work. The Urdhva Tiryagbhyam algorithm, which allows for the simultaneous generation of partial products through vertical and crosswise computation, is used in the architecture's development. The implementation of 2, 4, 8, and 16-bit multiplier units uses a hierarchical structure. An optimized hybrid full adder based on XOR and XNOR is integrated for effective sum and carry generation in order to improve performance. When compared to traditional implementations, the suggested design shows appreciable gains in power consumption, propagation delay, and power–delay product (PDP). The architecture's scalability and modularity make it appropriate for embedded applications, DSP processors, and high-speed arithmetic systems.

**Keywords:** Vedic Multiplier, Urdhva Tiryagbhyam, Hybrid Full Adder, Squaring Architecture, Low-Power Design, Power– Delay Product, Ripple Carry Adder.

Paper ID: 376

### **Design of a 64 bit SQRT CSLA for Reduced Area, Low power, and High Speed**

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**Abstract:** Carry Select Adders (CSLA) structures are one of the most common forms of fast arithmetic units as they can greatly reduce the carry propagation delay as compared with the traditional ripple carry adders. However, RCSLA design has been reported to consume more area and power mainly because of duplicate ripple carry adders. This research has carried out designing and performance estimating of 64-bit RCSLA vs a modified 64-bit SQRT-CSLA from the perspective of speed improvement and power saving. The modified SQRT-CSLA has the adder broken down into variable-sized blocks following the square root method and one of the ripple carry adders in each block replacing with a Binary to Excess-1 Converter (BEC) to eliminate redundant logic and reduce switching activity. Both architectures have been written in Verilog HDL, and functional simulation and performance analysis have been employed. From the simulation results, it can be seen that the modified SQRT-CSLA yields the substantial reduction of power, and delay the propagation compared with the regular CSLA architecture and is suitable for use in high-speed and low-power VLSI designs such as the arithmetic logic units, processors, and digital signal processing systems.

**Keywords:** SQRT-CSLA, Carry Select Adder (CSLA), Binary Excess- 1 Converter (BEC), Low Power VLSI, FPGA, High-Speed Adder.

Paper ID: 379

## AI Powered Resume Screening System with ATS Score

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**Abstract:** The use of an effective resume screening/application assessment service enables job candidates, hirers and colleges to properly and promptly scrutinize job applicants. An AI Resume Screening Application incorporating (ATS) Score features (ResumeATS Pro) is meant to provide an automated system for conducting resume analyses from an AI and NLP technology vantage point, thus permitting users to assess and evaluate their resumes within the framework and parameters dictated by the best practices of the industry in conjunction with ATS systems. A system for reviewing resumes will allow for the extraction of the important information in order to provide a score on how closely related the resume is to the job description. This system extracts keywords, qualifications and skills relevant to the position and produces an automatic score for ATS compatibility with the job description. The structured feedback provided by this system will include a skills gap analysis, keyword suggestions, recommendations for resume improvement and information about possible job roles. Users of this system can repeat this process many times to make their resume better and increase their chances of being on the "shortlist" when applying for positions that are processed through the automated application systems. The architecture of the system is divided into two major parts, the User Interface and the Processing Logic. Python is used to create the system's backend; within this structure, an Object-Oriented Design builds modularity into Python, allowing for greater scalability, re-use and maintainability of code. Additionally, AI is leveraged to analyze resumes uploaded by users utilizing Generative Models to provide contextualised and personalised feedback. In contrast, the Frontend employs Streamlit, permitting users to upload their resume, elect an analysis option, and view results interactively and intuitively. By utilizing the Intelligent Parsing, Indexing and Scoring Engine (IPESE) to evaluate job candidates through resume analysis, ResumeATS Pro provides hiring companies and candidates an exceptional degree of precision when evaluating resumes and improving their ability to be read by applicant tracking systems (ATS). The rapidity with which it produces results enables quick utilisation by applicants, education and supportive job placements for employers. Additionally, the application of IPESE's AI in recruiting technology reflects how AI can be used effectively in human resources while safeguarding individuals' privacy as well as data security and reliability in IPESE's recruiting process.

Paper ID: 382

## AI-Driven Fraud Detection in Blockchain Transactions

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**Abstract:** The technology of blockchain has become one of the most revolutionary inventions in the contemporary digital frameworks and provides decentralized, transparent, and unalterable systems of transactions. It has gained swift gains in various fields including cryptocurrencies, financial services, supply chain management, healthcare systems, and decentralized applications. Although cryptographic methods and distributed consensus mechanisms offer a level of security inherently, blockchain networks do not exclude fraudulent attacks. With the growing adoption of blockchain, malicious actors have constantly used the loopholes in the systems to perpetrate illegal activities and unethical practices such as money laundering, phishing, Ponzi schemes, counterfeit initial coin offerings, double spending, and illegal transfer of funds. Such fraud is of great risk to trust, financial stability and the general reliability of the blockchain-based ecosystems. Conventional methods of fraud detection that are employed in financial systems are more or less based on rule-based methods, preset values, and human oversight. Such techniques can be used in controlled systems, but do not perform well in a blockchain setting because the number of transactions is huge, the rate of data creation is rapid, the addresses of the wallets are pseudonymous, and the fraudsters are constantly innovating. In addition, rule-based systems are not flexible enough to accommodate new fraud patterns and the rule-based systems produce high false positive rates and thus ineffective detection and blocking of transactions. This has led to an increasing demand of smart, adaptive and automated fraud detection systems that can work effectively in the case of blockchain environments. Machine learning and methods of deep learning are the aspects of Artificial Intelligence (AI) that have demonstrated significant opportunities to solve challenging and difficult security problems that may involve various data sets. The systems based on AI can learn unobvious patterns, detect anomalies, and adjust to new behavioural patterns without strictly adhering to the rules, which are defined by humans. Considering blockchain transactions, the EDA of fraud can be applied to historical transaction records, identify behavioural patterns of wallet addresses, and identify suspicious transactions, which do not follow the regular pattern of transactions. The given research paper proposes a project of AI-based fraud detection in blockchain transactions, as it will contribute to improving security, accuracy, and reliability of blockchain-based financial systems. The offered method is aimed at processing the blockchain transaction data by the power of the data preprocessing, feature engineering, machine learning, and deep learning methods. The datasets that were used are publicly available blockchain transaction datasets, and they include attributes. as sender address, receiver address, transaction value, timestamp, transaction frequency and wallet activity patterns. The first important problem that is considered in this research is that blockchain fraud data is highly imbalanced, with only a minor percentage of the overall data being fraudulent transactions.

Paper ID: 386

## **Real-Time IoT-AI Enabled Nano-Sensor Platform for Predictive Fault Detection in Photovoltaic Panels**

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**Abstract:** Solar photovoltaic (PV) systems have become exponentially widespread throughout the globe as a component of sustainable energy policy. However, flaws in the operation process like micro-cracks, thermal irregularities, contamination and delamination consume energy production and threaten system stability. Traditional detection methods based on periodic electrical telemetry or serial thermal imaging suffer because they are reactive in nature, are expensive and not continuous. This paper presents an IoT-AI powered nano-sensing platform that is affordable in providing real-time predictive fault detection. Clear nano sensors are made of graphene plated through the surface of the PV module to interface with a highly power-efficient VLSI node which houses a RISC-V SoC, in-board analog front-end, low-power ADC and LoRaWAN wireless communication. A small (1-D convolutional) neural network, used through a TinyML platform, is used to classify faults- normal, hotspot, crack, delamination, delamoured, soiling, etc.- with over 96% accuracy at less than 8mW average power. Digital twin analytics on the cloud also simplify preventive maintenance and automated fault recovery by reconfiguring DC optimizers. Early detection of faults on a 1000W rooftop testbed of up to 72 hours before electrical abnormalities occur, 18% energy loss reduction and low-34% cost reduction, on average, in maintenance costs as compared to traditional monitoring. The article combines nanomaterials, VLSI design, IoT communication and machine learning in an energy-neutral scalable solution to next-generation smart PV.

**Keywords:** Photovoltaic fault detection, Graphene nanosensors, IoT, TinyML, Edge-AI, Predictive maintenance, VLSI, LoRaWAN, Digital twin.

Paper ID: 392

## Federated Learning with Feature Space Heterogeneity

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**Abstract:** In traditional personalized federated learning (FL), it is often assumed that all clients share a common feature space. This assumption breaks down in real-world applications, where clients collect and store data in structurally and semantically diverse formats, leading to heterogeneous feature spaces. While recent approaches like FLIC attempt to align client representations using Wasserstein distances to global anchor distributions, they rely on predefined assumptions about feature distributions and deterministic embeddings. This study proposes a novel framework that integrates Variational Autoencoders (VAEs) with contrastive learning to address key challenges in federated learning, especially those arising from heterogeneous and non-IID data settings. Each client learns a probabilistic latent representation of its local data using VAEs, enabling the construction of a shared latent space across clients. Rather than aligning features to global anchors, we employ contrastive learning (e.g., InfoNCE or Supervised Contrastive Loss) to align semantically similar instances across clients in a data-driven, anchor-free manner. This eliminates the need to estimate class-wise distributions and enhances the flexibility and richness of the learned representations. Our approach supports both supervised and unsupervised federated setups, enabling personalized yet collaborative learning in environments with limited communication and high client diversity. The proposed approach is evaluated on benchmark datasets encompassing both synthetic and real-world heterogeneity. Experimental findings demonstrate enhanced robustness and superior performance in low-resource and high feature-variance settings when compared with Wasserstein-based alignment techniques. This thesis contributes a scalable, generative, and flexible alternative to classical alignment techniques in cross-domain federated learning.

**Keywords:** Federated Learning, Feature Space Heterogeneity, Personalized Federated Learning, Variational Autoencoder, Contrastive Learning.

Paper ID: 398

## Comparative Analysis of BJT Models for SCR Simulation Using Two-Transistor Analogy

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**Abstract:** This paper presents a comparative analysis of Ebers–Moll and Gummel–Poon transistor models for the simulation of a silicon-controlled rectifier (SCR) using the two-transistor analogy. The SCR is implemented in SPICE using coupled PNP and NPN transistors, and its switching behavior is analyzed under identical conditions. The Ebers–Moll model exhibits abrupt switching due to the absence of dynamic effects, while the Gummel–Poon model demonstrates smoother transitions and transient oscillations due to charge storage and capacitance effects. Although both models show similar switching instants based on voltage collapse, the Gummel–Poon model provides a more realistic representation of SCR dynamics.

**Keywords:** BJT, Silicon Controlled Rectifier (SCR), Two-Transistor Model, Ebers–Moll Model, Gummel–Poon Model, SPICE Simulation.

Paper ID: 402

## **Multimodal Affective Computing: A Dual-Stream Architecture for Real-Time Emotion Verification**

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**Abstract:** Human communication is inherently multimodal, relying on a complex interplay between facial expressions and vocal prosody. However, traditional Affective Computing systems often rely on unimodal analysis—typically visual—which renders them susceptible to error when subjects mask their true emotions (e.g., a "social smile" concealing anxiety). To address this limitation, this paper proposes a real-time Multimodal Emotion Perception System that integrates visual and acoustic cues using a sequential asynchronous pipeline. The architecture leverages DeepFace (VGG-Face) for facial feature extraction and a fine-tuned Wav2Vec2 Transformer for speech sentiment analysis. The Multimodal Congruence Index (MCI) is a new decision level fusion algorithm that is used to measure the semantic agreement between modalities. The results of the experiment prove that unimodal accuracy varies in noisy conditions, whereas the proposed fusion model manages to detect emotional conflict with accuracy 88% correct, which is a strong solution to behavioral analysis and detecting lies in the interview context.

**Keywords:** Multimodal Fusion, Affective Computing, DeepFace, Wav2Vec2, Congruence Index, Human-Computer Interaction.

Paper ID: 406

## **Psychiatric Language Modelling for Suicide Risk Detection: MentalBERT Fine-Tuning Across Machine Learning Classifiers on Large Scale Data**

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**Abstract:** Suicide is a relevant worldwide social health issue and text analysis in social media can present an opportunity to intervene in time. This paper will provide a comparative analysis of the conventional feature extraction strategies and transformer-related methods of automated suicide risk identification based on posts in online mental health groups. Five methods of extracting features were tested: TF-IDF, Bag of Words (BoW), N-gram, fine-tuned BERT and MentalBERT embeddings. Two BERT models were explored: general-purpose BERT and MentalBERT, a domain-targeted model that was pre-trained on mental health discussions on Reddit communities. 20,000 balanced samples were fine-tuned with five machine learning classifiers: Random Forest, Support Vector Machine (SVM), Logistic Regression, XGBoost, and LightGBM. Findings have shown that the MentalBERT model with the Logistic Regression model surpassed all the other traditional feature extraction methods and Frozen BERT Embeddings by a significant margin with a high F1-score of 0.9808 and AUC of 0.98. Importance analysis of features showed that there are linguistic patterns with high linkage with suicidal ideation. Specialized linguistic patterns in mental health discourse: domain-specific pre-training of MentalBERT was very effective in capturing subtle linguistic patterns in mental health discourse, showing the vital role of specialized language models in sensitive text classification tasks in clinical domains.

**Keywords:** Suicidal ideation detection, BERT fine-tuning, MentalBERT, mental health NLP, social media classification, transformer embeddings, SHAP interpretability, Reddit.

Paper ID: 408

## AI Powered LMS for Online Learning

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**Abstract:** The Learning Management system (LMS) has turned into an indispensable part of the contemporary educational process as it allows institutions to provide online courses and control learning processes in an efficient manner. Nonetheless, the majority of currently available LMS solutions are based on outdated text-based interfaces and text-based search engines, which usually lead to low usability, narrow accessibility, and ineffective search of the course. The work of this research paper describes the design and development of an AI-powered Learning Management System created with the application of MERN Stack (MongoDB, Express.js, React.js, Node.js) and linked to the voice-enabled intelligent course search system on the Gemini API. The proposed system will enable various user aspects such as student and educator whereby the educator can create, upload and manage courses whilst the student can search the course using natural voice commands. The Gemini API can be used in speech-to-text translation, natural language comprehension, and query interpretation, which allows retrieving the required courses correctly. Through experimental assessment, it is shown that there is better search accuracy, increased user satisfaction, and accessibility as opposed to conventional LMS platforms. The suggested system points to the efficiency of the integration of AI-based voice interfaces with the current full-stack technologies to facilitate digital learning.

**Keywords:** AI-Powered LMS, MERN Stack, Voice Search, Gemini API, E-Learning, Semantic Search.

Paper ID: 412

## Deep Learning Approaches for Memory-Efficient MRI-Based Multi-Class Brain Tumor Segmentation Using 3D U-Net

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**Abstract:** Precisely and automatically dividing brain tumor subregions based on multi-modal magnetic resonance imaging (MRI) volumes is one of the most complicated issues in medical image analysis, mainly because the gliomas vary a lot between patients, the different tumor subregions are barely distinguishable, and working with volumetric three-dimensional data results in high computational demands. This work introduces a reproducible, memory-efficient segmentation pipeline utilizing a residual three-dimensional U-Net, trained with the MONAI framework and PyTorch, aimed at the Brain Tumor Segmentation (BraTS) 2020 benchmark dataset. The model receives four co-registered MRI modalities: FLAIR, T1, T1CE, and T2— as a four-channel volumetric input and produces voxel-wise predictions across four semantic classes: background, necrotic and non-enhancing tumor core (NCR/NET), peritumoral edema (ED), and enhancing tumor (ET). A tumor-aware patch sampling strategy enforces that 75% of training patches are anchored to foreground tumor voxels, dramatically improving convergence on the clinically critical but spatially sparse enhancing tumor class. Trained with composite Dice-CrossEntropy loss, AdamW optimization, cosine annealing scheduling, and automatic mixedprecision (AMP), the model achieves a best validation Dice of 0.6691 on a held-out split of 74 cases, with class-wise Dice scores of 0.976 (NCR/NET), 0.987 (ED), and 0.981 (ET), and a mean 95th-percentile Hausdorff distance of 3.41 mm. Ablation experiments confirm that tumor-aware sampling contributes the greatest single improvement (−0.030 mean Dice when removed), followed by data augmentation (−0.025). The complete pipeline operates within 6 GB VRAM on a consumer-grade NVIDIA RTX 3060 GPU and is released as a single self-contained script to promote reproducibility.

**Keywords:** Brain tumor segmentation, BraTS 2020, 3D U-Net, MONAI, patch-based training, tumor-aware sampling, multi-modal MRI, mixed-precision training, DiceCE loss, cosine annealing, sliding-window inference, medical image segmentation.

Paper ID: 415

## **A Comparative Study of Machine Learning, Deep Learning, and Transformer-Based Models for Fake News Detection**

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**Abstract:** The BERT model shows a steady decrease in both training and validation loss, as well as an improvement in accuracy. This shows that the model is converging and learning the context effectively, without any signs of overfitting. The digital news media and social media have significantly changed the manner in which people consume information. Although the digital news media has improved the dissemination of information, it has also resulted in an increase in the dissemination of false information. False information is disseminated rapidly due to its sensational headlines and the fact that it is disseminated without verification. Proposed in this paper is a comprehensive text- based fake news detection system using machine learning and deep learning techniques. Several traditional machine learning classifiers are experimented with TF-IDF feature extraction techniques, including Naive Bayes, Logistic Regression, Support Vector Machines, Random Forest, and SGD Classifier. In addition to this, several deep learning models like Convolutional Neural Networks (CNN), Bidirectional LSTM (BiLSTM), and a fine- tuned BERT transformer model are also employed for semantic feature extraction of the text. The performance of all models is compared using standard evaluation metrics such as accuracy, precision, recall, and F1-score. The proposed model achieves up to 99% accuracy. Results show that the transformer models are performing better than the traditional models because of their understanding of the context, and the traditional models are performing well with less computational complexity. The importance of the combination of classical and modern approaches in NLP for effective misinformation detection is the focus of this paper.

Paper ID: 417

## **Simplifying Personal Finance Management Through AI-Based Expense Analysis and Visualization**

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**Abstract:** The Personal Finance Management System is developed to assist persons in handling their income and expenditure in a convenient and systematic way. This project has been developed by means of HTML, CSS, JavaScript, and MongoDB as well as an analysis layer based on AI to enhance financial knowledge. The application is primarily targeted at users who are interested in the management of their income and expenditures without the usage of the complex financial applications. The system is able to document the daily financial transactions and examine the spending patterns to determine financial trends. These trends are presented in the shape of easy and simple charts, which make it easier to see their financial performances in a clear manner. The primary goal behind the system is to promote improved financial behavior and raise the awareness level of individual spending. In contemporary society, various people particularly young people have trouble controlling their finances as most of the available financial management tools were elaborate and not easily accessible. In this application, this problem will be resolved by offering a streamlined system that dedicates itself to key events like tracking of expenses, automatic categorization of transactions, and storage of data which is safe. The system has artificial intelligence that can analyze the financial data and provide the user with more information about the spending habits. It is implemented in form of web-based application that is connected to the database that guarantees the safety of information financial and allows it to be accessed whenever they want. The enhancement of the system can be done in the future with user- registration, real time financial analysis, predictive budgeting and individual financial recommendations to make the system more interactive and user friendly. In sum, the suggested system offers an easy, effective and smart approach towards personal finances management in the daily life.

**Keywords:** Personal Finance Management, Artificial Intelligence, Expense Tracking System, Financial Data Analysis, Web-Based Application, MongoDB Database, Spending Pattern Analysis.

Paper ID: 424

## Ferroelectric Material Design and Engineering toward Scalable Energy-Efficient NCFET Devices

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**Abstract:** The widespread reliance on the devices of laptops, smartphones, smartwatches, and cameras has contributed to the continued desire to achieve better processing, memory and energy efficiency in the current technological age. This requirement has seen CMOS technology grow very rapidly. This shrinkage leads to critical problems as a higher power consumption and limitations on scaling voltage and fabrication complexity and short-channel effects (SCEs). One of the primary limitations of the traditional MOSFETs is the thermionic subthreshold slope (SS) of 60 mV/decade that cannot be further reduced in power supply voltage (VDD). Another type of competitive alternative to this restriction is the use of Negative Capacitance Field-Effect Transistors (NCFETs), that incorporates ferroelectric materials into the gate stack to provide sub-60 mV/decade SS by internal voltage amplification without impacting on-state performance. It has steep SS, reduced leakage current, negative DIBL, and NDR suppressed SCEs, and lower switching at lower VDD are only some of the numerous benefits that NCFETs offer. Consequently, they can be used in applications in the future that require high efficiency and are performance sensitive and especially in portable electronic devices and in the Internet of Things.

**Keywords:** Hafnium Oxide, Energy Efficient, NCFET, Subthreshold swing (SS), Ferroelectric Materials.

Paper ID: 427

## Vision-Based Human Activity Recognition using Skeleton Pose Estimation and Machine Learning

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**Abstract:** Human activity recognition (HAR) is essential in domains such as healthcare, surveillance, security monitoring, and human-computer interaction. This study addresses the classification of six fundamental human behaviors: punch, stand, sit, squat, wave, and kick. Machine learning algorithms, including Logistic Regression, CV, Random Forest, and Support Vector Machine (SVM), are implemented for activity classification. A vision-based skeleton pose estimation technique is utilized to extract human body features, with the dataset processed using OpenPose. The model is evaluated across different age groups, including adolescents, adults, and middle-aged individuals. System outputs are presented as probabilities on a video feed, with the final classified action displayed onscreen. Results are dynamic and real-time, updating continuously as the system operates in an infinite loop. Face and body coordinates are mapped directly from the raw camera feed, enabling precise recognition of movements with high reliability in real time. The proposed framework demonstrates effective classification of human body actions under varied conditions. This approach underscores the societal applications of HAR, ranging from medical monitoring to public safety, and supports context-aware intelligent systems for human behavior interpretation. The probabilistic on-screen results enhance transparency and usability. The findings validate the potential of combining machine learning with pose estimation for real-time HAR tasks.

**Keywords:** Human Activity Recognition, Machine Learning, Pose Estimation, MediaPipe, Real-Time Detection, Computer Vision.

Paper ID: 432

## **Dynamic Functional Connectivity and Graph Neural Networks for EEG-Based Cognitive Workload: A Comprehensive Implementation Study**

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**Abstract:** Measuring mental workload is important to understand cognitive states while performing tasks in areas like human-computer interaction, aviation, education, and healthcare. Electroencephalography (EEG) signals provide valuable information about brain activity and are often used for cognitive analysis. This paper presents a detailed Graph Neural Network (GNN) approach for classifying mental workload into High and Low categories. The EEG signal undergoes bandpass filtering and z-score normalisation, then is divided into segments using a sliding window method. Phase Locking Value (PLV) is computed to estimate functional connectivity among EEG channels, indicating how neural oscillations synchronise. These connectivity matrices are represented as graphs, where nodes represent EEG channels and edges represent functional connections, which are input into the GNN model. The proposed system effectively captures inter-channel relationships through spatial graph convolutions and surpasses traditional machine learning methods for data classification. Experiments on the STEW (Simultaneous Task EEG Workload) dataset show in-subject accuracies of 93.79% and cross-subject accuracies of 55.33% in graph decoding. This deep learning approach applied to EEG signals successfully identifies mental workloads, indicating potential for real-time cognitive state monitoring applications.

**Keywords:** Mental Workload, EEG, Graph Neural Networks, Phase Locking Value, Functional Connectivity, Brain-Computer Interface, Deep Learning, Cognitive State Assessment.

Paper ID: 433

## **Low-Power Optimization of an FSM-Based Elevator Controller System**

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**Abstract:** Power consumption is a critical concern in contemporary Very Large-Scale Integration (VLSI) systems owing to increasing demand for energy-efficient electronic devices. Reducing power while maintaining system performance is an important objective in digital circuit design. This paper describes the design and low-power optimization of an elevator controller based on Finite State Machine (FSM) implemented in the Register Transfer Level (RTL). The controller manages elevator operations such as floor requests, movement, and emergency stop using a structured FSM architecture. The suggested design uses various low-power methods, such as power-aware state encoding with gray code and gray encoding with clock gating to lower the total amount of dynamic power used. The Xilinx Vivado suite is used to construct the suggested design in Verilog. According to empirical analysis, every method helps to lower dynamic power. In comparison to the baseline design, the improved design reduces total on-chip power by 36.69 % and dynamic power by 39.0 %. The findings show that the power efficiency of FSM-based elevator controller systems may be enhanced by combining several low-power strategies while maintaining functionality.

**Keywords:** state encoding, elevator controller, low-power VLSI architecture, clock gating, and finite state machines.

Paper ID: 451

## Neuromorphic Fingerprint Recognition via Dense Attention Enhancement and Spiking Neural Networks

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**Abstract:** Degraded fingerprints caused by dry skin, dirt, or weak sensors remain a significant problem in biometric authentication. To improve the efficiency of neuromorphic recognition, this paper proposes a two-stage framework that integrates fingerprint enhancement with neuromorphic recognition. A Dense Attention U-Net (DenseAttUNet), guided by ORRAM, is used to restore damaged ridge patterns. The restored output is subsequently injected into an EfficientNet-B2 backbone, where ERRAM bridges spatial characteristics with a Spiking Neural Network (SNN) for energy-efficient classification. The entire system was trained and tested on 4,695 degraded fingerprints. The enhancement gave a PSNR of 18.04 dB and SSIM of 0.7380. Recognition achieved 85.12% accuracy and an F1score of 85.74%. These findings verify that combining brain-inspired computing with intelligent image restoration provides a robust, scalable fingerprint recognition system under real-world degradation.

**Keywords:** Fingerprint Enhancement, Spiking Neural Network (SNN), Dense Attention U-Net, EfficientNet-B2, Biometric Recognition, Neuromorphic Computing.

Paper ID: 456

## Convergence of Block chain and Cyber security: A Systematic Review of Emerging Threats and Advanced Defenses

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**Abstract:** A system of ledger that is decentralized and that cannot be changed, dubbed blockchain technology has received considerable interest beyond cryptocurrency. It can provide a groundbreaking means of enhancing cybersecurity. This essay provides a review of literature to analyze the current state of the blockchain integration into cybersecurity developments. Our qualitative research design is a combination of the knowledge gained through the recent scholarly literature, the industry publications, and technical research, in order to explore the diverse uses of these two disciplines, the challenges in these disciplines that persisted over the years, and the new solutions to these fields which are converging. We find that blockchain could potentially fix significant cybersecurity issues, in particular, identity and access management (IAM), data integrity, and Internet of Things (IoT) protection (Ndri, 2023). However, new threats such as advanced smart contract exploits, cross-chain bridge attacks, and privacy holes cost billions of dollars annually and are full of the landscape (Chainalysis, 2025a; Halborn, 2024). The research and business worlds are responding by developing superior methods of securing themselves. To give an example, they are integrating the fields of artificial intelligence (AI) and machine learning (ML), privacy-enhancing techniques such as Zero-Knowledge Proofs (ZKPs), and Post-Quantum Cryptography (PQC) to create quantum-resistant blockchains. This paper provides detailed discussion of these threats and mitigation strategies, discusses viable case studies, and deals with the strategic importance of surpassing regulatory issues and issues of scalability to large scale adoption. We end by identifying future research areas of interest and implicated by stating the need to collaborate in developing resilient, scalable, and compliant blockchain-based security solutions.

**Keywords:** Blockchain Security, Cybersecurity, Decentralized AI, Zero-Knowledge Proofs, Post-Quantum Cryptography, Smart Contracts, Cross-Chain Bridges, Systematic Review.

Paper ID: 459

## AI-Based Resume Matching System Using BERT Semantic Analysis

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**Abstract:** Online recruitment has increased at a very fast in recent years, and the shortlisting of a resume is a very tough task for a company recruiter because he/she received 1000 of resumes for a job, and checking each resume is a time-consuming task and it increases the human bias also. In the earlier time the resume matching is performed by the keyword-based shortlisting, which fails to understand the meaning of the that word. This paper is a resume matching and also resume analysis developed by MERN stack integrated by Python based BERT pipeline. These systems have mainly two function job giver and a job seeker. In the job giver the recruiter can upload a multiple resume and job description The system shortlists the candidate based on resume screening Also recruiter can sort list N number of candidates they want to sort list the job seeker can upload a resume and check their percentage of matching with job description. This system uses the BERT model to understand the meaning of the keyword Also, it differentiate between the similar keyword This results in a more accurate and transparent screening process It enhances accuracy and also fairness in the selection of the candidate. The proposed system provides a scalable and intelligent solution for the modern candidate selection process through the Resume screening.

**Keywords:** Resume Screening, Semantic Resume Matching, BERT, Natural Language Processing (NLP), Skill Gap Analysis, Resume Ranking, Recruitment Automation, MERN Stack, Python-based AI Pipeline.

Paper ID: 480

## CrowdSourced Event Management System

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**Abstract:** The need for effective and intelligent management systems in the event management industry is growing quickly as events are getting bigger, more complex, and more abstract than ever before. The event management process currently has many issues that make managing an event difficult for events managers, including difficulties with scheduling (due to conflicts), problems with accuracy of data (e.g., due to inconsistent data), staffing issues (e.g., due to being overworked), and limited opportunities to interact with the public. Solutions to solve these event management issues are categorized into two main classes: 1) The Capstone Event Management System (CEMS) and 2) The Smart Scheduling Solution (SSS). The CEMS is a computer application that offers intelligent features using artificial intelligence technology. The CEMS will be provided to event managers via the web in an enterprise-level application, as opposed to an event-by-event basis. The CEMS will utilize Machine Learning technologies to provide event managers with individual event suggestions based upon event managers' preferences, as well as their previous event attendance history. SSS offers event managers with smart scheduling technologies that help them to eliminate scheduling conflicts and ensure that all available resources are utilized at every event. The fundamental design of an integrated event management system is based on a database-driven and scalable architecture that provides security, and a role-based access management process to enable event managers to effectively manage all data related to events.

Paper ID: 483

## **An iOS Application for Intelligent Creator-Talent Discovery and Collaboration Driven by Design Thinking**

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**Abstract:** The creator economy, estimated to be worth more than 2.1 billion dollars and expanding fast, has offered huge benefits of individuals to commercialize their abilities, but one of the most critical problems remains the ability to find an appropriate partner who compliments capabilities and has comparable creative goals. Research has shown that almost 71 percent of creators or about 50 million individuals around the world find it difficult to discover their talents, this affects ambitious projects, and leads to inefficiency and burnouts. To overcome this challenge, Creatist is envisioned as an iOS application that is based on design thinking and is focused on smart collaborator discovery and simplified collaboration. In addition to the normal networking, the platform features features such as end-to-end features; intelligent search and filtering, portfolios, project portfolio, tasks with a deadline, centralized files sharing, and real-time communication through chat rooms and phone calls. All these functions allow creators to engage in meaningful collaborations, project management, and increase the visibility of both individual and collective work. Creatist helps creators reach more people, gather less solitude, and access additional revenue sources by enhancing collaboration working processes, and partnered projects have been demonstrated to earn up to 30% more income.

**Keywords:** Design thinking, creator economy, talent discovery, iOS application, collaboration platform, intelligent search, SDG 8.

Paper ID: 484

## **A Smartphone-Based Framework for Real-Time Mental Health Monitoring Using Active and Passive Data Integration**

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**Abstract:** Most digital wellness apps are about helping people relax, like with meditation or just tracking how productive they are. These things can be a little helpful. They do not really help people get better at thinking or give them useful ideas based on what they are actually doing. Also, when people have to tell the app how they are doing it can be subjective and not very accurate. This research is about making an app that is just for helping professionals keep their minds sharp. The app has exercises to help people think better. It looks at how people use their smartphones to understand how their minds are working. The app gets information from what people do on purpose and from what it can see people're doing without them trying so it gets a complete picture of how people are thinking. The app uses a way of scoring to see how mentally fit people are and it gives people suggestions that are just, for them. The app is something that can be used by a lot of people it does not cost much and people do not need to buy any extra equipment so it is a good thing for professionals to use.

**Keywords:** Mind Fitness, Cognitive Training, Behavioral Analytics, Mobile Applications, Productivity, Mental Performance.

Paper ID: 485

## **A Comprehensive Review of DC-DC Multiplier Topologies for Low Current Applications**

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**Abstract:** This paper presents a comprehensive review and comparative analysis of various active two-phase charge pump voltage multiplier architectures for low-current, high-voltage applications. The studied topologies include Dickson, series parallel, cross-coupled, exponential, and Fibonacci charge pumps. All circuits are designed and simulated using 180 nm CMOS technology to achieve an output voltage of approximately 5 V from a 1.8 V input. The performance is evaluated based on key parameters such as power dissipation, rise time, voltage conversion efficiency (VCE), power conversion efficiency (PCE), and area. The results show that the cross-coupled architecture achieves the highest efficiency (VCE of 96.33% and PCE of 71%) with low power consumption and fewer stages. The series parallel topology provides the fastest response, while the Fibonacci structure offers minimum area. A figure of merit (FoM) is also introduced for overall comparison, where the cross-coupled architecture shows the best performance. This study helps in selecting suitable charge pump architectures for low-power integrated applications such as biomedical devices, IoT systems, and energy harvesting circuits.

**Keywords:** Charge Pump, Power Conversion Efficiency, Voltage Multiplier, Voltage Conversion Efficiency.

Paper ID: 494

## **HRLF-Net: A Smarter Way to Route Data in Wireless Sensor Networks**

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**Abstract:** Wireless sensor networks used in smart devices and IoT environments often face difficulties in maintaining stable communication paths. These issues mainly arise due to limited battery capacity, variations in temperature, environmental interference, and unexpected node failures during operation. To overcome these challenges, this paper introduces HRLF-Net, a reliability-aware routing framework that combines two machine learning approaches. The first component uses a Random Forest model to evaluate each node based on six key factors: remaining battery level, hardware temperature, surrounding noise, network load over time, signal distance, and hop count. These factors are used to generate a score that reflects the quality of each connection. The second component is an LSTM-based model that analyzes recent battery patterns to predict the likelihood of node failure in upcoming time steps. The proposed system dynamically updates the network structure at each stage according to the current energy levels of nodes, ensuring that routing decisions are based on real-time conditions. The model was tested on a network of 30 nodes over 50-time steps, where it achieved a reliability score of 0.87 and successfully identified valid communication paths in 97.2% of the cases. Compared to baseline approaches, HRLF-Net showed clear improvements, outperforming the distance-based method by 0.26, the energy-based method by 0.13, and the RF-only approach by 0.06. In addition, the failure prediction model achieved an accuracy above 85% and an AUC-ROC value greater than 0.88. These results indicate that combining multi-factor evaluation with predictive failure analysis significantly enhances routing reliability in dynamic sensor networks.

**Keywords:** component, formatting, style, styling, insert.

Paper ID: 495

## Credit Card Fraud Detection System with Real-Time Alerts

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**Abstract:** The growth of online payment industries and online businesses has brought forth some significant security challenges, especially when it comes to credit card use that is unauthorized. In this paper, an innovative framework that detects fraud in real-time has been presented, immediately alerting the stakeholders of suspicious to an activity. We compare several classification methods with real trans- action data, with the performance of the methods measured in terms of several important performance measures such as accuracy, precision, recall and F1-score. We find that the methods of ensemble learning provide this benefit over both standard algorithms, namely better accuracy and reduced levels of false positives. The combined warning system gives the user the opportunity to respond instantly to protect themselves. Our study shows that smart analytical systems can be used to enhance security procedures in modern financial ecosystems.

**Keywords:** Credit card fraud, machine learning, ensemble methods, real-time detection, alert system, imbalanced dataset.

Paper ID: 496

## Heart Disease Prediction Using Logistic Regression: A Machine Learning Approach

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**Abstract:** Heart disease is the number one cause of death across the globe with millions of deaths annually and is a serious challenge to healthcare systems in the world today. The early and efficient diagnosis is vital in guaranteeing the timeliness of treatment and the management of the disease which may further decrease the overall mortality rate. In this study, we use the tools of Machine Learning (ML) namely, Logistic Regression (LR) to estimate the probability of heart disease through several clinical and physiological variables including age, blood pressure, cholesterol, and heart rate. The main hypothesis of the research is to test the predictive power and clinical interpretability of the Logistic Regression model in order to detect people with the risk of developing heart disease. We used a publicly available heart disease dataset to train and validate the LR model to be able to classify patients as either being at risk or not. The model has an accuracy of 85 which shows that it has a good balance between sensitivity and specificity. According to our results, Logistic Regression can provide a valid, clear, and computationally greedy way of predicting heart disease. Moreover, we ran LR performance against other machine learning models like the Decision Trees, the Random Forests, and the Support Vector Machines. Some of the models had a slight improvement in the accuracy, but LR had a better interpretability- which is critical in clinical decision-making. This study highlights the importance of interpretable ML models in healthcare since they help medical professionals to comprehend risk factors better, assist in diagnostic work, and optimize patient outcomes.

**Keywords:** Heart disease, machine learning, Logistic Regression, healthcare, predictive modeling, risk assessment, clinical data, machine learning.

Paper ID: 497

### **Mixed Reality Assembly Guidance System**

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**Abstract:** Products which have many parts are usually put together using printed guides, or with a teacher showing people what to do. These ways of doing things can be slow, and not easy to understand – and people, especially those new to the task, can often make mistakes. Mixed Reality, or MR, merges the actual area where someone is working with digital help, so as to make assembly help better. In this study, we put forward a Mixed Reality system for putting together multiple parts which uses computer vision, spoken directions, and making knowledge ahead of time, to help precise assembly and good learning. A React Native mobile app which watches how the user is getting on, gives spoken help, and displays detailed assembly directions supports the system we suggest. Assembly knowledge comes from technical guides; this is then kept by back-end services as organised JSON data. This previous knowledge makes sure that no stage is left out and helps the system keep to the correct order of stages. A Unity-based MR engine gives visual help, including warning notices, where to put things tips, and showing parts. The technology employs YOLO to recognise assembly parts in real time from a live video stream. Once parts are found, the camera's place and the parts' direction are worked out using the RANSAC-PnP method. This stage allows the system to be certain the part is in the correct place before the user goes on. YOLO and RANSAC-PnP together give better spatial knowledge and lessen usual putting-in-the-wrong-place errors. By using software to model MR behaviour, the system does not need special MR tools, meaning it is good for small industrial training, as well as for teaching. Findings show better understanding, fewer assembly faults, and a working – but cheap – answer.

**Keywords:** Mixed Reality, Assembly, Training, Part Detection, User Guide.

Paper ID: 501

### **PermGraph: A Lightweight Graph-Based Workflow Engine for Deterministic Stateful Execution**

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**Abstract:** Most automation workflows are not actually linear. A code review pipeline might need to loop back and re-evaluate after applying fixes. A data processing job might branch down different paths depending on what the input looks like. Existing tools handle one side of this or the other: DAG-based systems like Apache Airflow are deterministic and reliable but cannot express loops; agent frameworks like Lang Graph support cycles but introduce non-determinism through probabilistic routing. Neither is ideal for workflows that need to be both expressive and reproducible. This paper describes PermGraph, a graph-based workflow engine built in Python that tries to sit in between these two categories. Workflows are defined as directed graphs where nodes are plain Python functions operating on a shared state dictionary. The engine supports conditional routing, looping, and dynamic tool invocation, and creates a persistent checkpoint in SQLite after every node execution. The entire system runs on FastAPI and SQLite with no external infrastructure requirements. Two workflows are used to evaluate the system: a Code Review Mini-Agent that exercises looping and conditional routing, and a Schema Validation Pipeline that exercises conditional branching without looping.

**Keywords:** Graph-Based Workflows, Workflow Engine, Shared State, Conditional Routing, Checkpointing, Deterministic Execution, SQLite, FastAPI.

Paper ID: 511

## Reducing Diagnostic Errors in Medical Imaging via Selective Prediction

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**Abstract:** Deep learning models have achieved remarkable success in medical image analysis in recent times. However, their tendency to produce overconfident predictions even under high uncertainty, limits their reliability in safety-critical applications. In the clinical setting, minimizing the incorrect predictions is often more important than maximizing the overall coverage. This paper investigates the use of selective prediction via training dynamics (SPTD) to improve diagnostic reliability by enabling models to abstain from uncertain predictions. Unlike the conventional confidence-based approaches, SPTD leverages prediction instability across training checkpoints as a proxy for uncertainty. Experiments are conducted on three different medical imaging datasets including diabetic retinopathy, urine cell classification and bone tumor classification datasets. Results clearly demonstrate that SPTD has consistently improve the prediction accuracy at lower coverage levels and achieved more than 20% improvement compared to non-SPTD model. The findings highlight the effectiveness of training dynamics as a robust uncertainty estimation mechanism and establish selective prediction as a viable strategy for reducing diagnostic errors in healthcare AI systems.

**Keywords:** Deep learning, Medical Imaging, Selective Prediction, Training Dynamics, Uncertainty Estimation, Abstention.

## The Vidyasagar Awardee

The Vidyasagar Award is conferred to **Prof. Rana Pratap Singh**, Vice Chancellor, Gautam Buddha University, Greater Noida, Uttar Pradesh, India. 13th International Conference on Microelectronics Circuits and Systems Micro2026 Dates: 24th – 25th April 2026. Applied Computer Technology, Kolkata, West Bengal, India & Indira Gandhi Delhi Technical University For Women, Kashmere Gate, New Delhi, India.



## The Lotfi A. Zadeh Awardee

The Lotfi A. Zadeh Award is conferred to **Prof. Brijesh Kumar**, Registrar & Professor (IT), Indira Gandhi Delhi Technical University for Women, Kashmere Gate, Delhi, India. 13th International Conference on Microelectronics Circuits and Systems Micro2026 Dates: 24th – 25th April 2026. Organizer & Venue: School of Information and Communication Technology, Gautam Buddha University Greater Noida, Uttar Pradesh, India. Joint Organizers: Applied Computer Technology, Kolkata, West Bengal, India.



## The Young Scientist Awardee

The Young Scientist Award is conferred to **Dr. Mukku Pavan Kumar**, Associate Professor, Lendi Institute of Engineering and Technology (Autonomous), Andhra Pradesh, India. 13th International Conference on Microelectronics Circuits and Systems Micro2026 Dates: 24th – 25th April 2026. Organizer & Venue: School of Information and Communication Technology, Gautam Buddha University Greater Noida, Uttar Pradesh, India. Joint Organizers: Applied Computer Technology, Kolkata, West Bengal, India. & Indira Gandhi Delhi Technical University For Women, Kashmere Gate, New Delhi, India.



**Awards to Young Scientists** who are working in USA; these Awards are also conferred to the Awardees. They receive these awards as online mode.

- (1) “Cloud Architect Award” to Mr. Vinoth Punniyamoorthy, Vice President – Lead Software Engineer, JPMorgan Chase & Co., Texas, USA.
- (2) “Cloud Architect Award” TO Mr. Vamshidhar Reddy Vemula, Lead Software Engineer, Wells Fargo Bank, Arizona, USA.
- (3) “AI Tool/Algorithm Developer Award” TO Mr. Nabeel Mohammed Iliyas Sheikh, Senior software developer, Oracle, Austin, Texas, USA.
- (4) “Tech Leadership Award” TO Mr. Manas Srivastava, Sr. Customer Engineer, Google, USA.
- (5) “System Architect Award” TO Mr. Balaji Shesharao Ingole, Project Manager, Amla Commerce, Milwaukee, Wisconsin, USA.
- (6) “AI Tool/Algorithm Developer Award” TO Mr. Aswathnarayan Muthukrishnan Kirubakaran, Data Engineer, Northeastern University, California, USA.
- (7) “AI Tool/Algorithm Developer Award”, Mr. Aditya Gupta, Software Engineering, Amazon Web Services, WAS, USA..

Micro2026, 24<sup>th</sup> – 25<sup>th</sup> April, 2026.  
List of Speakers

	<p style="text-align: right;">Keynote Speaker</p> <p><b>Professor Ajay Agarwal</b> Professor, Department of Electrical Engineering, IIT Jodhpur, Rajasthan, India.</p>
	<p style="text-align: right;">Keynote Speaker</p> <p><b>Prof Preetam Kumar</b> Professor, Department of Electrical Engineering, IIT Patna, Bihar, India.</p>
	<p style="text-align: right;">Keynote Speaker</p> <p><b>Prof. Dr. Ehsan Sheybani</b> Professor, Faculty of Engineering, University of South Florida, USA.</p>
	<p style="text-align: right;">Keynote Speaker</p> <p><b>Prof. Abhijit Biswas</b> Publication Chair of Micro2026, and Professor, Department of Radio Physics and Electronics, University of Calcutta, West Bengal, India.</p>
	<p style="text-align: right;">Keynote Speaker</p> <p><b>Prof. Jerzy R. Szymanski</b> International Ambassador of Micro2026, Kazimierz Pulaski University of Technology and Humanities, Poland.</p>
	<p style="text-align: right;">Invited Speaker</p> <p><b>Dr. Mukku Pavan Kumar</b> Associate Professor &amp; RnD Coordinator, Dept. Of ECE, Lendi Institute of Engineering and Technology (Autonomous), Vizianagaram, Andhra Pradesh.</p>
	<p style="text-align: right;">Keynote Speaker</p> <p><b>Prof. Rishu Chaujar</b> Professor, Department of Applied Physics, Director-Vinod Dham Centre of Excellence for Semiconductors and Microelectronics, Delhi Technological University, Delhi, India.</p>
	<p style="text-align: right;">Keynote Speaker</p> <p><b>Dr. Chandrima Mandal</b> Department of ETCE, Jadavpur University, Kolkata, WB, India.</p>
	<p style="text-align: right;">Invited Speaker</p> <p><b>Prof. Pankaj Gupta</b> Professor, ECE Indira Gandhi Delhi Technical University for Women, New Delhi, India.</p>

	<p style="text-align: right;">Invited Speaker</p> <p><b>Dr. Rajesh Dey</b> Adjunct. Professor, ECE, Gopal Narayan Singh University, Bihar, India. And Principal, Camellia Institute of Technology &amp; Management, Burdwan, WB</p>
	<p style="text-align: right;">Invited Speaker</p> <p><b>Mr. Nikunj Gajera</b> Manager, PCB design and Testing Expert (LabVIEW and Python). SVTronics Inc., USA.</p>
	<p style="text-align: right;">Invited Speaker</p> <p><b>Mr. Balaji Shesharao Ingole</b> System Architect, Project Manager, Amla Commerce, Milwaukee, Wisconsin, USA.</p>
	<p style="text-align: right;">Invited Speaker</p> <p><b>Dr. Bernard Szymanski</b> Industry Automation Offer Manager, Schneider Electric, Poland.</p>
	<p style="text-align: right;">Invited Speaker</p> <p><b>CEO Slawomir Szymanski</b> Investment Director /Head of Corporate Group at PVE Group, Poland.</p>
	<p style="text-align: right;">Invited Speaker</p> <p><b>Engr. Jubin Soni</b> Independent Researcher, (New York University), Senior IEEE Member, San Francisco, CA, USA.</p>

**Advertisement:**



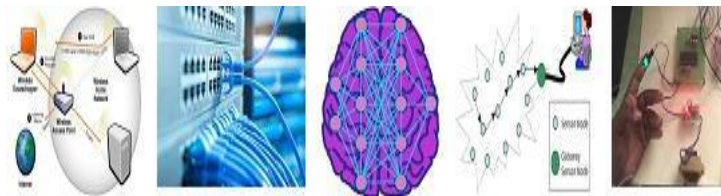
**CCSN2026**  
**15<sup>th</sup> International Conference on**  
**Computing, Communication and Sensor Networks**  
**(Physical mode / Online mode Conference)**

**Venue: not decided**

**Website: Under Processing**

**Conference Date: September, 2026(date not decided)**

**Organizer: Applied Computer Technologies, Kolkata**



**Contacts:**

**Prof. D Acharjee**, Executive Chairman, CCSN2026, and Director, Applied Computer Technology, Kolkata, India. Email: [ccsn2012@gmail.com](mailto:ccsn2012@gmail.com), [info@actsoft.org](mailto:info@actsoft.org)

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**ESDA-2026**  
**9<sup>th</sup> International Conference on**  
**Energy Systems, Drives and Automations**  
**(Physical mode / Online mode Conference)**



**Venue: not decided**

**Website: Under Processing**

**Conference date: December, date not decided**

**Organizer: Applied Computer Technologies**



**Contacts:**

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**Abstract Proceeding of  
Micro2026**

**Editors:**

**Dr. Gunajit Kalita**  
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**Dr. Vivek Chaudhary**  
**Mr. Arup Halder**



**Nanomaterials**



**Optoelectronics**



**Chip Fabrication**



**Joint-Organizer:**  
**Applied Computer Technology,**  
**Kolkata, West Bengal, India.**