NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNESCO Chair on Secure High-Performance Computing for Higher Education Research

unesco Chair

2026 International Conference on Emerging Trends in Networks and Computer Communications (ETNCC)

04 - 06 August, 2026

08:00 - 17:30 (CAT)

6th Floor, High-Tech Transfer Plaza Select (HTTPS), NUST Lower Campus

Day 1: Tuesday, 4 August 2026

10:30 - 11:20	Registration

Time (CAT)	Keynote Speaker's Session-A
11:20 - 13.00	Chair 1: Prof Ambrose Azeta, Namibia University of Science and Technology Chair 2: Prof Dipti R Sahu, Namibia University of Science and Technology Moderator: Mr Abubakar Hamisu Kamagata, NUST

Time (CAT)	Activity/Title	Presenter/Speaker
11:20	Research Philosophy With Secure Multi-Party Computation: A Case Study	Prof Durgesh Kumar Mishra Symbiosis University of Applied Sciences, Indore
11:40	LLMs are Today's Superstars! Will they Remain so in the Future?	Prof Abhishek Srivastava Indian Institute of Technology, Indore, India
12:00	Smart Contract Vulnerabilities and Deep Learning	Prof Meenakshi Tripathi MNIT Jaipur, Professor
12:20	Building Trustworthy Higher Education through Responsible Artificial Intelligence: A Framework for Authentic Assessment and Academic Integrity	Dr Saroj Hiranwal Australian Institute of Advanced Technologies (AIAT), Adelaide, Australia
12:40	A Data Sovereignty Model for Secure Cloud Governance and Critical National Infrastructure to Reclaim Africa's Digital Assets	Prof Nobert Rangarirai Jere University of Fort Hare, South Africa

13:00 - 14:00	LUNCH BREAK

Time (CAT)	Technical Session – D1-T1-A
14:00 - 15.30	Chair 1: Dr Munyaradzi Maravanyika, NUST Chair 2: Dr Rituraj Soni, Engineering College Bikaner Moderator: Mr Abubakar Hamisu Kamagata, NUST

Paper ID	Paper Title and Author(s)
25	AI-Enabled Multimodal Sensor Systems for Human Performance Monitoring in Smart Industrial Environments *Adinife Patrick Azodo, Fidelis Ifeanyi Okeke, Francis Canice Tochukwu Mezue, Chibuzor Chidiogo Mezue, Obi Sheila Ifeakarochukwu, Idama Omokaro*
41	Ensemble Learning for Vehicle Health Diagnostics Using Simulated Performance Indicators *Preeti Rana, Lalit Kumar, Anup Lal Yadav, Beer Singh, Jay Kumar, Ritu Gupta*
50	Deep neural networks for improved perception of emotion on socially connected sites: Image-driven sentimental expression *Narinder Kumar, Rahul Azmeera , Vikram Kumar*
93	Hybrid Artificial Intelligence Models for Scalable Network Intrusion Detection in Cloud Computing: A Comprehensive Evaluation Analysis *Vara Prasad Pinnintis*
105	Design and Implementation of a Dynamic Multi-Tiered Staking Protocol for DeFi on Ethereum *Jinkang Chen, Jie Li, N.Z. Jhanjhi, Siva Raja Sindiramutty*
107	An Analytical Assessment of a 5G-Enabled Agricultural Drone System Using Support Vector Machines and Smart Farming Sensor Data *Jianfeng Su, Yida Wang, Jiayue Wang, Jie Li, N.Z. Jhanjhi, Navid Ali Khan*
142	Wireless Blood Pressure Sensors and IoT Telemonitoring to Assess Hibiscus Sabdariffa Effects on Hypertension *Kavitha M, S Kalabarathi, Padmapriya D, Vijayalakshmi R, Parimala L*
145	IoT-Cloud Integrated Framework for Continuous Monitoring of Stroke-Related Neurological Symptoms *V Prathipa, Robin Rohit Vincent, R Jagadeesh Kannan, P K Sheela Shantha Kumari, Sundara Kumar M R, Karthika A*
619	Design And Theoretical Analysis of a High Sensitivity 2D Photonic Crystal Biosensor for Malaria Diagnosis *Sahu Dipti Ranjan, Stone Macheso Paul, Kashe Divason*

Time (CAT)	Technical Session – D1-T1-B
14:00 - 15.30	Chair 1: Prof Chirag S Thaker, L. D. College of Engineering, Ahmedabad, India Chair 2: Mr Isaac Nhamu, NUST Moderator: Mr João Baptista Bastos, NUST

Paper ID	Paper Title and Author(s)
146	Cloud-Based IoT Monitoring of Hawai'i Exercise on Depression in Type II Diabetes Patients *Suganthi S, G Bhuvaneswari*
149	An Intelligent Threat Detection Framework for Secure Systems Using Behavioral Analysis of Network Intrusion Data *Sundaram Yadav*
231	Intelligent Cyber Threat Detection Using Artificial Intelligence (AI) -Driven Machine Learning Techniques for Modern Cybersecurity Infrastructure *Ashay Mohile*
404	A Secure Network Architecture for IoT Devices in Smart Spaces *Elritz Kaahangoro, Anton Limbo*
410	Design of Energy-Efficient and Reliable MAC Protocol for Distributed Asset Monitoring in Wireless Sensor Networks *Seun E. Khumalo, Emmanuel M. Migabo, Antonie J. Smith, Shengezi Du*
414	Cost-Aware WAN Modernisation: A Hybrid Phased Transition Model from MPLS to SD-WAN for South African SMMEs *Ntshuxeko Makondo*
520	Multilevel Routing for Data Transmission in IoT-Based Supply Chain Networks

	Theophilius Alpha Yambasu, Kavita Kavita, Sukhjinder Kaur, Goldi Makhija, Muhammad Ikhsan ThohirMuhammad
564	Kalman Filter-Based Noise Reduction and Reinforcement Learning-Driven Efficient Routing in WSNs *L N Jayanthi, Vijayalakshmi R, R Velayutham, Mahesh A, Nilamadhab Mishra, Mohankumar N*

Time (CAT)	Technical Session – D1-T1-C
14:00 - 15.30	Chair 1: Prof Guy-Alain Zodi, Namibia University of Science and Technology Chair 2: Dr Vishal Gour, Engineering College Bikaner Moderator: Mr Edward Chisala, NUST

Paper ID	Paper Title and Author(s)
565	Blockchain-Based IoT Network for Secure Telemedicine Consultations in Respiratory Disorders *V Yasodha, V Vijaya Baskar, R Velayutham, R Kamaraj, Sandra Johnson, N Mohankumar*
568	Secure Data Transmission in WSNs Using RC4 Encryption and Rabin-Karp Pattern Verification *R Sathya, Mahesh A, K C Sharmili, Priya Dasarwar, B Suresh Chander Kapali, Sathishkumar V E*
639	Hybrid DenseNet Approach for AI-Synthesized Media Detection *Lalit Kumar, Preeti Rana, Samima Nasrin, Ankita Yadav, Devanupally Archana, Kadambari Jain*
647	A Real-Time Forensic Readiness Framework for Evidence Preservation in Kubernetes-Deployed Cassandra System *Prerit Bhandari, Oluwasola Mary Adedayo*
653	Edge Computing-Enhanced Fulfillment Orchestration in Federated Multi-Brand Apparel Retail Ecosystems *Utpal Kumar Das*
657	Graph Neural Network-Based Anomaly Detection and Traffic Classification for Intelligent Network Management *Venkata Rama Uday Kiran Bokam, Sachin Vasanthkumar*
658	Design and Simulation of a Carbon-Aware Workload Scheduler for Delay-Tolerant Cloud Tasks *Nihal Panwar, Ramesh Chandra Poonia, Vandana Mehndiratta*

Time (CAT)	Technical Session – D1-T1-D
14:00 - 15.30	Chair 1: Dr Sesham Srinu, University of Namibia Chair 2: Mr Peter Gallert, NUST Moderator: Mr Werkineh Eshete, NUST

Paper ID	Paper Title and Author(s)
17	A Comparative Review of Deep Learning, Transformer, Ensemble, and Cross-Modal Fusion Approaches for Liver Histopathology Classification *Nivedita Sharma, Rakesh Kumar, Meenu Gupta*
49	Image-based emotional of sentiment powered by deep neural networks for better identification of emotions on interpersonal platforms *Narinder Kumar*
51	AI-Powered District Evaluation and Tracking System for Better Administration Quality *Narinder Kumar, Kiranpreet Kaur*
58	Renewable Energy Forecasting Using Multiple Linear Regression: A Comprehensive Study

	Krishan Kumar, Neeraj Kumar
83	Digital Twin-Based Disaster Management System Using Edge and Dew Computing for Smart Cities *Rohan Verma, Prabh Deep Singh, Kiran Deep Singh*
84	Big Data-Driven Coordination of Autonomous Vehicles for Smart Urban Transportation Systems *Rohan Verma, Prabh Deep Singh, Kiran Deep Singh*
86	Blockchain-enabled DApp for secure Land Registration System *Ayush Bisht, Nishtha Teotia, Ayush Sharma, Taniya Agarwal, Shivani Pandey, Vinay Rishiwal*

Time (CAT)	Technical Session – D1-T1-E
14:00 - 15.30	Chair 1: Prof Ramesh Chandra Poonia, CHRIST, Ghaziabad, India Chair 2: Mr Julius Silaa, NUST Moderator: Mr Kebadu Mekuriaw Adamu, NUST

Paper ID	Paper Title and Author(s)
99	A Stencil Elliptical Masking Technique for Quantitative Privacy Preservation in Crowd Surveillance *Laxmi Choudhary, Kawaljeet Singh, Vineet Sharma*
106	Seasonal Auto-Regressive Integrated Moving Average for Price Prediction: A Study of Tesla *Jie Li, Jinkang Chen, Siva Raja Sindiramutty, Weiwei Goh, N.Z. Jhanjhi, Navid Ali Khan, Jianfeng Su, Yuming Shao*
113	A Multi-Source Context Fusion Architecture for Conversational AI Systems: Engineering an Integrated Framework for Memory, Document Retrieval, and Emotion Cues *Shashwat Shukla, Deep Patil, Sahil Nerkar, Nayan Paleja, Nandkishor Narkhede*
121	A Unified Framework for Image and Video Captioning Using BLIP with Retrieval-Augmented Generation and Temporal Consistency *Anant Kumar, Dilip Kumar Sharma, Maulik Gautam*
123	AI-Integrated Health Interventions for Modulating Fast-Food Intake in Collegiate Populations *Kavitha M, Kalabharathi S, Padmapriya D, Vijayalakshmi R, Parimala L*
124	AI-Assisted Play Therapy Interventions for Mothers Supporting Emotional Development in Preschool Children *Bavithra V, Thenmozhi P*
125	Intelligent Classroom System Enhancing English Language Teaching Through AI and IoT Data *Joseph Manoj Babu S, V Jayalakshmi, Pushpa Nagini Sripada, Harini Cherukuri*

15:30 - 15:40	**TEA BREAK**

Time (CAT)	Keynote Speaker's Session-B
15:40 - 16.00	Moderator: Dr Arpit Jain, NUST

Time	Activity/Title	Presenter/Speaker
15:40 – 16:00	Advances in Decreasing Virtual Reality Cybersickness	Prof Stephen B. Gilbert Iowa State University, Faculty Director for Undergraduate Research and Creative Activities

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2026 International Conferenceon Emerging Trends in Networks and Computer Communications (ETNCC)

Tuesday, 04 August - Thursday, 06 August 2026

6th Floor, High-Tech Transfer Plaza Select (HTTPS), NUST Lower Campus

Click here to join via Zoom
Meeting ID: 816 0768 5367
Passcode: ETNCC@26

Opening of International Conference on 2026 Emerging Trends in Networks and Computer Communications (ETNCC)

Date: **Tuesday, 04 August 2026**
Time: **16:00 - 18:00**
Venue: **6th Floor, High-Tech Transfer Plaza Select (HTTPS), NUST Lower Campus**

Director of Ceremonies: **Ms Rennie Munyayi**, *Manager: Research and Post-Graduate Development, Directorate: Research, Innovation and Partnerships, Namibia University of Science and Technology*

Time	Activities/Topics	Presenter
16:00	National and AU Anthems	
16:05	Welcoming Remarks	**Prof Colin Stanley** *DVC: Research, Innovation and Partnerships: NUST*
16:15	Overview of the Conference	**Prof Dharm Singh Jat** *TPC Chair* *UNESCO Chairholder* *Chairman: ACM Windhoek Chapter*
16:25	Remarks	**Mr Gernot Piepmeyer** *Secretary-General of the Namibia National Commission: UNESCO*
16:35	Remarks	**Prof Dr Anicia Peters** *Chief Executive Officer: National Commission on Research, Science and Technology (NCRST)*
16:45	Remarks	**Dr Licky Erastus** *Managing Director: Mobile Telecommunications Limited*
16:55	Remarks	**Dr Udochukwu Akuru** *Chair: IEEE South Africa Section*
17:05	Remarks	**Prof Teresia Kaulihowa** *DVC: Teaching, Learning and Technology, NUST*
17:15	Remarks	**Dr Happy Sithole** *Executive Manager: National Integrated Cyber-Infrastructure System (NICIS), CSIR, South Africa*
17:25	Official Opening Remarks	**Hon Sanet L Steenkamp** *Honourable Minister: Ministry of Education, Innovation, Youth, Arts and Culture*
17:40	Vote of Thanks	**Prof Fungai Bhunu Shava** *Acting Executive Dean: Faculty of Computing and Informatics*
17:55	AU and National Anthems	
18:00	Networking	

INDIA - NAMIBIA CEIT CENTRE OF EXCELLENCE IN INFORMATION TECHNOLOGY

IEEE Advancing Technology for Humanity

IEEE South Africa Section

Day 2: Wednesday, 5 August 2026

Time (CAT)	Technical Session – D2-T1-A
08:30 - 09.45	Chair 1: Dr Mellisa Allela, NUST Chair 2: Dr Kamal Kant Hiran, Sir Padampat Singhania University, India Moderator: Mr Abubakar Hamisu Kamagata, NUST

Paper ID	Paper Title and Author(s)
128	SVM-Based Prediction of Stress and Depressive Symptoms among Women in Menopausal Transition *A. Bebina Vincia Anjala Mary, Padmapriya D, Suja Suresh*
129	Analysis of Menopausal Symptoms in Rural Women Using BERT Transformer Model *Bebina Vincia Anjala Mary A, Padmapriya D, Suja Suresh*
133	Sleepy Driver Detection from EEG Brainwave Data Using Logistic Regression *Bijilin Reeni D, Rajesh Kambattan Kovarasan, T Karpagam, D Sethuraman, Mohankumar N, Kohilan K*
136	Secure Blockchain and IoT System for Transparent Waste Export Import and Sustainable Management *S Subi, Akhil Gupta, Raziya Begam S, R Senkamalavalli, G Rajasekar, S Murugan*
139	SVM-Based Multimodal Sensor Analysis for Real-Time Exercise Monitoring and Injury Risk Classification *G Prince Rose, N Mohankumar, Bandaru Mounika, P Suresh, Sathishkumar V E, Hemnath S*
141	Role of Digital Interventions in Treatment Adherence in Chronic Disease Management *Padmapriya D, Akshara K Shaji, Suganya M, Hemavathi R, Vijayalakshmi R, Parimala L*

Time (CAT)	Technical Session – D2-T1-B
08:30 - 09.45	Chair 1: Dr Cleopas Kwenda,NUST Chair 2: Dr Shweta Bhandari,MANIT Bhopal Moderator: Mr João Baptista Bastos, NUST

Paper ID	Paper Title and Author(s)
150	Multi-Class Knee Osteoarthritis Classification Using ResNet-50 on X-ray Images *J Sofia Bobby, Mohana Priya P, M Pavani, Akhil Gupta, Sathyaraj Sellamuthu, M Muthulekshmi*
152	ANN Model for Predicting ICU Patient Mortality from Clinical Data *Jayavarunani V, S Hemalatha, K Karthick, K V Sunil Varma, C Srinivasan, Seelam Siva Rakesh*
160	LSTM-Based ICU Patient Vital Signs Monitoring and Early Risk Prediction System *V J Binipaul, Pon Harshavardhanan, M Thangamani, RM Sivagama Sundari, M Muthulekshmi, Vicky James*
161	Artificial Neural Network Model for Predicting Walking Stability on Floor Materials *Mary Ann J, Priya Dasarwar, Robin Rohit Vincent, C Srinivasan, Ishwarya M V, V Brindha*
162	Entropy-Guided Cuckoo Catfish Optimizer for Efficient Resource Allocation in Cognitive Radio and Biomedical Healthcare Systems *Subhashini K, Rajasekar Rangasamy, Shiney M Abraham, S Murugan, R Kamaraj, Nasreen A*
179	IoT and Supply Chain Logistics Prevention: Using Emerging Technologies to Increase Security and Performance *Nasrin Fatima, Pooja Sharma, Sukhjinder Kaur, Goldi Makhija, Zeldi Suryadi*

Time (CAT)	Technical Session – D2-T1-C
08:30 - 09.45	Chair 1: Dr Hugh Ellis-Mwiya, NUST Chair 2: Prof Kamal Upreti, CHRIST, Ghaziabad, India Moderator: Mr Edward Chisala, NUST

Paper ID	Paper Title and Author(s)
180	A Hybrid Stacking Ensemble Model for Accurate Depression Detection Using Machine Learning *Prabhjot Kaur, Sukhjinder Kaur, Venkata Satya Sai Rohit Kuppili, Kavita, Lusiana Sani Parwati*
181	Digital Wellbeing and AI Addiction Mitigation *Damini, Kavita Kavita, Moneyta Dholah Rosita, Zahrah A. Almusaylim*
182	Comparative Analysis of Deep Learning Architectures for Skin Cancer Lesion Detection and Classification *Kompal, Simran varma, Sahil Verma, Daniel Durai Raj, Mochammad Arvin Syarifuddin*
184	Comparative Analysis of Deep Learning Models for Phishing Detection *Aaqib Bashir Bhat, Shubpreet Kaur, Tejinder Kaur, Sukhjinder Kaur, Narinder, Gina Purnama Insany*
199	Artificial Intelligence in Education : Transforming Learning and Teaching *Anmol Goyal, Komalpreet kaur*
200	Fake Face Generation Using Deep Learning *Anubhav Shakya, Anita Goyal, Shivangi Gujjar, Ekpreet Kaur, Harpinder Kaur, Sukhpreet Kaur, Alun Sujjada*

Time (CAT)	Technical Session – D2-T1-D
08:30 - 09.45	Chair 1: Dr Sadrag Panduleni Shihomeka, NUST Chair 2: Mr Saurabh Maheshwari,Govt. Mahila Engineering college Ajmer Moderator: Mr Werkineh Eshete Yifru, NUST

Paper ID	Paper Title and Author(s)
201	Improving Transient Stability in Multi-Machine Power Systems Through Governor Action *Snowber Mushtaq, Maninder Kaur, Snowber Mushtaq, Iwan Setiawan, Zahrah A. Almusaylim*
202	A Deep Learning & NLP for Fake News Detection: A Comprehensive Analysis of Models *Prabhjot Kaur, Anmol Goyal, Anita Goyal , Imam Sanjaya*
203	Hybrid LSTM–CNN Models for Spatiotemporal Weather Prediction *Ishant Bharol, Anita Goyal , Anmol Goyal, Alun Sujjada*
204	Artificial Intelligence Based Anime Conversion System for Interactive and Engaging Learning *Harmanpreet Kaur, Arvind Chauhan, Mandeep Kaur, Parminder Kaur, Simran , Fikri Arif Wicaksana*
205	Robotics, Green Construction, and Regulatory Standards *Deepika, Shalom Akhai, Mahapara Abbass, Suman Khanna Jyoti Sharma , Uzma Abbas , Sudin Saepudin*
206	AI Enabled Intelligent Manufacturing for Sustainable Infrastructure Development *Mehjabi Pravin, Shalom Akhai, Mahapara Abbass, Suman Khanna, Deepika, Uzma Abbas , Mochammad Arvin Syarifuddin*

Time (CAT)	Technical Session – D2-T1-E
08:30 - 09.45	Chair 1: Dr Sebastian Mukumbira, NUST Chair 2: Dr Anugrah Jain, Sardar Vallabhbhai NIT, Surat Moderator: Mr Kebadu Mekuriaw Adamu, NUST

Paper ID	Paper Title and Author(s)
234	A Review and Analysis of Insect Classification in Field Crops Using Artificial Intelligence Algorithms with Preprocessing Strategies *Roop Lal, Sanjay Singla*
249	SAINT-Based Analysis of Emotional Regulation Mediating Cyberbullying and Adolescent Girls Well-Being *Pradhiba S.P.M, Padmapriya D, M Kotteeswaran, R Murugesan*

250	Edge AI Wearable Monitoring Using Accelerometer Data for Herbal Steam Therapy in Cold *Kavitha M, Vijayalakshmi R, Kalabharathi S, Parimala L, Padmapriya D*
253	INORA: A Low-Cost 3-Channel EEG Acquisition System with Driven-Right-Leg Noise Suppression for BCI Prototyping *Annu Tiwari, Sanjeev Kumar*
258	Scenery Classification Using Convolutional Neural Networks (CNN) *Allycia Chin Kia-Hui , Abdul Salam Shah , NZ Jhanjhi , Farzeen Ashfaq, Tehmina KaramatUllah*
260	Custom CNN model for Food images classification *Bunta Iwasaki, Abdul Salam Shah, NZ Jhanjhi, Farzeen Ashfaq, Tehmina Karamat Ullah Khan*
620	Smart Shopping Trolley with OCR Based Audio Assistance for the visually impaired *Harish MS, Parameswaran Ramesh, Madhumitha J,Hindhuja S,Jeab Nimsiya N,Preetha A*

Opening Ceremony of the Symposium & HA-CRAA Workshop

Symposium Theme: Responsible Use of Artificial Intelligence and Emerging Technologies in Higher Education (RUAIETH)
Workshop Theme: High-Performance Computing and Artificial Intelligence Skills Development for Climate-Resilient African Agriculture (HA-CRAA)

Date: Wednesday, 5 August 2026
Time: 09:45 - 11:00 (CAT)
Venue: Zoom (Online) and HTTPS NUST (In person)

Director of Ceremonies
Dr Arpit Jain, Lecturer: Cyber Security, Namibia University of Science and Technology

Time (CAT)	Activity	Presenter/Speaker
09:45	Participant Arrival and Seating	
09:50	Welcoming Remarks	**Prof Fungai Bhunu** Acting Executive Dean Faculty of Computing and Informatics
09:55	Overview of the Workshop and Symposium	**Prof Dharm Singh Jat** TPC Chair UNESCO Chairholder, SHPCHER
10:05	Remarks	**Prof Haddush Goitom** UNESCO Chairholder in Water Resources, Planning and Environmental Engineering, Mekelle University, Ethiopia
10:15	Remarks	**Dr Dorcas Beryl Otieno** UNESCO Chairholder Higher Education for a Green Economy and Sustainability, Kenyatta University (KU), Kenya
10:25	Speaker	**Prof G Kumar Venayagamoorthy** Professor: University of Pretoria, South Africa
10:40	Opening Remarks	**Mr Gernot Piepmeyer** Secretary-General of the Namibia National Commission for UNESCO
10:55	Closing Remarks	**Mr Edward Nepolo** HoD Computer Science Department: Computer Science

11: 00 - 11:15	**TEA BREAK**

Time (CAT)	HA-CRAA Workshop: Technical Session – -D2-T2-A
11:15- 13.00	Chair 1: Dr Arpit Jain, Namibia University of Science and Technology Chair 2: Mr Anton S. Limbo, University of Namibia Moderator: Mr *Abubakar Kamagata, NUST*

Paper ID	Paper Title and Author(s)
642	HPC-Enabled Video-based Coastal Wave Parameter Estimation Using V-JEPA and Deep Spatiotemporal Learning *Abubakar Kamagata, Dharm Singh Jat, Attlee Munyaradzi Gamundani, Saravanakumar Paramasivam, Babangida Sani, Aliyu Zakariyya*
681	An AI powered Large-Language Model Orchestrated Framework for Weather Resilient Crop Advisory *Om Jadhav, Dharm Singh Jat , Sabbi Vamshi Krishna, Edward Nepolo, Fungai Bhunu Shava , Loini Iiyambo*
679	Advances in Deep learning-Based Medicinal Plant Classification: A Systematic Review *Kebadu Mekuriaw Adamu, Stephen Gbenga Fashoto, Dharm Singh Jat , Clopas Kwenda*
497	Autonomous Agri-IoT: An IoT based Next-Generation Intelligent Farming Ecosystem *Sunita Yadav, Vinay Rishiwal, Udit Agarwal, Mano Yadav , Dharm Singh Jat, Edward Nepolo*
333	A Systematic Evaluation of Byzantine-Robust Federated Learning in Tactical 5G Networks Gagandeep Malhotra, Dharm Singh Jat
344	Application-Aware Comparative Evaluation of V2X Radio Access Technologies for Advanced 5G-V2X Use Cases *Werkineh Yifru, Dharm Singh Jat, Arpit Jain*
418	Maximizing Accuracy in Long-Time Horizon Predictions of Variables in Complex Systems *Michael Walters, Ganesh Kumar Venayagamoorthy*
	Conclusion and Way Forward *Dr Gabriel Nhinda, NUST*

Time (CAT)	African Research Symposium: Technical Session – D2-T2-B
11:15- 13.00	Chair 1: Dr Simate Zilole, Namibia University of Science and Technology Chair 2: Dr Jay Dave,BITS Pilani, Hyderabad Campus Moderator: Mr João Baptista Bastos, NUST

Paper ID	Paper Title and Author(s)
7	Multimodal Learning with Interpretable Models for Lithium-Ion Battery Degradation Prediction *Pareekshit Sachan, Donnell Ngoma, Joyce Mwangama*
303	An Integrated Multi-Source Data Architecture for Enhanced Malaria Surveillance and Decision Support: Experience from Zambia's National Malaria Elimination Programme *Jeremiah J Mwiinga, Kaluba K Mataka, Aaron M Mutinta*
336	AI-Forensic: A Multi-Modal Artificial Intelligence Content Detection and Forensic Analysis Platform *Smart C Lubobya, Gabriel Musonda*
412	Design and Implementation of an IoT-Based SMART Real-Time Carbon Emission Monitoring System *Smita Francis, Victoria Shafombabi, Rut Shiwambi, Shilongo Mwiwa, Dino Almirall, Gideonna Awases, Wassorson Nzangu, Sashan Pareekshit*
543	Design Principles for AI-Driven KPI for Work-Integrated Safety Training in Immersive Learning Environments: An Action Design Research Project *Jesse Katende, Amir Haj-Bolouri, James Katende*

632	Artificial Intelligence guided design and optimisation of advanced functional materials *Dipti Ranjan Sahu*
646	Design and Implementation of a YOLOv8-Based System for Brain MRI Tumor Detection with Lightweight Attention and Feature-Refinement Enhancements *Ameh Owoicholoci Anthony, Emmanuel Ejembi, Okwudili Anthony Ikechukwu, Paulinus Okechukwu Ugwoke, Stanford Musarurwa*
387	Performance of InceptionV3 Model for Crack Detection in Reinforced Concrete Structures Under Varying Illumination Conditions *Sesham Srinu, Philemon Arito, Nokuphila Dlamini*
392	Closed-Loop Dynamic Validator Node Scaling in Private Substrate Blockchains Using Takagi-Sugeno Fuzzy Inference *Thandile Nododile, Ayinde M. Usman, Clement N. Nyirenda*

Time (CAT)	Technical Session – -D2-T2-C
11:15- 13.00	Chair 1: **Dr Wanja Njuguna, NUST** Chair 2: Ms Monalisa Meena, Govt. Mahila Engineering College Ajmer Moderator: Mr Edward Chisala, NUST

Paper ID	Paper Title and Author(s)
268	Intelligent Feature Optimization Using RPASO for Real-Time IoT Healthcare Monitoring *M A Femina, S P Anbukodi, A V N Chandra Sekhar, K Thirunadana Sikamani, C Subalakshmi Priya, M Muthulekshmi*
269	IoT-Based Intelligent ECG Monitoring for Elderly Patients with Chronic Heart Conditions *R Meenakshi, S Subi, Dillibai R, Akhil Gupta, A Annie Lotus, C Srinivasan*
284	An Integrated Machine Learning and Deep Learning Approach for Crop Recommendation Fertilizer Prediction and Disease Detection *Rupali Dhabarde, Aditya Sonwane, Anjali Chimane, Srushti Kale, Priyanka Pawar, Vijay Manwatkar*
285	Artificial Intelligence Based Solution for Delayed Discharge in Hospitals *Lalit M Rao, Nidhi Kundu, Geeta Rani, Vijaypal Singh Dhaka*
288	RoBERTa-Based Mental Health Classification with Differential Privacy *Smriti Sett, Sarvesh Tanwar, Shruti Keshari*
290	Cognitive Healthcare Operating System Using Large Language Models and Digital Twins for Autonomous Disease Intelligence *Lalit Kumar, Preeti Rana, Surbhi Dhiman, Sunil Chauhan, Dinesh Kumar, Ritu Gupta*

Time (CAT)	Technical Session – -D2-T2-D
11:15- 13.00	Chair 1: Mr Johnson Billawer, NUST Chair 2: Dr. Udit Agarwal, RBMI Group of Institutions, Bareilly Moderator: Mr Werkineh Eshete, NUST

Paper ID	Paper Title and Author(s)
315	Postoperative Abdominal Pain Reduction Through Hand and Foot Massage Using IoT and Fog Computing *S. Shalini, Vijayalakshmi R, Padmapriya D, Parimala L, Marydasan Francis*
330	Lightweight Malware Classification via Sequential Feature Enrichment: A Five-Stage Pipeline Framework Evaluated on CICIDS-2017

	Dipesh Vaya, Rakesh Saxena
331	TACENet: An Attention-Modulated Data-Efficient Framework for Tea Leaf Disease Classification and Severity Estimation *Md Yasin Zihad, Khawja Imran Masud, Md. Mamunur Rasid, Md Obaidur Rahman, Sahara Ali*
337	Quantifying Greenhouse Gas Emissions Across Soil Types Using Predictive Machine Learning Models *Arnima Pathak, Monika Sharma, Devendra Kumar*
341	Exploring Research Trends in Explainable AI (XAI) *M. Kalyan Chakravarthi, M. Navyasri, K. Purna Prakash, K. Himajyothi, Gogulamudi Pradeep Reddy, M. Srikanth*
350	Simulator-to-Real Fault Signature Adaptation for AI-Based Predictive Maintenance of Ship Rotating Machinery *Akash Mohanty, Bharat Kamble, Debasis Patnaik, Prabhakaran Hani, Aryan Gaur, Kunal Palsodkar*

Time (CAT)	Technical Session – -D2-T2-E
11:15- 13.00	Chair 1: Dr Rashmi Chaudhry, Netaji Subhas University of Technology, Delhi Chair 2: Mr Mike Kale, NUST Moderator: Mr Kebadu Mekuriaw Adamu, NUST

Paper ID	Paper Title and Author(s)
364	Benchmarking Pose-Guided Person Image Generation on the CrossAttire Dataset *Biponjot Kaur, Sarbjeet Singh*
381	Detection and Mitigation of Prompt Injection Attacks in GitHub Copilot: A Security Analysis *Anushka Jain, Arnav Rathi, Anita Shrotriya, Lav Upadhyay*
385	Intelligent Osteoporosis Monitoring Through IoT and CNN-Based Non-Invasive Analysis *Dhanya K Vijaya, Priya Dasarwar, Rajeswar Mahidar P, R Kavitha, S Murugan, V Vidya Lakshmi*
417	An Attention-Centric Real-Time Defect Detection and Classification Framework for High-Density PCBs Using YOLOv12 *Jyoti Chauhan, Kalpana Jain*
424	Enhancing Data Integrity in Healthcare Applications Using Multi-Factor Authentication *Vasantha Kohila K R, Baskar P, K Periyarselvam, R Santhanakrishnan, S Murugan, Naveen Kumar*
498	Layer-Oriented Analysis of Security Challenges in IoT *Gaurav Vats, Sarvesh Tanwar, Pankaj Sharma*
623	Smart Energy Management System Using Occupancy Based Load Control and Priority Power Distribution *Parameswaran Ramesh, Vaanmarai S, Ukesh Raj V, Sangeetha R, Sridhar O, Puneeth L, Bino J, Bhuvaneswari P T V*

13:00 - 14:00	**LUNCH BREAK**

Time (CAT)	African Research Symposium: Technical Session – D2-T3-A
14:00- 15.30	Chair 1: Dr Sonu Lamba, Malaviya National Institute of Technology Jaipur Chair 2: Mr Naftal Indongo, NUST Moderator: Mr Abubakar Hamisu Kamagata, NUST

Paper ID	Paper Title and Author(s)
29	Trust Deficits as Barriers to Blockchain Adoption in Supply Chain Management *Mercy Chitauro, Ericky Iipumbu*
118	Harnessing Big Data for Wildlife Conservation: A Strategic Framework for Data-Driven Decision-Making and Ecosystem Management *Arpit Jain, Meitavelo L. Himufe*
251	Offline and Edge AI Tutoring in Low- and Middle-Income Countries: Rapid Evidence Synthesis and a Field-Ready Validation Protocol for Energy, Cost, and Inclusion *Muyideen Adewale, Ambrose Azeta,Muyideen Adewale,Amina Sambo-Magaji, Eliazer Mbaeva, Daniel L. Enosegbe, Bashiru A. Ojulari*
252	From Promise to Constraint: Infrastructure, Equity, and Governance in Artificial Intelligence for Education *Amina Sambo-Magaji, Muyideen Adewale, Ambrose Azeta, Muktar Bello, Steven U. Tjiraso, Umaina I. Muhammad*
372	Deep Learning Models for Sugarcane Leaf Disease Detection *Khanyisile Magagula, Petros Mnisi, Boluwaji Akinnuwesi, Samkelo Msibi, Petros Mashwama, Mphumelelo Ndlovu, Stephen Fashoto, Elliot Mbunge, Olusola Olabanjo*
382	Comparing TVWS and Wi-Fi Installation Costs in Rural Namibia *Ronald Karon, Nomusa Dlodlo, Alfredo Terzoli*
627	Fiscal Fraud Detection and Prevention through Artificial Intelligence: A Unified Perspective on Models, Challenges, and Emerging Innovations *Rajeev Gupta, Pooja*

Time (CAT)	African Research Symposium: Technical Session – -D2-T3-B
14:00- 15.30	Chair 1: Prof Navneet Agrawal, MPUAT, Udaipur Chair 2: Mr Steven Tjiraso, NUST Moderator: Mr João Baptista Bastos, NUST

Paper ID	Paper Title and Author(s)
43	Mobile Ad Hoc Networks to Bridge Infrastructure Gaps in Higher Education, Case of Botswana *Alton Mabina, Simisani Ndaba*
65	AI Driven System for Prediction of Blood Group using Human Fingerprint Images *Kudirat Jimoh, Adenike Adegoke-Elijah, Abdulwakil Kasali, Olumide Ajayi, Akeem Alabi, Ayobami Tewogbade*
66	Adaptive Big Data Analytics for Real-Time DoS/DDoS Mitigation in Healthcare IoT: A Synthesis of Current State-of-the-Art Frameworks and Future Resilient Architectures *Fidelis Ifeanyi Okeke, Adinife Patrick Azodo, Virginia Ebere Ejiofor, Mezue Francis Canice Tochukwu, Chibuzor Chidiogo Francisca Mezue, Maxwell Omeje*
207	SCG-Optimized Neural Network for Doppler-Resilient Link Adaptation in VANETs *Etienne Alain Feukeu*
222	A BEHRT-Based Deep Learning Model for Heart-Risk Stratification in Low-Resource Settings *Kholofelo Jonase Kgatla, Nthabiseng Michael Moeti, Daniel Hlaudi Masethe, Makhulu Relebogile Langa*
309	Confidence-Aware Federated Explainable Deep Learning Framework for Cross-Platform Cyberbullying Detection *Augustine Omotayo Fatoba, Deborah Olaniyan, Julius Olaniyan*

Time (CAT)	Technical Session – -D2-T3-C
14:00- 15.30	Chair 1 & Speaker: Prof. Dr Noor Zaman Jhanjhi, Sunway University, Malaysia Chair 2: Mr Tendai Mataranyika, NUST Moderator: Mr Edward Chisala, NUST

Paper ID	Paper Title and Author(s)
499	Intelligent Fermentation Process Control Using Cloud-Edge Architecture with Digital Twin-Driven Deep Reinforcement Learning *Kamal Hiran, Darshana Soni, Manish Mittal, Suhani Agrawal, Ruchi Doshi, Rohit Mittal*
500	A Hybrid Deep Learning Framework for Autism Spectrum Disorder Detection Using Eye-Tracking and Behavioral Features *Pooja Polshetwar, Santosh Narayankhedkar, Neetin Desai*
506	HyCoSNet: A Clinical-Guided Asymmetric Network for Preoperative Glioma Survival Prediction *Yu Qiao, Sayan Kumar Ray, Md Akbar Hassain, N.Z. Jhanjhi*
507	Environmental Trigger Discovery for Extreme Acute Myocardial Infarction Risk: An Adaptive Temporal Pattern Mining Framework *Dandan Zhou, Sayan Kumar Ray, Daotong Guo, Garry Singh, N.Z. Jhanjhi*
508	Gated Unpaired Multimodal Fusion for Cervical Cancer Detection using Colposcopy Images and Risk Factors *Nasrin Sultana, Sayan Kumar Ray, Tehmina Karamat Ullah Khan, N.Z. Jhanjhi*
510	Smart Farming and Precision Agriculture Transforming Agriculture through Technology: LoRaWAN Based IoT Device for Monitoring and Control Solutions *Sanjeetha Gowthaman, Bhuvaneswari P T V, Parameswaran Ramesh, Bino J, Anis Begum S, Shabana Parveen M*

Time (CAT)	Technical Session – -D2-T3-D
14:00- 15.30	Chair 1: Mr Wilbard Kamati, NUST Chair 2: Prof Amit Sanghi, Jodhpur Institute of Engineering &amp, Technology, India Moderator: Mr Werkineh Eshete Yifru, NUST

Paper ID	Paper Title and Author(s)
513	Ethical and Intelligent Procurement: How AI Reduces Risk, Bias, and Inefficiency in Global Supply Networks *Srinivasan Narayanan*
516	Computational Formulation of Explainable Genomic AI for Breast Cancer Risk Prediction *Dilip Sisodia*
521	Prompt injection in “Agentic” Enterprise Workflow: Defending Against Dialogue Injection via Instruction-Data Isolation *Allu Sudarshana Murthy, Amandeep Singh, Gurbinder Singh Brar), Zahrah A. Almusaylim*
522	Symptom-Based Disease Prediction System Using Machine Learning with Integrated Health Guidance *Gurbinder Singh Brar, Gnanesh Banka , Harsh Kumar, Vindhyasri Gurrapu*
524	Optimal Task Scheduling using Cuckoo Search and Neural Network from Cloud Data Centres *Kamalpreet Kaur, Sahul Goyal, Rachit Garg, Gurbinder Singh Brar*
527	Hidden Assumptions in IoT Anomaly Detection: A Critical Review of Machine and Deep Learning Approaches *Sofia Sofia, Arun Malik, Isha Batra, Zahrah A. Almusaylim*

Time (CAT)	Technical Session – -D2-T3-E
14:00- 15.30	Chair 1: Dr Jitendra Singh Chouhan, Geetanjali Institute of Technical Studies Chair 2: Ms Helena Hainana, NUST Moderator: Mr Kebadu Mekuriaw Adamu, NUST

Paper ID	Paper Title and Author(s)
528	A Comprehensive Study of Glycemic Event Prediction Models: Trends, Challenges, and Opportunities for IoT Integration *Ruhi Saxena, Arun Malik, Isha Batra, Zahrah A. Almusaylim*
529	HOG–ELA Fusion Framework for Cyber Threat Detection in Digital Image Forensics *Kamalpreet Kaur, Rachit Garg, Gurbinder Singh Brar, Zahrah A. Almusaylim*
545	AI-Based Leadership Transforming Managerial Decision Making and Market Innovation in the Digital Age *Saranya J, S Athilinga Senjith, Anugragha S S, I Shanmugapriya, M Kotteeswaran, D Leelavathi*
546	Automated Breast Cancer Classification from Mammography Images Using CNN Model *K Sudha, Bhuvaneswari G*
547	Lightweight Blockchain-Based Security Architecture for 6G Edge-Cloud Computing *G Dhanalakshmi, K Ramkumar*
548	Efficient Secure Data Transmission in Wireless Sensor Networks Using ChaCha20 Encryption *R Aiyshwariya Devi, K Ramkumar*

15:30 - 15:45	TEA BREAK

Time (CAT)	African Research Symposium: Technical Session – D2-T4-A
15:45- 17.30	Chair 1 and Speaker: **Mr Mohammad Raashid Ansari, Silicon Labs, USA** Chair 2: Ms Hillary Kwala, NUST Moderator: Mr Abubakar Hamisu Kamagata, NUST

Paper ID	Paper Title and Author(s)
384	Federated and Transfer Learning Based Techniques for Privacy-Aware Lung Cancer Detection *Sonal Sharma, Vinay Rishiwal, Mano Yadav, Udit Agarwal, Charu Singh,Simon Muchinenyika*
388	Securing Digital Document Storage and Verification through Blockchain and Homomorphic Encryption *Shivani Pandey. Vinay Rishiwal, Mano Yadav, Yash Sharma, Chirag Singh, Arpit Jain*
389	Designing a Digital Identity Prototype for Marginalised Indigenous Communities in Namibia *Minikuee Kasaona, Shilumbe Chivuno-Kuria, Arpit Jain*
390	Development of a Secure and Optimised Digital Signature Framework For E-Commerce Financial Transactions *Ambrose Azeta, Odunayo Osofuye, Ogochukwu Nwamata, Ariyo Osofuye, Josephina Muntuumo, Oluwaseun Adedeji*
397	Grover's Quantum Search Algorithm for Byzantine Node Detection in Scalable Multi-Node Sensing Networks *Sesham Srinu, Jovita Mateus, Kenneth Gideon, Tiyeho Mathews*
398	A Novel Machine Learning Approach Using Concept Clustering to Enhance Early Case Assessment in Electronic Discovery *Julius Silaa, Lusilao-Zodi, Attlee Gamundani, Pilisano Masake*

Time (CAT)	Technical Session – -D2-T4-B
15:45- 17.30	Chair 1: **Dr Koundinya Challa, Minnesota state university, Mankato** Chair 2: Ms Jovita Mateus, NUST Moderator: Mr João Baptista Bastos, NUST

Paper ID	Paper Title and Author(s)
81	A Hybrid Rule-Based and AI-Augmented Framework for Automatic Failure Recovery in DevOps Deployments *Raju Chowdhury*
109	Improving MySQL Query Performance Through Runtime Execution Statistics Analysis *Hari Babu Dama*
289	AI-Driven Framework for Detecting Segregation of Duties Risks in Enterprise Access Control Systems *Vivek Kumar Polurouthu, Sekhar Manda*
306	The Missing Middle: A Systematic Review of Machine Learning for Municipal-Level Residential Energy Forecasting *Marten Weijer, Rushit Dave, Mansi Bhavsar*
307	AI-Driven Fraud Detection and Risk Scoring for Mobile FinTech Payment Systems *Venu Sannamuri*
310	Zero Trust Architecture-Driven Intelligent Threat Detection Framework Using Behavioral Analysis of Network Intrusion Data *Sundaram Yadav*
322	Agent-Driven Autonomous Resilience Framework for Real-Time Threat Neutralization and Systemic Risk Mitigation in Global Financial Systems *Sagar Bharat Shah*

Time (CAT)	Technical Session – -D2-T4-C
15:45- 17.30	Chair 1: Mr Vivek Arora, Wawa Inc, USA Chair 2: Ms Katazo N Amunkete, NUST Moderator: Mr Edward Chisala, NUST

Paper ID	Paper Title and Author(s)
328	Optimizing Cloud Identity and Access Management Policies through an Intelligent Machine Learning Framework *Barinder Pal Singh, Sharad Sharma*
329	Agent-Based Explainable Governance Framework for Autonomous AI Systems in Enterprise Environments *Rinu Dhanaraj*
332	Optimizing API Communication in Full Stack Systems: A Latency and Throughput Analysis *Satyam Nikhra*
335	Digital Twin-Driven Semiconductor Training: A Framework for AR/VR-Based Educational Systems *Meccaya Brock, Challa Koundinya, Anamika Das, Issa Alhmoud, Balakrishna Gokaraju, Shyam Aravamudhan*
339	Artificial Intelligence-Driven Defect Prediction and Risk Analysis Framework Based on SDLC Platforms *Aashish Baldwa, Premal Bhatt, Devang Upadhyay, Pratham Bhatt*

376	Smart Irrigation Digital Twin: Integrating Machine Learning and Real-Time Data for Sustainable Agriculture *Victor Emma-Wele, Koundinya Challa, Busrat Jahan, Sai Praveen Dadi, Venkata Sai Teja Reddy Gajula, Chandra Jaiswal*
377	Using College Basketball Statistics as Predictors of NBA Draft Selection *Jack Lang, Koundinya Challa, Sai Praveen Dadi, Venkata Sai Teja Reddy Gajula, Chandra Jaiswal*

Time (CAT)	Technical Session – -D2-T4-D
15:45- 17.30	Chair 1: Prof James Katende, Namibia University of Science and Technology Chair 2: Ms Loini Iiyambo, NUST Moderator: Mr Werkineh Eshete Yifru, NUST

Paper ID	Paper Title and Author(s)
572	GenAI-Enabled Enterprise Architecture Framework for Workday Transformation and Optimization *Venkatarami Redy Nallappagari*
573	A Resilient Error Handling and Monitoring Framework for Large-Scale Workday Integration Landscapes *Madhulika Gajjala*
574	AI-Driven Predictive Monitoring for Workday Integrations: Enhancing Reliability and Operational Efficiency *Madhulika Gajjala*
575	Policy Versioning and Rollback Strategies in Hybrid Networks: Managing Change in Distributed Infrastructure as Code Environments *Sai Raghu Ram Gummadidala*
576	A Topology-Adaptive Federated Learning Architecture for Privacy-Preserving Model Aggregation across Non-IID, Resource-Constrained Nodes *Nishanth Narendra*
577	VORTEX-MED: A Hybrid Quantum Machine Learning Framework for Predicting Chronic Disease Indicators *Manasvi Garg*
578	PreVisit AI: Retrieval-Augmented Generation for Patient Readiness in Clinical Encounters *Rolande Umuhoza, Mansi Bhavsar, Rushit Dave*

Time (CAT)	Technical Session – -D2-T4-E
15:45- 17.30	Chair 1: Dr Kalpna Jain, MPUAT, Udaipur Chair 2: Ms Selma Phillemon, NUST Moderator: Mr Kebadu Mekuriaw Adamu, NUST

Paper ID	Paper Title and Author(s)
599	Federated AI Architectures for Privacy-Preserving Genomic and Healthcare Data Processing *Srinivas Goud Thadakapally*
612	A Machine Learning Framework for Identifying and Classifying Road Accident Hotspots to Enhance Traffic Safety *Hemant Yadav, Bibek Yadav*
621	A Canonical Microservice-Oriented Payment Integration Architecture for Secure Digital Transaction Processing *Vivek Arora*
622	Deep Reinforcement Learning–Based Adaptive API Rate Limiting for QoS-Aware Cloud-Native Systems *Vivek Arora*
678	Hardware-Enforced Signing Governance for Mobile Stablecoin Payments: Evaluating Biometric Re-Authentication and Secure-Enclave Time-Delay Authorization *Sriram Ramakrishnan, Bhaskar Rajbongshi*

DAY 3

Date: Thursday, 6 August 2026
Time: 09:00 - 1:00 (CAT)

Time (CAT)	African Research Symposium: Technical Session – -D3-T1-A
09:00- 11.00	Chair 1: Prof Neelamadhab Padhy, GIET University, Gunupur Chair 2: Ms Shilumbe Chivuno-Kuria, NUST Moderator: Mr Abubakar Hamisu Kamagata, NUST

Paper ID	Paper Title and Author(s)
403	StemMate: A Retrieval-Augmented Generation Architecture for Curriculum-Grounded STEM Education *Josephina Muntuumo, Isabel Tchikenge, ilkka Jormanainen, Jacob Nielsen , Gabriel Nhinda, Markku Tukiainen*
405	Infobesity and Fake News Mitigation on WhatsApp and Telegram : A Retrieval-Augmented Generation Approach *Rooney Kalumba, Kahenga Ngongo, Bayongwa Bulialugo , Jovita Mateus*
411	Machine Learning-Based Meteorological Drought Prediction for Namibia Small-Scale Farmers in Khomas Region *Singwell Hondonga, Munyaradzi Maravanyika*
640	Explainable Artificial Intelligence for Video Deepfake Detection *Vikas Kumar Jain, Meenakshi Tripathi, Jyoti Gajrani, Dharm Singh Jat, Shoopala Nambahu*
644	A Machine Learning-Based Predictive Failure Detection Model for IoT-Enabled Cold Chain Systems *Khalid Yusuf,Emmanuel Ejembi ,Shawulu Hunira Nggada, Ambrose Azeta,Tendai Mataranyika*
515	Antenna Design for Regional National Satellite System: A Review Report in Indian Perspective *Navneet Agrawal, Anshu Gaur, Dharm Singh Jat, Himangi Agrawal, Suriti Gupta*
680	Automatic Speech Recognition for Afaan Oromoo: A Systematic Literature Review *Tadesse Kebede Guge, Stephen Fashoto, Sebastian Mukumbira, Haileluel Zeleke Woldemariam*

Time (CAT)	Technical Session – -D3-T1-B
09:00- 11.00	Chair 1: Dr Preety Shoran, CHRIST (Deemed to be University, Delhi-NCR, Ghaziabad) Chair 2: Ms Viktoria Shakela, NUST Moderator: Mr João Baptista Bastos, NUST

Paper ID	Paper Title and Author(s)
581	A Hybrid Approach to Flight Phase Segmentation Using Expert Rules and Deep Learning *Murtaja S. Jalawkhan, Radhwan Dakhil, Mohsin Hasan Hussein, Mohamed M. Albydhany*
584	Explainable AI-Based Smart Applications Using Apache Hadoop Architecture *K Balachander, K Ramkumar*
586	ADT-W: A GPU-Free AI Model for Segmentation of Overlapping and Touching Chromosomes in Karyotype Metaphase Images *Deepanshi Joon, Rakesh Kumar, Meenu Gupta, Harsh Jangid*
589	XGBoost-Enabled Smart Beamforming Management for Efficient 6G IoT Communication *G Manokaran, T Satheesh Kumar, A Jayanthi, R Indumathy, H Shamina*
590	Decoding Emotions Beyond Text: A Hybrid VADER-RoBERTa Approach To Sentiment Analysis *Mudita Sharan, YDS Arya, Gaurav Agarwal, Akash Sanghi*

617	AI-Driven Green Beyond 5G Wireless Communication Framework for Carbon Footprint Reduction in Smart Sustainable Networks *Abhay Bindle*

Time (CAT)	Technical Session – -D3-T1-C
09:00- 11.00	Chair 1: Dr Mayank Patel, Geetanjali Institute of Technical Studies, Udaipur Chair 2: Prof Samuel Akinsola, NUST Moderator: Mr Edward Chisala, NUST

Paper ID	Paper Title and Author(s)
549	Real-Time Flood Detection and Warning System for Smart Disaster Management Using IoT and Cloud Computing *P Murugan, Aarthi Suresh, K Famitha Begum, E Brindha Devi, B Sanjeevan, Sudha K*
550	Breast Cancer Diagnosis using Naive Bayes with AES-Based Data Security *Ajitha Kumari G, S Sujatha, Suriyakala K, R Sathya, S Hariharasudhan, Lavanya A*
552	Cloud-Based Deep Learning Architecture for Remote Sports Biomechanics and Kinematics Analysis *R Gayathri, N Mohankumar, Kottu Veeranna Babu, B Suganya, S Sujatha, Seelam Siva Rakesh*
553	XceptionNet-Based Doppler Ultrasound Analysis for Intelligent Muscle Cramp Prediction in Haemodialysis Patients *Shalini S, Padmapriya D, Marydasan Francis, Vijayalakshmi R, Parimala L*
556	Edge-Assisted IoT Electrical System Control for Enhanced Industrial Energy Efficiency *V Muthukumar, Sagar B S, S Krishna Reddy, Akhil Gupta, S Murugan, Sadasivam M*
557	Real-Time Gait and Balance Evaluation in Post-Stroke Patients Using Edge-Based IoT Systems *J Christina Linsey, Akhil Gupta, Rajmohan M, R Meenakshi, S Murugan, Hari Prasath M*

Time (CAT)	Technical Session – -D3-T1-D
09:00- 11.00	Chair 1: Dr Ajay Kumar Sharma, Geetanjali Institute of Technical Studies, Udaipur Chair 2: Prof Mercy Chitauro, NUST Moderator: Mr Werkineh Eshete Yifru, NUST

Paper ID	Paper Title and Author(s)
560	Mantis Search Optimization for Robust and Secure Relay Selection in Autonomous Mobile Environments *A V Harshika, Roshini M, R Sathya, Vijayalakshmi R, S Murugan, Sathishkumar V E*
566	AI-Powered Cloud Analytics System for Early Detection of Patient Health Deterioration *M Kesavan, K Madhavan, Sravani Donepudi, Y Ebenezer, Monisha R, C Srinivasan*
567	Predicting Residential and Commercial Energy Costs Using Random Forest for Sustainable Energy Planning *H Shamina, T Satheesh Kumar, R Indumathy, G Manokaran, A Jayanthi, Monisha R*
568	Secure Data Transmission in WSNs Using RC4 Encryption and Rabin-Karp Pattern Verification *R Sathya, Mahesh A, K C Sharmili, Priya Dasarwar, B Suresh Chander Kapali, Sathishkumar V E*
579	I-SLTS: IoT Enabled Smart Letter Tracking System *Murugesan M, Kannan A, Hari Prasath S, Naresh S, Anis Begum S, Vidhya N, Parameswaran Ramesh, Bhuvaneswari PTV*
580	I-CRA: IoT Enabled Smart Classroom and Resource Automation System

	Sowmiya N, Antony Pearlson Jeyam J, Hrishikesh D, Kirrthana A, Sai Shravya P, Sanjeetha Gowthaman, Parameswaran Ramesh, Bhuvaneswari P T V

Time (CAT)	Technical Session – -D3-T1-E
09:00- 11.00	Chair 1: Dr Jain Arpit, NUST Chair 2 and Speaker: Charu Singh, NVIDIA Moderator: Mr Kebadu Mekuriaw Adamu, NUST

Time (CAT)	TechWorkshop on "Digital Parenting in the Age of Responsible AI: Meet Gogo COPPAA" – -D3-T3-E
11:15- 12.30	Chair: Mercy Chitauro, Namibia University of Science and Technology Moderator: Marsela Rita, Namibia University of Science and Technology Recorder: Benson Ntemo, Namibia University of Science and Technology
	Facilitators: *Marsela Rita, Benson Ntemo, Fungai Bhunu Shava, Mercy Chitauro, Jennyphar Kavikairiua, Mamoqenelo Morolong, Isaac Nhamu, NUST Digital Forensics and Information Security Research Cluster*

11:00 - 11:15	TEA BREAK

Time (CAT)	African Research Symposium: Technical Session – -D3-T2-A
11:15- 12.30	Chair 1: Dr Jyoti Gajrani, Engineering College Ajmer, India Chair 2 and Speaker: Mr Siddarth Singh, LiveRamp Moderator: Mr Abubakar Hamisu Kamagata, NUST

Paper ID	Paper Title and Author(s)
383	A Competency-Based Cybersecurity Training Framework For Air Traffic Safety Electronics Personnel *Richard Abang Owan, Annlize Marnewick, Masike Malatji*
396	Integrating Automatic Speech and Image Recognition to Assist Individuals with Visual and Auditory Impairments: A Deep Learning Approach *Rester Goliati, Bennett Kankuzi, Menard Phiri*
400	Comparative Study of Multi-Agent Actor-Critic Algorithms in Parameterized Action Reinforcement Learning *Ubayd Ali Bapoo, Clement Nyirenda*
413	Tamper-Evident Self-Sovereign Identity and Hash Anchoring for Local Authority Revenue Collection in Botswana *Cleverence Kombe, Wilson Bakasa, Moemedi Lefoane*
613	Considerations for proposing a Postgraduate Cyber security qualification *Jan Eloff*
648	Redesigning a Research Collaboration Web Portal Using Human-Computer Interaction Principles *(not available - anonymized submission)*
652	Development of an AI-Assisted Web Application for Detecting and Classifying Brain Tumours in Scanned Images *Douglas Mashonganyika, Nalina Suresh*
408	A Smart IoT-Based Autonomous Robotic System for Pothole Detection and Filling Dzinaishe Mpini, Maxmillan Giyane, Sindiso Mpenyu Nleya,Amos Tendai Mushinye, Kevin Moyo

Time (CAT)	African Research Symposium: Technical Session – -D3-T2-B
11:15- 12.30	Chair 1: Prof Vinay Rishiwal,MJP Rohilkhand University, Bareilly Chair 2: Dr Avinash Srivastava Designation : Associate Professor, IMI Kolkata Moderator: Mr João Baptista Bastos, NUST

Paper ID	Paper Title and Author(s)
317	Quantum-Inspired Neuro-Biophysical Twin with Tumor Growth Modeling for Brain Tumor Classification and Prediction *Deborah Olaniyan, Ibidun C. Obagbuwa, Julius Olaniyan*
319	YOLOv26-EMSA: An Enhanced Multi-Scale Attention Architecture for Potato Insect Pest Detection in Complex Field Environments *Edem Ahialey, Regina Esi Turkson, Abdul-Lateef Yussif, Boluwaji Ade Akinnuwesi, Madoda Nxumalo*
326	A SAINT-Based Approach for Multi-Class Classification of Liver-Related Conditions *Julius Olaniyan, Adedeji Emmanuel Adebayo, Deborah Olaniyan, Ibidun C. Obagbuwa*
343	Semantic Network Modeling and Interactive Visualization of Academic Curricula for Profession Area of Specialization *Kayode Emmanuel Akinola, Kehinde Williams, Oluwasanya Oyedele, Odugbesan Olusegun Abayomi, Ayobami Emmanuel Mesioye*
347	Cybersecurity Incidents and Challenges in Operational Technology Within Water Treatment Facilities *Uben Pather, Annlize Marnewick, Masike Malatji*
357	Security and Privacy-Preserving Frameworks in E-government Systems: A Systematic Review *Arnet Zitha, Noluntu Mpekoa, Sheethal Tom*

Time (CAT)	Technical Session – -D3-T2-C
11:15- 12.30	Chair 1: Prof Sanjay Shah,Government Engineering College, Rajkot Chair 2: Prof Omobayo Ayokunle Esan, Walter Sisulu University, South Africa Moderator: Mr Edward Chisala, NUST

Paper ID	Paper Title and Author(s)
651	TabNet-Based Sleep Quality Assessment Through Adolescent Screen Usage Analytics *Kalaiselvi R, Monika S, Gomathi E, Gokulakrishnan S, Soundharya M, Mohan Raj M*
659	Validation of a Hybrid Explainable Artificial Intelligence Framework for Mental Health Risk Assessment and Prediction *Richa Datta, Bhupesh Gupta*
663	FedCausal-LLM-RS: A Federated Causal Reasoning Framework for Privacy-Aware E-Commerce Recommendation via Large Language Model Intent Encoding *Bhavana, Mukesh Sharma, Kanika Pahwa, Neetika Gupta, Sonam Bajaj, Amit Bindal*
668	Bidirectional Evaluation of ML Ensembles for T1D Glucose Prediction *Neeraj Kumar, Meenu Gupta, Rakesh Kumar*
669	Integrated Deep Learning Architectures for Chronic Pulmonary Disease Prediction from CT Scans *Garima Jain, Amit Kumar Goyal, Rahul Kumar*
670	TabNet-Based Automated Feature Learning for Scalable Data Transformation in AI-Driven Analytics Platforms *Ramesh Kumar Nanjundappan, K Prakasam, Sasirekha Desabathula, Dillibai R, R Meenakshi, S Sujatha*
101	Design and Implementation of a Secure Cybersecurity Q&A Chatbot Using Hybrid Search and Safe Prompts Resham Kumar Chaudhary

Time (CAT)	Technical Session – -D3-T2-D
11:15- 12.30	Chair 1: Dr Satya Narayan Tazi,Engineering college Ajmer Chair 2: Dr Ruchi Sharma, IMI, Kolkata. Moderator: Mr Werkineh Eshete Yifru, NUST

Paper ID	Paper Title and Author(s)
671	AIOps Foundation Model Architecture for Intelligent Incident Analysis in Cloud Computing Ecosystems *Anjaiah Methuku, J Jagan Babu, G Vijaya Lakshmi, Sagar B S, R Meenakshi, S Sujatha*
674	An Intelligent Hybrid Framework for Prostate Cancer Diagnosis Using Multi-Modal MRI and Context-Aware Deep Learning *Tanush Goel, Meenu Gupta, Rakesh Kumar*
675	Active Metadata Governance Capability and Enterprise AI-Readiness: The Mediating Roles of Data Trust and Semantic Interoperability in Cloud-Native Financial-Service Data Ecosystems *Prabhav Rathi, Sriram Ramakrishnan, Sai Sandeep Koneti*
676	A Metadata-Driven Framework for Scalable Data Quality Management and Automated Governance Enforcement in Cloud-Based Enterprise Data Systems *Sai Sandeep Koneti, Vivek Kadam, Himant Goyal*
297	Single Carrier Modulated Signal Time-Domain Denoising with Deep-Learning Algorithms *Mate Marton Mezei, Zsuzsanna Ilona Suta, Zsolt Alfred Polgar*
636	HYPROT: Explaining Black-Box Models using Hypergraph Theory Image Prototype Generation *Adolfo Diaz-Sardinas, Rafael Rodriguez-Puentes, Manuel S. Lazo-Cortes*
338	Scalable Data Engineering Framework for Large-Scale Retail Transaction Processing Using Distributed Data Pipelines Krishna Chaitanaya Chittoor

Time (CAT)	TechWorkshop on "Digital Parenting in the Age of Responsible AI: Meet Gogo COPPAA" – -D3-T2-E
11:15- 12.30	Chair: Mercy Chitauro, Namibia University of Science and Technology Moderator: Marsela Rita, Namibia University of Science and Technology Recorder: Benson Ntemo, Namibia University of Science and Technology
	Facilitators: *Marsela Rita, Benson Ntemo, Fungai Bhunu Shava, Mercy Chitauro, Jennyphar Kavikairiua, Mamoqenelo Morolong, Isaac Nhamu, NUST Digital Forensics and Information Security Research Cluster*

Valedictory Session

Time (CAT)	Activity	Presenter / Speaker
13.00	Welcoming Remarks	**Dr Colin Stanley** DVC Research, Innovation and Partnerships DVC: Research, Innovation and Partnerships, NUST
13:10	Recommendations of the Conferences	**Prof Dharm Singh Jat** Professor and UNESCO Chairholder
13:20	Remarks	**Prof A K Nayak** Pro-Chancellor: Global Open University, Nagaland
13:30	Remarks	**Prof Fungai Bhunu Shava,** General Chair, ETNCC
13:40	Vote of Thanks	**Dr Simon Muchinenyika** Head of Department: Software Engineering, NUST

13:40	LUNCH

Abstracts

P_ID7

Multimodal Learning with Interpretable Models for Lithium-Ion Battery Degradation Prediction

Pareekshit Sachan (University of Cape Town), Donnell Ngoma (Namibia University of Science and Technology), Joyce Mwangama (University of Cape Town)

pareekshit.sachan@gmail.com, donnell.j.ngoma@gmail.com, joyce.mwangama@uct.ac.za

As lithium-ion batteries are increasingly adopted in battery energy storage systems they will require robust predictive-maintenance strategies to ensure their longevity, safety, and cost effectiveness. Using NASA's battery degrada- tion dataset, this study proposes a multimodal and explainable artificial-intelligence (XAI) framework for predictive maintenance of lithium-ion batteries. The framework combines multiple data modalities including current, voltage, temperature, and impedance using a hybrid deep-learning model that combines Convolutional Neural Networks (CNN) with Bidirectional Long Short-Term Memory (BiLSTM) and additionally an additive attention mechanism to forecast the State of Health (SoH) over a five-step horizon. Explainable AI (XAI) methods, such as attention visualization and SHAP analysis, help interpret the learned degradation indicators for transparency. Evaluated under a strict cross-battery protocol (training on cells B0005/B0006, validation on B0018, and testing on the fully unseen cell B0007), the model achieves a Mean Absolute Percentage Error (MAPE) between 1.62% and 2.58% and a coefficient of determination (R2) up to 0.959 on the test cell, which demonstrates strong accuracy and generalization. A comparison with representative deep-learning SoH studies and a residual analysis further situate the model within the current state of the art.

P_ID17

A Comparative Review of Deep Learning, Transformer, Ensemble, and Cross-Modal Fusion Approaches for Liver Histopathology Classification

Nivedita Sharma (Chandigarh University), Rakesh Kumar (Chandigarh University), Meenu gupta (Chandigarh University)

niveditasharma8350@gmail.com, rakesh77kumar@gmail.com, gupta.meenu5@gmail.com

Histopathology image analysis of the liver is an important aid in diagnosis and evaluation of tumor, steatosis and fibrosis. In recent years, the use of computational methods to enhance the diagnostic accuracy and consistency and to minimize reliance on manual interpretation has been expanded, including the application of machine learning, convolutional neural networks (CNNs), transformer-based models, ensemble learning, and cross-modal fusion strategies. This paper provides an overview of the main algorithmic approaches for the classification of liver histopathology, highlighting the characteristics of the model in terms of architecture, representation of the input, evaluation metrics, advantages, and disadvantages, and clinical applications. The CNN model, ResNet50 model, EfficientNet-B3 model, Vision Transformer model, ensemble learning model, and cross-modal fusion models are comparatively reviewed. The analysis indicates that cross-modal fusion approaches generally achieve superior classification performance compared with conventional CNN, residual, transformer, and ensemble-based methods across reported studies. The review suggests that multi-representation learning improves feature diversity and classification robustness by integrating complementary histopathological representations. The external validation and dataset diversity, computation cost, interpretability, and clinical deployment, however, are all limited. The review identifies current research trends, performance gaps, existing challenges, and future directions for developing reliable and generalizable liver histopathology classification systems.

P_ID25

AI-Enabled Multimodal Sensor Systems for Human Performance Monitoring in Smart Industrial Environments

Francis canice mezue (Wilmington University), Adinife Azodo (Department of Mechanical Engineering Federal University of Agriculture, P. M. B. 2240, Abeokuta, Ogun), Sheila Ifeakarochukwu Obi (University of Alberta), Fidelis Ifeanyi Okeke (Education, Federal College of Education (Technical), Umunze, Anambra State, Nigeria), Chibuzor Chidiogo Agwunobi (Paul University No. 1 Nnamdi Azikiwe Avenue P.M.B. 6074 Awka, Anambra State Nigeria)

fmezue001@my.wilmu.edu, azodopat@gmail.com, sheilaifyobi@gmail.com, fidelis.okeke@fcetumunze.edu.ng, bubu4real2012@gmail.com

Smart industrial environments are increasingly integrating artificial intelligence and multimodal sensing to improve worker monitoring and support safer, more efficient operations. This paper reviews recent developments in AI-enabled multimodal sensor systems for human performance monitoring in smart industrial environments. It examines the main sensing modalities used in practice, including wearable, physiological, motion-based, vision-based, and environmental sensors, and discusses how machine learning, deep learning, and sensor fusion techniques are applied for fatigue detection, stress and workload assessment, ergonomics, safety behavior monitoring, and task performance evaluation. The review also highlights major deployment barriers, including privacy concerns, worker acceptance, noisy and heterogeneous data, limited explainability, interoperability challenges, and real-time implementation constraints. The paper concludes that future progress depends on privacy-aware, adaptive, and interoperable systems that are technically robust and practically deployable in real industrial settings

P_ID29

Trust Deficits as Barriers to Blockchain Adoption in Supply Chain Management

Ericky Iipumbu (NUST), Mercy Chitauro (NUST)

erickyiipumbu@gmail.com, mchitauro@nust.na

Blockchain technology has emerged as a disruptive digital innovation with the potential to improve transparency, traceability, security and operational efficiency across supply chain ecosystems. However, the adoption of blockchain in inter-organizational settings continues to be limited because of enduring socio-technical and institutional difficulties. The prevalence of trust deficits between competing organizations is one of the most significant impediments, with issues around data confidentiality, governance imbalance, competitive exposure and control of shared information still presenting challenges to collaborative technology integration. This study examines the impact of inter-organizational trust on the adoption of blockchain technology within the supply chain context. A structured literature review methodology based on thematic analysis was used to explore reoccurring socio-technical impediments to distributed ledger technology application in logistics and operational networks. The study conceptualized a synthesis of the available academic literature to explore the impact of institutional mistrust on collaboration, governance frameworks, transparency needs and technology uptake in blockchain-enabled ecosystems. The results suggest that the successful integration of blockchain technology is dependent not only on the technological capability but also on the setting of the governance neutrality, enforceable confidentiality mechanisms, equitable participation models and transparent accountability structures among the participating stakeholders. Theoretically, the study deepens the understanding of socio-technical barriers behind blockchain implementation. Practically, it provides insights to organizations, policymakers and supply chain stakeholders who want to improve collaborative trust, governance frameworks and digital transformation strategies in the blockchain-enabled supply chain ecosystems.

P_ID41

Ensemble Learning for Vehicle Health Diagnostics Using Simulated Performance Indicators

Lalit Kumar (CGC University), Preeti Rana (MMDU), Ritu Gupta (CU), Anup Lal Yadav (CGC University), Beer Singh (Seth Vishambhar Nath Institute of Engineering & Technology, Barabanki), Jay Kumar (Seth Vishambhar Nath Institute of Engineering & Technology, Barabanki)

lalit.cse@gmail.com, ranapreeti106@gmail.com, erritugupta02@gmail.com, anupsaran@gmail.com, beersinghtu@gmail.com, jaykumar.svn@gmail.com

Automotive industry has turned the tables completely upside down. Industry was looking down the barrel at one time, then sudden flourish due to good innovative minds in last two decades or so have infused freshness in the struggling automobile industry. With all this, vehicle complexity also increased. Sensor networks can be observed in almost all vehicles. So, in this era, a predictive maintenance is the need of hour. In this work, direct sensor data was not used. In fact, a large synthetic data set was built up to copy the vehicle health indicators which will be based on statics. Intent of this paper is to highlight the importance of the control module of a machine. Simulated metrics which include mileage, battery health, brake health, engine maintenance, and engine optimal performance without relying on physical sensor installations. This paper presents the performance of multiple machine learning programs after getting trained & their comparison between themselves using synthetic data. Results have proven the exemplary effectiveness while using collective methods. Random forest model is one such example. The proposed framework achieved a high classification accuracy of 99.8%. All this totally reflects the possible predictive diagnostics even in the absence of direct sensor data. A component failure might occur before its actual scheduled & planned maintenance which will lead to increased repair costs & downtime.

P_ID43

Mobile Ad Hoc Networks to Bridge Infrastructure Gaps in Higher Education, Case of Botswana

Alton Mabina (University of botswana), Simisani Ndaba (University of Bostwana), Boago Seropola (University of Bostwana)

altonmabina@gmail.com, simisani.ndaba013@gmail.com, seropolag@ub.ac.bw

The infrastructure and connectivity challenges in deploying emerging technology in higher education, especially in the developing world, are analysed and an investigation into the advantages of Artificial Intelligence-driven Mobile Ad Hoc Networks(AI-MANET) as a proposed solution to these barriers is at the centre of this study. The study used a single systematic review and synthesis of available evidence found from literature review using PRISMA, which identified a large void within existing literature on the use of decentralised network structures in improving models of use for AI in resource-poor educational settings. Research shows that AI-powered MANETs are useful in providing localised connectivity, offline access to AI learning content, and inclusive and resilient digital learning ecosystems. The conclusion is that MANETs could serve as a promising low-cost solution to closing digital divides and moving towards equitable access to technology-enhanced education in poor environments.

P_ID49

Deep neural networks for improved perception of emotion on socially connected sites: Image-driven sentimental expression

Narinder Kumar (Rayat Bahra University), Vikram Kumar (Rayat Bahra University)

nk616319@gmail.com, vk9403449@gmail.com

Sentiment analysis constitutes a very important part of social media analysis to understand the user's perspective on different problems. In numerous apps it is becoming more and more important to have social media analysis of sentiment via written communication, words, and images. Social media users post more photos and videos than words. Textual information is used in many sentiment analysis (SA) studies. One picture is worth a thousand words. We want an SA model based on social media pictures. VGG19, ResNet50V2, and DenseNet-121 transfer learning (TL) models were used for standard pixel SA. They were enhanced by regularization and fine-tuned by freezing and unfreezing layers. The CrowdFlower collection consists of URLs of photos on Twitter annotated with sentiment polarity. We also compare the sentiment prediction of pictures on our dataset using these pre-trained algorithms. Our fine-tuned TL models for VGG19, ResNet50V2, and DenseNet-121 attain 0.83, 0.85, and 0.92 accuracy. Our approach outperformed earlier visual sentiment analysis methods using machine and deep learning by 8% to 15%. The DenseNet-121 model predicted picture sentiment better than VGG19 and ResNet50V2.

P_ID50

D^2RNN: A Diverse Dual-Directional Recurrent Neural Network for Early Multi-Crop Leaf Disease Detection

Narinder Kumar (Rayat Bahra University), Rahul Azmeera (University of The Cumberlands), Vikram Kumar (Rayat Bahra University)

nk616319@gmail.com, rahulazmeera@gmail.com, vk9403449@gmail.com

Leaf illnesses threaten crop well-being and decrease the yield of important staple crops such as bell peppers, potatoes, and conventional cotton. The detection of illnesses requires considerable time and effort from people who can make mistakes during the process. It proposes a robust deep learning system using an HBD-RNN for fast and accurate identification of leaf pathogens in several varieties of crops. Since the framework uses the permission generated by both color- and texture-based data, it can analyze and find connections among various datasets. The HBD-RNN is trained with bi-directional learning to evaluate the correlation between past and projected features for enhancing the understanding of the entire course of the disease. The testing was done on a set of leaf images of diseased and healthy samples of pepper, bell, potato, and cotton leaves. Compared with traditional CNN, DL models, and unidirectional RNN theories, the HBD-RNN model achieved a higher accuracy rate of 99.3%. It was found that the established model could present real-time data on different arrhythmias during independent experiments and performed well for different plants. The developed approach will help the smart farming technologies to automatically detect the disease at an early stage, saving a lot of crops and hence improving food safety while remaining economical.

P_ID51

AI-Enhanced District Inspection and Observation Framework for Quality Assurance

Narinder Kumar (Rayat Bahra University), Vikram Kumar (RAYAT BAHRA UNIVERSITY)

nk616319@gmail.com, vk9403449@gmail.com

Effective governance requires exact, open, as well as nearly immediate oversight of service quality at a district level. In this work, an AI-powered district-specific inspection and surveillance system is presented, which aims to automate the collection, verification, and reporting of field data from major governmental industries such as schooling, medical care, and farming. Geo-tagged photos can be taken by field law enforcement, inspection findings can be uploaded, and uploads can be verified via safe OTP authentication. The AI component improves the system's trustworthiness by verifying image authenticity, recognizing redundant uploads, and recognizing abnormalities in reports. A centralized dashboard allows administrators to view field activities in real-time to approve reports, monitor performance, and conduct historical and standard analysis. The system being proposed combines AI-based verification, geotagging, and secure online processes to support operational openness, data security, and enhanced productivity in district decisions.

P_ID58

Renewable Energy Forecasting Using Multiple Linear Regression: A Comprehensive Study

Neeraj Kumar (Chandigarh University), Krishan Kumar (Chandigarh University), Shivani Kamboj (Chandigarh University), Swathi M (Ramaiah Institute of Technology), Pooja Snehal `Janwe (Sai Vidya Institute of technology)

neerajkumar518362@gmail.com, krishan.e14313@cumail.in, kambojshivani12@gmail.com, swathi.m@msrit.edu, janwepooja@gmail.com

Integrating renewable energy into the grid will be problematic due to the diversity and uncertainty of the generation of the resource. Accurate forecasting of the generation of renewable energy, especially solar radiation levels, will help support the reliability of the grid, support the better management and supply of generation assets, and increase utility operational efficiency. In this paper, we provide a comprehensive overview of forecasting solar energy using a Multiple Linear Regression (MLR) method, based on meteorological and atmospheric parameters. This will be accomplished using past data on Downward Thermal Infrared Radiative Flux, Specific Humidity, and Insolation Clearness Index as provided by NASA for a defined geographical location, and through the proposed model, solar radiation incident on a flat horizontal surface is successfully predicted. The study will include data preparation/preparation, exploratory analysis, predictive model training and model evaluation with various predictive regression models. The experimentation performed demonstrated that the use of Multiple Linear Regression provides a reasonable predictive power for renewable energy forecasting with R-squared values exceeding 0.85. The proposed method is demonstrated to be robust when compared to other machine learning models. The study findings further support renewable energy strategic planning and establish a foundation for future research in improved advanced forecasting techniques.

P_ID65

AI Driven System for Prediction of Blood Group using Human Fingerprint Images

Kudirat Jimoh (Osun State University, Osogbo), Adenike Adegoke-Elijah (Obafemi Awolowo University, Ile-Ife), Olumide Ajayi (Adeleke University, Ede), Abdulwakil Kasali (Federal Polytechnic, Ede), Akeem Alabi (Osun State University, Osogbo), Ayobami Tewogbade (Osun State University, Osogbo)

kudirat.jimoh@uniosun.edu.ng, aadegoke-elijah@oauife.edu.ng, ajayi.olumide@adelekeuniversity.edu.ng, gabdulwakil@gmail.com, akeem.alabi@uniosun.edu.ng, ayobami.tewogbade@uniosun.edu.ng

This study presented predictive model for human blood group using fingerprint images. The study developed an automatic detection of blood group as an alternative method to replace the manual process of blood group identification. Sample of fingerprint images were collected from Kaggle and preprocessed for modeling. The model was implemented using two deep learning architectures to predict blood group with a conventional Convolution Neural Network (CNN) and VGG16 model. The models were validated and evaluated using recall, precision, accuracy, and F1-score. The obtained results demonstrated that the CNN achieved a training accuracy of 88.32% and validation accuracy of 91.56%, the VGG16 performed slightly better with training accuracy of 90.35% and validation accuracy of 91.98%. These results indicate that both models maintained a relatively low training and validation losses which show a robust feature extraction and better generalization. The performance of the VGG16 outperformed CNN model is an indication that AI-driven analysis of human blood group can be accurately predicted. The deployment of the system as a web-based application further enhances its practical relevance by enabling real-time prediction and user interaction.

P_ID66

Adaptive Big Data Analytics for Real-Time DoS/DDoS Mitigation in Healthcare IoT: A Synthesis of Current State-of-the-Art Frameworks and Future Resilient Architectures

FRANCIS CANICE MEZUE (Wilmington University), Fidelis Ifeanyi Okeke (Department of Computer Science Education Federal College of Education (Technical) Umunze, Anambra State, Nigeria), Virginia Ebere EJIOFOR Ejiofor (Department of Computer Science, Faculty of Physical Sciences, Nnamdi Azikiwe University, Awka), Adinife Patrick Azodo (Department of Mechanical Engineering Federal University Wukari Taraba State, Nigeria), Chibuzor Chidiogo Mezue (Chibuzor Chidiogo Francisca Mezue Department of Library and Information Science (LIS), College of Education (Technical) Umunze, Anambra State Nigeria.), Maxwell Omeje (School of Modeling and Simulation, College of Engineering and Computer Science, University of Central Florida, Orlando, United States)

fmezue001@my.wilmu.edu, fidelis.okeke@fcetumunze.edu.ng, ve.ejiofor@unizik.edu.ng, azodopat@gmail.com, chibuzor.mezue@fcetumunze.edu.ng, maxwell.omeje@ucf.edu

The proliferation of Healthcare Internet of Things (H-IoT) Devices have revolutionized patient care while introducing critical vulnerabilities to DDoS attacks that threaten life-critical medical services. Traditional security approaches fail to meet stringent clinical requirements: sub-100 ms latency, false positive rates below 0.01%, and explainability for clinical liability. This paper synthesizes state-of-the-art big data analytics frameworks for real-time DoS/DDoS mitigation in H-IoT contexts, analyzing detection methodologies and architectural patterns employing SDN, edge computing, and cloud analytics. We propose an adaptive analytics pipeline incorporating online learning (model refresh every 6–12 hours) to address concept drift, alongside two resilient architectural patterns: edge–cloud co-analytics (15–20 ms) inference) and SDN-enabled security fabric (sub-second mitigation, micro-segmentation). Our synthesis reveals critical gaps: 93% of frameworks lack clinical integration, 78% of clinicians reject black-box decisions, and adversarial ML reduces detection from 98% to 54–61%. We outline a three-track research agenda spanning foundational technologies, clinical integration, and regulatory frameworks, emphasizing that security must be integral to patient safety.

P_ID81

A Hybrid Rule-Based and AI-Augmented Framework for Automatic Failure Recovery in DevOps Deployments

Raju Chowdhury (Microsoft), Aniruddha Singh Gautam (Microsoft), Apurv Ghai (Microsoft)

raju.chowdhury.1384@gmail.com, aniruddhasinghg81@gmail.com, apurvgh@gmail.com

Automatic failure recovery is another difficult area of DevOps deployments due to the complexity of the system, high workload and the limitations of the traditional rules-based or manual approach. This study proposes a hybrid model integrating deterministic, rule-based recovery with the assistance of AI by fault prediction to automatically monitor failures, identify, classify and recover failures in real time. To test the architecture, a distributed log dataset of 100,000 records was used for models such as Decision Tree, Random Forest, Logistic Regression, LightGBM, Autoencoder with BiLSTM. The Decision Tree had a strong performance in defect identification with an F1 score of 80.8%, recall of 80.0%, precision of 81.6%, and accuracy of 89.4%. An impressive 83.3% success rate was achieved by the automated recovery measures, resulting in a 94.6% decrease in mean time to recovery (MTTR), a 95.4% reduction in downtime, and annual savings of 7,462. The combination of explainable rule-based logic and adaptive AI prediction in the framework means it is more resilient, operationally efficient, and scalable, and an effective, autonomous approach to DevOps environments evaluated under controlled experimental conditions.

P_ID83

Digital Twin-Based Disaster Management System Using Edge and Dew Computing for Smart Cities

Rohan Verma (Deemed to be University), Prabh Singh (GEU), Kiran Singh (Chitkara University)

rohanvermahnb@gmail.com, ssingh.prabhdeep@gmail.com, kdkirandeep@gmail.com

Smart Cities are more susceptible to natural and man-made disasters, which calls for smart, low latency, and reliable Disaster Management Systems. The paper introduces a new model of a Digital disaster Management system (DT-DMS) which is a synergistic system of Digital Twin (DT) technology and Edge computing and Dew computing and is capable of predicting and warning of disaster in real time and coordinating disaster in smart city environment. We propose a new Adaptive Disaster Prediction and Response Algorithm (ADPRA) which based on the weighted data fusion model, probabilistic disaster risk model and multi-objective optimization scheme can minimize the impact of damage, response time, and power consumption simultaneously. Using a simulated dataset of a smart city disaster, Simensive experiments demonstrate that DT-DMS can achieve a 96.4 percent accuracy in disaster prediction, a 62 percent average reduction in response time over a cloud-only baselines, and a 38 percent reduction in energy consumption over a state-of-the-art system. The results confirm the combination of Dew and Edge intelligence and Digital Twin simulation in the context of proactive City scale disaster governance.

P_ID84

Big Data-Driven Coordination of Autonomous Vehicles for Smart Urban Transportation Systems

Rohan Verma (Deemed to be University), Prabh Singh (Deemed to be University), Kiran Singh (Chitkara University)

rohanvermahnb@gmail.com, ssingh.prabhdeep@gmail.com, kdkirandeep@gmail.com

Coordinating autonomous vehicles (AVs) across an entire city is a fundamentally different problem from making a single AV drive safely: it requires fusing heterogeneous, high volume traffic data, forecasting short-term congestion, and resolving conflicts between thousands of vehicles within a tight real-time budget. This paper presents BD-AVCS, a Big Data-Driven Autonomous Vehicle Coordination System, structured as a six-layer architecture that combines V2V/V2I

communication, edge/fog computing, streaming big-data analytics, and a multi-objective coordination layer. Rather than treating perception, communication, and analytics as separate concerns, BD-AVCS couples them through a single optimization problem that jointly minimizes travel time, collision risk, and delay, solved at each edge node by the proposed Intelligent Autonomous Vehicle Coordination Algorithm (IAVCA), with worst-case complexity O(n2 k log nk) per coordination cluster of nk vehicles. We evaluate BD-AVCS in a SUMO-based city-scale simulation (124 intersections, up to 800 vehicles) calibrated using real-world traffic data (TfL London, METR-LA, NGSIM US-101), and benchmark it against three baselines, including a multi-agent reinforcement learning traffic-signal controller (MARL-TSC) reproduced from recent literature so that the comparison is not limited to older, weaker baselines. Across 30 randomized simulation runs, BD-AVCS reduces average travel time by 34.7% and collision probability by 62.3% relative to a non-coordinated AV deployment, and by 15–18% and 25–30% respectively relative to the stronger MARLTSC baseline (paired t-test, $p < 0.001$).

P_ID86

Blockchain-enabled Framework for Secure Land Registration System

Ms. Shivani Pandey (MIET, Meerut), Ayush Bisht (Meerut Institute of Engineering and Technology), Nishtha Teotia (Meerut Institute of Engineering &amp, Technology), Ayush Sharma (Meerut Institute of Engineering &amp, Technology), Taniya Agarwal (Meerut Institute of Engineering &amp, Technology), Vinay Rishiwal (MJP Rohilkhand University, Bareilly)

shivani.pandey0992@gmail.com, ayushbisht0902@gmail.com, nishthateotia1805@gmail.com, ayushsharma11991@gmail.com, taniyaagarwal2003@gmail.com, vrishiwal@mjpru.ac.in

Secure land registry systems still rely on centralized databases and traditional registration methods, which can be vulnerable to fraud, corruption, delays, and land transparency issues. These challenges include disputed ownership details, inefficient property transfers, and reliance on third-party brokers to complete transactions. To tackle these challenges, this paper proposes an Ethereum Blockchain-based Land Registry System (BLSR) that ensures secure, immutable digital records of land and transparency during ownership transfers. The proposed system BLSR, has been designed as a web portal for property owners to upload information about their land with related documents proving ownership, to digitize the land registry, and store documents on decentralized storage with authority verification. The proposed system provides a mechanism for buying and selling land with easy ownership transfer. The proposed system also provides a permanent record of ownership by creating and deploying pre-defined smart contract rules on the Ethereum blockchain. The proposed system BLSR, is implemented as a web portal using Solidity for smart contract development, Flask for the backend, MongoDB for document storage, and Truffle, Ganache, or MetaMask for interacting with the blockchain. The proposed BSLR system has been evaluated and compared with the existing LandSure framework on various performance metrics. The experimental results demonstrate that the proposed BSLR system has outperformed in terms of throughput (20 Tps), maximum verification time (19.35\%), maximum transfer time (26.67\%), increased automation Score (42.86\%), maximum transparency score or traceability Score (25\%), and reduced fraud prevention score. These results show that the proposed system is highly reliable and trustworthy, offering greater efficiency in the processes of verifying property ownership and transferring titles.

P_ID93

Hybrid Artificial Intelligence Models for Scalable Network Intrusion Detection in Cloud Computing: A Comprehensive Evaluation Analysis

Vara Prassad Pinninti (CEM Global Solutions, Inc)

vara.aiengineer@gmail.com

Cloud computing platforms are increasingly targeted by sophisticated cyberattacks that are able to circumvent traditional security mechanisms. The research developed a hybrid intrusion detection system (HIDS) combined with advanced ML and DL techniques to improve anomaly detection in the cloud environment. The proposed approach overcomes the drawbacks of the existing intrusion detection frameworks by embedding the temporal dependency learning module based on CNN-BiLSTM, which enhances the ability to recognize complex attack patterns. In addition, the framework includes measures of importance analysis and strong data preprocessing techniques that boost the detection reliability and measure of importance evaluation. Data cleaning, encoding, normalization, Feature Selection, and class balancing using SMOTE are some of the significant pre-processing steps used to improve the system performance on the UNSW-NB15dataset. The experimental findings show that the suggested model is valuable, it outperforms numerous current intrusion detection methods with an accuracy of 99.64%. The outcomes indicate that the proposed hybrid architecture can effectively detect various types of attacks and safe network activities, while producing fewer false alarms, thus promising to have a good potential for scalable cloud security applications.

P_ID99

A Stencil Elliptical Masking Technique for Quantitative Privacy Preservation in Crowd Surveillance

Dr. Laxmi Choudhary (Engineering College Ajmer), Kawaljeet Singh (Engineering College Ajmer), Vineet Sharma (Engineering College Ajmer)

laxmi.choudhary@ecajmer.ac.in, kawalgeet999@gmail.com, vineetsharma6378@gmail.com

Privacy protection is a critical requirement in computer-vision-based crowd monitoring due to growing ethical and legal constraints on the processing of identifiable facial attributes. This paper presents a privacy-preserving crowd anal ysis framework that performs accurate crowd counting while systematically removing identity-sensitive information. The pro posed approach introduces a Stencil Elliptical Masking Tech nique (SEMT), in which annotation-guided elliptical regions are dynamically generated over individuals and anonymized using a context-aware, background-consistent blurring strategy. This structured anonymization preserves essential geometric and density cues required for reliable crowd estimation. The resulting privacy-compliant images are used to fine-tune a ResNet-50-based density estimation model. Experiments conducted on benchmark datasets, including ShanghaiTech Parts A and B, the Mall dataset, and UCSD, demonstrate the effectiveness and robustness of the proposed framework. The model achieves a final counting accuracy of 97%, a peak Average Precision (AP) of 95.50%, and an optimized Pixel Anonymization Ratio (PAR) of 56.20%, indi cating strong privacy preservation with minimal loss of analytical utility. Compared with conventional blurring, pixelation, and adversarial obfuscation techniques, SEMT provides a superior privacy–utility trade-off and maintains stable performance across varying crowd densities. These results validate the feasibility of accurate crowd analytics under strict privacy constraints using a unified and practical system design.

P_ID101

Design and Implementation of a SecuremCybersecurity Q&A Chatbot Using Hybrid Search and Safe Prompts

Resham Kumar Chaudhary (DePaul University)

resham.ai.research@gmail.com

This complexity of cybersecurity threats has led to the fact that smart question-answering systems should be deployed to provide efficient technical advice without jeopardizing information security. The paper suggests a secure cybersecurity Q&A chatbot, which combines lexical/semantic retrieval, fallback to controlled GPT-5-based large language model (LLM) and deterministic safety enforcement. The framework integrates the sparse retrieval based on BM25 and dense semantic representations indexed with FAISS to promote the contextual relevance and retrieval strength. A safety and intent classification component, which operates based on rules, achieves keyword-boundary risk detection to avoid exploitative or offensive results. A safeguarded GPT-5 fallback mechanism can produce controlled responses when retrieval confidence is below some pre-established threshold to provide more knowledge coverage. Experimental testing on a controlled data base illustrates that the safety and intent module attains an ideal classification under structured testing situation. The hybrid retrieval methodology offers better contextual matching of information than lexical or semantic retrieval techniques. Moreover, the architecture also enables real-time observability and auditing, highlighting the fact that it is a secure, governance-oriented conversational AI platform that can be applied to cybersecurity.

P_ID105

Design and Implementation of a Dynamic Multi-Tiered Staking Protocol for DeFi on Ethereum

Jinkang Chen (Universiti Putra Malaysia), Jie Li (Taylor's University), NZ Jhanjhi (Sunway University), Siva Raja Sindiramutty (Taylor's University)

gs66417@student.upm.edu.my, lijiesat@hotmail.com, zamanj@sunway.edu.my, Siva.sindiramutty@taylors.edu.my

Our staking scheme consisted of a tri-layered design implemented on the Ethereum blockchain, and we carried out simulations to verify the performance of the proposed model. The difference between the layers lies in the length of the locking period (7, 14, and 30 days) and the level of the return, but a user switches from one layer to another automatically depending on his balance, and he is free to partially withdraw his investment while retaining earned returns. Capital utilization reached 92% as opposed to 65% in the baseline setup.

P_ID106

Seasonal Auto-Regressive Integrated Moving Average for Price Prediction: A Study of Tesla

Jie Li (Taylor's University), Jinkang Chen (Center of Research and Design Meta Universe Petaling Jaya, Malaysia), Siva Raja Sindiramutty (, Taylor's University), Weiwei Goh (, Taylor's University), N.Z. Jhanjhi (Schoolf of Computer Science, Taylor's University), Navid Ali Khan (, Taylor's University), Jianfeng Su (School of Management, Shenyang University of Technology), Yuming Shao (School of Management, Shenyang University of Technology)

lijiesat@hotmail.com, cjk007cjk@gmail.com, siva.sindiramutty@taylors.edu.my, weiwei.goh@taylors.edu.my, noorzaman.jhanjhi@taylors.edu.my, navidali.khan@taylors.edu.my, jianfeng_su@sut.edu.cn, sym@smail.sut.edu.cn

This paper investigates the impact of incorporating seasonality into time series forecasting models for stock price prediction, with a focus on Tesla's stock data from 2015 to 2025. By employing the Seasonal Autoregressive Integrated Moving Average (SARIMA) model, the study demonstrates that accounting for seasonal patterns significantly enhances

predictive accuracy compared to non-seasonal approaches. The research process involved rigorous data preprocessing, including detrending and differencing, to ensure stationarity and reduce noise, as confirmed by statistical tests and autocorrelation analysis. The SARIMA model's performance was evaluated using multiple error metrics, which are MAE, RMSE, and MAPE, revealing substantial improvements over traditional models. Key findings indicate that the inclusion of seasonal components leads to more reliable and robust forecasts, underscoring the importance of seasonality in financial time series analysis. The paper contributes a practical framework for implementing and tuning SARIMA models in real-world financial contexts and highlights the necessity of thorough preprocessing for optimal model performance. Limitations include the focus on a single stock and the exclusion of external macroeconomic factors, suggesting avenues for future research such as the integration of exogenous variables, application to broader asset classes, and the exploration of hybrid or machine learning-enhanced forecasting techniques.

P_ID107

An Analytical Assessment of a 5G-Enabled Agricultural Drone System Using Support Vector Machines and Smart Farming Sensor Data

Jianfeng Su (School of Management, Shenyang University of Technology), Yida Wang (School of Management, Shenyang University of Technology), Jiayue Wang (University of Derby Derby), Jie Li (Taylor's University), N.Z. Jhanjhi (, Taylor's University), Navid Ali Khan (, Taylor's University)

sujianfengha@163.com, 3076789565@qq.com, 100665500@unimail.derby.ac.uk, lijiesat@hotmail.com, noorzaman.jhanjhi@taylors.edu.my, navidali.khan@taylors.edu.my

This article draws on the concept of building a "5G agricultural drone system for precision agriculture" to empirically analyze the potential and limitations of this system in monitoring crop pests and diseases through machine learning. The model consists of simulated sensor data with an overall accuracy of 30%. However, due to the great overlap of characteristics between different degrees of severity of the disease, their ability to discriminate is limited, especially in the case of mild diseases. Despite this implementation confirms the technical viability of an integrated data pipeline, the findings highlight the need for more diverse multimodal data, more accurate algorithms, and careful socio-technical integration to guarantee its dependable application in precision agriculture.

P_ID109

Improving MySQL Query Performance Through Runtime Execution Statistics Analysis

Hari Babu Dama (Bank of America)

babuharidama@gmail.com

The complexity and volume of data in the new Web application has made optimization of queries a critical requirement for database-based systems. MySQL is one of the most widely used relational database management systems (RDBMS) and is known to degrade performance as queries grow more complex and data sets become larger, particularly when dealing with latency issues in real-time applications where latency has an impact on the user experience. The paper discusses how runtime execution statistics can be applied to systematically analyze and optimize MySQL query performance. It recommends a systematic process: dataset preparation, measuring initial performance, identification of performance bottlenecks using timings, and optimization using index design, query restructuring and schema changes. Simple and complex queries were tested, and execution time showed an improvement ranging from small increments to massive decreases of up to 85% and an average of 21.6%. The results demonstrate that runtime sensitive optimization strategies are of considerable benefit, particularly to complex queries that may involve multiple joins, subqueries and aggregation functions.

P_ID113

A Multi-Source Context Fusion Architecture for Conversational AI Systems: Engineering an Integrated Framework for Memory, Document Retrieval, and Emotion Cues

Shashwat Shukla (Shah and Anchor Kutchhi Engineering College Chembur Mumbai), Deep Patil (Shah and Anchor Kutchhi Engineering College Chembur Mumbai), Sahil Nerkar (Shah and Anchor Kutchhi Engineering College Chembur Mumbai), Nayan Paleja (Shah and Anchor Kutchhi Engineering College Chembur Mumbai), Nandkishor Narkhede (Shah and Anchor Kutchhi Engineering College Chembur Mumbai)

shashwatakhileshshukla@gmail.com, patildeepcr7@gmail.com, sahilnerkar164@gmail.com, nayanpaleja5@gmail.com, nandkishor.narkhede@sakec.ac.in

Conversational AI agents increasingly demand the ability to reason using heterogeneous context sources—recent dialogue history, long-term user information, external documents, and real-time emotional cues. Existing systems typically treat these signals independently, resulting in fragmented reasoning and limited personalization. This paper presents an engineering driven framework that unifies short-term memory (STM), long term memory (LTM), retrieval-augmented generation (RAG) over PDF documents, and facial-expression–derived emotion cues into a single contextual reasoning pipeline suitable for production systems. The proposed architecture employs Redis backed STM [7], a Pinecone vector index for LTM and document embeddings [8], and an emotion cache that operates as an auxil iary cognitive signal. A centralized reasoning module fuses these inputs asynchronously and constructs contextual prompts for an LLM. The system further integrates real-time speech processing and a WebSocket-based voice interface built around Whisper based ASR [5]. Our implementation achieves sub-2-second text response latency, stable low-latency speech interaction, and more than 95% context consistency across sessions. The engineering methods presented here provide a scalable and modular blueprint for designing multi-context conversational agents.

P_ID118

Harnessing Big Data for Wildlife Conservation: A Strategic Framework for Data-Driven Decision-Making and Ecosystem Management

Meitavelo L. Himufe (Namibia University of Science and Technology), Arpit Jain (Namibia University of Science and Technology)

meitavelohimufe@gmail.com, ajain@nust.na

Namibia has faced challenges in combating poaching, habitat degradation, and funding constraints related to wildlife conservation. Although the conservation results cannot be attributed to a single factor, it is essential to understand the intricate relationships within the complex and conflicting ecological, environmental, and management frameworks. This knowledge will enhance strategic planning and the development of future policies. This research work proposes a conceptual framework for data-driven decision-making and ecosystem management, and the study of various machine learning models to improve the outcomes of conservation efforts. Machine learning techniques such as Random Forest, Support Vector Machine (SVM), and Neural Network have been utilised for predictive and classification models focused on the key determinants of conservation outcomes. The study was conducted to predict Poaching Risk, Wildlife Population, and Ecosystem Health across different conservancies and national parks in Namibia. The study performed comparative analysis, which indicates that Random Forest achieved the highest accuracy of 94.75% in predicting Poaching Risk and 94.69% in predicting wildlife populations. In predicting ecosystem health, the Neural Networks outperformed with 94.42%. The study further affirms that predictive analytics can effectively guide anti-poaching efforts, species and ecosystem monitoring, and management, in alignment with the Namibia Vision 2030, the Sustainable Development Goals, and the United Nations Development Programme (UNDP) Nature Pledge. Most importantly, the results affirm that

predictive analytics and a framework for decision support are necessary in the governance of natural resources and the planning of conservation strategies.

P_ID121

A Unified Framework for Image and Video Captioning Using BLIP with Retrieval-Augmented Generation and Temporal Consistency

Anant Kumar (GLA University, Mathura), Dilip Kumar Sharma (GLA University, Mathura), Maulik Gautam (Jaypee Institute of Information Technology)

anantbabu44@gmail.com, dilip.sharma@gla.ac.in, gautammaulik2.mg@gmail.com

Automated caption generation for images and videos plays an important role in improving multimedia accessibility and content understanding. Existing approaches for multimedia caption generation are mostly focused on static image caption generation and video caption generation. However, the existing approaches are mostly lacking in terms of context enrichment and temporal consistency. In this context, this paper proposes a unified framework for integrating static image and video caption generation using the BLIP (Bootstrapping Language Image Pretraining) model with the incorporation of the Retrieval Augmented Generation (RAG) and temporal memory. In the proposed framework, the system retrieves context information from Wikipedia for the improvement of the generated captions. Moreover, the proposed system uses an automation pipeline based on the n8n tool for the improvement of the system. Experimental evaluation using CLIPScore and human assessment demonstrates improved semantic alignment and contextual richness compared with baseline BLIP models.

P_ID123

AI-Integrated Health Interventions for Modulating Fast-Food Intake in Collegiate Populations

Kavitha M (Saveetha College of Nursing, SIMATS, Chennai), Kalabharathi S (Saveetha Institute of Medical and Technical Sciences), Padmapriya D (Saveetha Institute of Medical and Technical Sciences), Vijayalakshmi R (Saveetha Institute of Medical and Technical Sciences), Parimala L (Saveetha Institute of Medical and Technical Sciences)

kavithakarthik98@gmail.com, kalabarathi2@gmail.com, padmapriya.scon@saveetha.com, principalnursing@saveetha.com, parimala.scon@saveetha.com

This research introduces an AI-enhanced health intervention system aimed at regulating fast-food intake among college students. The system integrates user profile, nutritional data acquisition, and predictive modeling with a Random Forest algorithm to identify those at high risk and provide tailored suggestions. One thousand meal records from 120 students were studied over a 12-week period, using an 80:20 train-test split for model assessment. The Random Forest model attained an accuracy of 98.75%, precision of 98.99%, recall of 98.50%, F1-score of 98.74%, and specificity of 99%, indicating substantial dependability in identifying kids at risk of frequent fast-food consumption. Post-intervention outcomes indicated a 28.6% decrease in weekly fast-food intake, accompanied by an enhancement in average Dietary Health Scores from 62.3 to 71.5. Engagement metrics revealed that 85% of users actively engaged with the system by reacting to reminders, tracking meals, and performing gamified activities. Residual analysis verified negligible prediction errors, whereas ROC and confusion matrix assessments corroborated model efficacy. The findings demonstrate that AI-driven, personalized interventions can significantly enhance dietary behavior, diminish unhealthy eating patterns, and foster sustainable health practices among college students, underscoring the efficacy of data-driven strategies in preventive nutrition and behavior modification initiatives.

P_ID124

AI-Assisted Play Therapy Interventions for Mothers Supporting Emotional Development in Preschool Children

Bavithra V (Saveetha Institute of Medical and Technical Sciences), Thenmozhi P (Saveetha Institute of Medical and Technical Sciences)

snakshatra607@gmail.com, thenmozhi.sethu@gmail.com

This research introduces an AI-enhanced play therapy system aimed at assisting moms in promoting emotional development in preschool-aged children. The system gathers multimodal data, such as facial expressions, speech patterns, and behavioral interactions, and analyzes it using a Long Short-Term Memory (LSTM) model to forecast emotional states and provide tailored intervention suggestions. A dataset including 3,000 samples, uniformly allocated among three result categories Improved, Positive, and Stabilized was used, divided in a 70:30 ratio for training and testing purposes. The LSTM attained a final test accuracy of 99.33%, with precision, recall, and F1-scores averaging 99.00% across all categories. The confusion matrix demonstrated few misclassifications, affirming dependable class distinction. The training and testing accuracy graphs exhibited constant convergence, while loss values consistently declined, indicating good learning and little overfitting. The quantitative assessment of engagement, mood management, and mother response quality demonstrated significant improvement in child outcomes during AI-facilitated play sessions. The findings underscore the system's capacity to provide real-time, data-informed coaching for moms, improving kid emotional expression, engagement, and self-regulation. These results indicate that AI-assisted therapies may significantly enhance early childhood emotional development and reinforce parent–child interactions.

P_ID125

Intelligent Classroom System Enhancing English Language Teaching Through AI and IoT Data

Joseph Manoj Babu S (Vels Institute of Science, Technology & Advanced Studies), V Jayalakshmi (Vels Institute of Science, Technology & Advanced Studies), Pushpa Nagini Sripada (Meenakshi Academy of Higher Education and Research), Harini Cherukuri (Adikavi Nannaya University)

josephsaga94@gmail.com, vjayalakshmi.smc@vistas.ac.in, pushpansripada@gmail.com, harinicherukuri@gmail.com

The proposed Intelligent Classroom System consults the IoT devices and the Artificial Intelligence to enhance the learning of the English language through bespoke education. The system will collect real time information on student activity, achievement on tasks, emotional measures, and time spent in Reading, Writing, Listening, Speaking, and Grammar. This data set consists of 500 students with both numeric and categorical characteristics which give full analysis of learning attitudes and development. The forecast of learning progress and the division of pupils into Low or Medium progress category are based on the model of a Random Forest. The model has an accuracy of 99.88, a precision of 99.95, a recall of 99.91 and a time of F1-score of 99.92, which means it has excellent reliability in the evaluation of the level of student performance. The feature significance analysis shows that the most important factors affecting the learning outcomes are Engagement Level (28.4%), Time Spent (21.7%), and Accuracy (18.9%). Technology provides tailored feedback and high-quality learning paths and enables the implementation of different interventions on each learner. Integration of IoT data collection and AI analysis enable adaptive learning, engagement, correction of skill gaps, as well as acquisition of the English language. This approach depicts the ability of scalable intelligent classroom environments with data-driven, personalized education.

P_ID128

SVM-Based Prediction of Stress and Depressive Symptoms among Women in Menopausal Transition

Bebina Vincia Anjala Mary A (Saveetha Institute of Medical and Technical Sciences), Padmapriya D (Saveetha Institute of Medical and Technical Sciences), Suja Suresh (SRM Trichy College of Nursing)

bebinavinciaanjalamary@gmail.com, padmapriya.scon@saveetha.com, sujasuresh1999@gmail.com

The menopausal transition is a significant period characterized by heightened stress and depressive symptoms, impacting women's general well-being. The early identification of these disorders continues to be difficult owing to dependence on subjective evaluations. This research presents a prediction model using Support Vector Machine (SVM) techniques to detect stress and depression symptoms from demographic, physiological, lifestyle, and psychological data. The dataset consists of 1500 samples, evenly allocated among Low, Moderate, and High risk categories, hence providing balanced categorization. The suggested model exhibits exceptional performance, with an overall accuracy of 99.33%, alongside precision and recall metrics of 99.00%. Class-specific assessment indicates accuracy rates of 98.99%, 99.00%, and 99.01% for Low, Moderate, and High-risk categories, respectively, with recall values of 98.00%, 99.00%, and 100.00%. The F1-scores further validate uniform performance across all categories. Furthermore, ROC analysis produces AUC values above 0.99, indicating exceptional discriminating ability. The findings underscore the efficacy of the SVM model in delineating intricate correlations among characteristics and precisely categorizing mental health risk levels. The proposed paradigm offers a dependable, data-driven methodology for early identification and facilitates prompt therapeutic intervention throughout the menopausal transition.

P_ID129

Analysis of Menopausal Symptoms in Rural Women Using BERT Transformer Model

Bebina Vincia Anjala Mary A (Saveetha Institute of Medical and Technical Sciences), Padmapriya D (Saveetha Institute of Medical and Technical Sciences), Suja Suresh (SRM Trichy College of Nursing)

bebinavinciaanjalamary@gmail.com, padmapriya.scon@saveetha.com, sujasuresh1999@gmail.com

Menopausal symptoms in women residing in rural areas remain under researched, despite their significant impact on health and quality of life. This study seeks to understand and classify symptom patterns to improve assessment and awareness in marginalized communities. The objective is to build a useful classification system that can deal with the fact that symptoms might show up in different ways. The aim is to use a BERT-based Transformer architecture to comprehend the interrelations of symptoms within context. The proposed technique classifies issues into five classes such as healthy ovarian, dominant follicle, polycystic ovary, simple cyst, and difficult cyst. This technique illustrates the distinctions among several ovarian health issues. The procedure comprises careful preprocessing, extracting contextual information, and fine-tuning classification to make sure the findings are always clear and relevant. For prediction of results this architecture is ideal. It has an accuracy of 98.83%, a precision of 97.09%, a recall of 97.09%, and an F1-score of 97.09%. These results suggest that it works effectively to discover intricate patterns of symptoms and assist individuals in rural regions better understand their health throughout menopause. The study uses a meticulously structured dataset obtained from Kaggle for model development and evaluation.

P_ID133

Sleepy Driver Detection from EEG Brainwave Data Using Logistic Regression

Bijilin Reeni D (Bharath Institute Of Higher Education And Research), Rajesh Kambattan Kovarasan (Vel Tech Rangarajan Dr. Sagunthala R&D Institute Of Science And Technology), T Karpagam (R.M.K. College Of Engineering And Technology), D Sethuraman (Saveetha College Of Liberal Arts And Sciences), Mohankumar N (Symbiosis International (Deemed University)), Kohilan K (St. Joseph's College Of Engineering)

bijilinreenid@gmail.com, rajesh.kambattan@gmail.com, karpagamads@rmkcet.ac.in, sethu.vd@gmail.com, nmkprofessor@gmail.com, kohilank146@gmail.com

Globally, drowsy drivers bring about road accidents that occupy a disproportionate number of injuries, fatalities, and financial losses that result as a result. Some of the limitations of traditional methods of monitoring like eye-tracking cameras and steering behavioral review include background noise, inadequate lighting, and variation in the driver. This paper describes a machine learning approach to driver weariness detection through processing electroencephalogram (EEG) brainwave signals. EEG is objective evidence of mental attention, as it shows patterns of brain activity. In this experiment, publicly accessible Sleepy Driver EEG Brainwave Data provided by Kaggle, where the recordings were made of both awake and sleeping drivers. The EEG features that were recovered and fed to a Logistic Regression model included alpha, beta and theta oscillations. The recommended approach was able to attain an overall classification rate of 99.17, easily differentiating between drowsy and alert drivers. These results help verify that small, real-time drowsiness monitoring systems could work as a positive move towards making cars safer, preventing hazards on the road caused by the drowsiness of drivers.

P_ID136

Secure Blockchain and IoT System for Transparent Waste Export, Import and Sustainable Management

S Subi (R.M.K. College of Engineering and Technology), Akhil Gupta (Symbiosis International (Deemed University)), Raziya Begam S (Prathyusha Engineering College), R Senkamalavalli (AMC Engineering College), G Rajasekar (Vinayaka Mission's Kirupananda Variyar Engineering College), S Murugan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences)

subiads@rmkcet.ac.in, akhilgupta112001@gmail.com, raziyabegam156@gmail.com, senkamalavalli.r@amceducation.in, rajasekarg@vmkvec.edu.in, smuresjur@gmail.com

EU importation and exportation have both caused significant environmental and regulatory challenges in the global trade of trash such as contraband trading, poor management and lack of transparency. This study is a safe solution that involves Blockchain and IoT data to have a transparent control of the trash and sustainable management. 100% of 40 shipments were tracked and data including type, weight, location, and environmental conditions were captured in real time by IoT (sensors and RFID tags). The blockchain technology would provide a minimum of a backup record at a point where the data cannot be modified, which ensures that integrity of the data is ensured and compliance can be checked automatically through smart contracts. Its findings showed that 25 cargos passed the mark of compliance, 5 were noted as problematic and the period to approve it has dropped also by 40 percent (respectively 4.2 hours and 2.2 hours). Lifecycle monitoring revealed that 85 percent of garbage went to approved recycling or disposal centers and constant monitoring of the environment reduced the cases of hazardous occurrences by 30 percent. Dashboard analytics gives meaningful data that can be acted upon by meticulous planning and predictive decision-making of stakeholders. The integrated system shows increased transparency, efficiency of operation, and level of regulation of accommodation. The framework business model combines IoT-driven real-time monitoring with an immutable record-keeping system of Blockchain to offer a

scalable, sustainable solution to waste management, including export-import management, to enhance global sustainability and promote responsible, technology-driven waste management activities.

P_ID139

SVM-Based Multimodal Sensor Analysis for Real-Time Exercise Monitoring and Injury Risk Classification

G Prince Rose (Bharath Institute of Higher Education and Research), N Mohankumar (Symbiosis International (Deemed University)), Bandaru Mounika (SRKR Engineering College (A)), P Suresh (Saveetha School of Engineering), Sathishkumar V E (Sunway University), Hemnath S (St. Joseph's College of Engineering)

princepraba111@gmail.com, nmkprofessor@gmail.com, bmounika@srkrec.ac.in, sps1765@gmail.com, sathishkumarveerappampalayam@gmail.com, hemnath9096@gmail.com

Precise measurement of exercise performance and early detection of risk of injury is critical to improve fitness outcomes as well as prevent musculoskeletal issues. The paper provides a real-time monitoring of exercises and categorization of the risk of injury with the help of a Support Vector Machine (SVM) and Multimodal Gym Sensor Dataset. The dataset combines information of seven wearable sensors as, Surface EMG, Force, Strain Gauge, Magnetometer, GSR, and Optical Heart rate capturing physiological and kinematic variables like acceleration, angular velocity, muscle activities, heart rate and stress reaction over seven different gym exercises. Subsequent steps were determined: after the preprocessing, and feature fusion, SVM models were trained on radial basis and polynomial kernels to detect the kind of exercise and determine the level of injury risk. The experimental evaluation achieved the general precision of 96.8 percent in categorization of activities type and damage risk prediction and precision-, recall-, and F1-scores of more than 97 percent in each category. The proposed system recorded latency of less than 0.12 seconds on real time inference, which confirmed the effectiveness of the proposed system to work on embedded and wearable requirements. These results highlight the potential of the multimodal SVM-based approaches in developing new high-tech fitness and rehabilitation monitoring devices enabling the proactive prevention of injuries.

P_ID141

Role of Digital Interventions in Treatment Adherence in Chronic Disease Management

Padmapriya D (Saveetha Institute of Medical and Technical Sciences), Akshara K Shaji (Saveetha Institute of Medical and Technical Sciences), Suganya M (Saveetha Institute of Medical and Technical Sciences), Hemavathi R (saveetha college of Nursing), Vijayalakshmi R (Saveetha Institute of Medical and Technical Sciences), Parimala L (Saveetha Institute of Medical and Technical Sciences)

padmapriya.scon@saveetha.com, 172201007.scon@gmail.com, suganyam.scon@saveetha.com, hemavathir.scon@saveetha.com, principalnursing@saveetha.com, parimala.scon@saveetha.com

Chronic conditions such as Diabetes Mellitus, Hypertension, and cardiovascular disease need continuous attention to medication for good management. This research introduces a digital intervention strategy using mobile health (mHealth) applications and SMS reminders to enhance patient adherence. Sixty patients were observed over a 12-week period. The results indicated that average medication adherence rose from 66.8% to 87.0%, indicating a 20.2% enhancement after the intervention. The average number of missed doses per week decreased from 2.3 to 0.9. Alert response rates achieved 89.0%, indicating robust user engagement with the system. Clinical results improved, with average blood glucose levels lowering by 22%, systolic blood pressure by 12%, and cholesterol levels by 15%. Patient satisfaction ratings averaged 4.35 out of 5, indicating a favorable user experience. The results indicate that the incorporation of mHealth applications with

SMS reminders markedly increases adherence, promotes health outcomes, and offers a scalable, cost-efficient approach for chronic illness treatment.

P_ID142

Wireless Blood Pressure Sensors and IoT Telemonitoring to Assess Hibiscus Sabdariffa Effects on Hypertension

Kavitha M (Saveetha Institute of Medical and Technical Sciences), S Kalabarathi (Saveetha Institute of Medical and Technical Sciences), Padmapriya D (Saveetha College of Nursing), Vijayalakshmi R (Saveetha Institute of Medical and Technical Sciences), Parimala L (Saveetha Institute of Medical and Technical Sciences)

kavithakarthik98@gmail.com, kalabarathi2@gmail.com, padmapriya.scon@saveetha.com, principalnursing@saveetha.com, parimala.scon@saveetha.com

High blood pressure is one of the global human health conditions that should be observed continuously to treat it effectively. The study proposes a blood pressure monitoring device operating according to the Internet of Things (IoT) technology to evaluate Hibiscus sabdariffa against antihypertension. Wearable sensors were continuously used to measure systolic and diastolic blood pressure and heart rate and transfer the information to a cloud service to be analyzed in real-time. There were 10 subjects who were observed within three weeks when taking daily supplementation of Hibiscus sabdariffa. The outcomes have shown that the mean systolic and diastolic blood pressure level reduced significantly (144.4 mmHg to 131.8 mmHg and 92.6 mmHg to 84.2 mmHg). The systolic reading decreases were between 7-10 percent, and the diastolic ones were between 6-9 percent. Mean heart rate decreased from 78 bpm to 74bpm, which means the patient was more stable. Moreover, there was a reduction in the number of alerts in the level of abnormal readings and after three weeks, 80 percent of people moved into normal or pre-hypertension levels. The findings show that the integration of IoT-based monitoring accompanied by Hibiscus sabdariffa supplement has been an effective, scalable as well as patient-centre approach to continuous management of hypertension and real-time monitoring of health.

P_ID145

IoT-Cloud Integrated Framework for Continuous Monitoring of Stroke-Related Neurological Symptoms

V Prathipa (Bharath Institute of Higher Education and Research), Robin Rohit Vincent (Presidency University), R Jagadeesh Kannan (SRM Institute of Science and Technology), P K Sheela Shantha Kumari (Vel Tech High Tech Dr. Rangarajan Dr. Sakunthala Engineering College), Sundara Kumar M R (Dayananda Sagar University), Karthika A (St. Joseph's College of Engineering)

prathipavenkat1012@gmail.com, robinrohit.vincent@presidencyuniversity.in, jagadeeshraju1904@gmail.com, sheelashanthakumari@velhightech.com, sundarakumar-aids@dsu.edu.in, ekarthikaa259@gmail.com

Stroke is a primary cause of prolonged disability, necessitating ongoing surveillance of neurological symptoms to avoid complications. This research introduces an integrated Internet of Things (IoT)-cloud platform for the real-time monitoring of stroke-related disabilities. Wearable sensors collect multi-modal data, including electromyography (EMG) signals, walking patterns, and speech measurements. Edge devices do preliminary signal filtering, smoothing, and organizing, therefore decreasing noise and delays in transmission. Processed data is securely transported to a cloud platform for analysis, pattern detection, and storage. Unusual patterns are identified, and automated notifications are sent to physicians and caregivers for prompt response. The system was assessed using both simulated and actual patient behaviors. EMG signal variations were diagnosed with an accuracy of 98.5%, gait abnormalities with 97.2% accuracy, and speech pattern anomalies with 96.8% precision. The warning system effectively informed doctors of aberrant event

detection in less than 2 seconds. Interactive dashboards give a real-time picture of the conditions of the patients to make custom rehabilitation possible. The findings illustrate the efficacy of combining wearable sensors with cloud analytics for ongoing, real-time stroke monitoring, early symptom identification, and proactive post-stroke management, markedly improving patient safety and rehabilitation success.

P_ID146

Cloud-Based IoT Monitoring of Hawai'i Exercise on Depression in Type II Diabetes Patients

Suganthi S (Saveetha Institute of Medical and Technical Sciences), G Bhuvaneswari (Saveetha Institute of Medical and Technical Sciences)

suganthimadan01@gmail.com, bhuvana.prabha1981@gmail.com

Depression has been closely associated with Type II Diabetes Mellitus (T2DM), and it negatively affects the way patients adhere to medication, maintain glycemic control as well as the quality of life. Exercise has also been found to improve both physical and emotional health of diabetes patients. The current study proposes the use of a cloud-based Internet of Things (IoT) platform to monitor exercise among participants with T2DM in Hawai'i and determine its impact on depressed symptoms. The results of 5 patients who participated in an 8-week intervention using the IoT-enabled devices that constantly monitored the heart rate, length of exercise, number of steps the patient takes daily, and the intensity of activity in a patient were presented. Information was sent wirelessly to a cloud system where it could be processed, aggregated and shown dynamically on clinician dashboards. The patients received comments and reminders, and depression was assessed through PHQ-9 questionnaire. The findings revealed that there was a lot of adherence (88.95% 91.8%), the exercises were regular and of moderate nature (3540 minutes, 37.6 minutes) and that the responses of the heart rate were moderate (108115 bpm, 111bpm). PHQ-9 patients decreased in scores by 23-28.6 scores which translates to significant improvement of depression symptoms. Remote monitoring, feedback, and mental health assessment were accurately integrated into the solution, and they allowed engaging patients and making them adhere to exercises. The findings highlight the potential of cloud-based IoT to monitor to enhance physical activity and mental health in T2DM patients, which can be used as a scalable approach to a personalized healthcare regimen.

P_ID149

An Intelligent Threat Detection Framework for Secure Systems Using Behavioral Analysis of Network Intrusion Data

Sundaram Yadav (Texas Tech University)

sundaramy2025@gmail.com

Cyber threats are becoming increasingly complex, and so real-time detection systems smart and scalable to detect traditional and novel attack patterns. This paper offers a clever hybrid intrusion detection model on the foundation of the UNSW-NB15 dataset, including diverse preprocessing procedures, such as label encoding, feature engineering, class balancing by using SMOTETomek, and feature selection by using XGBoost to enhance the quality of the data and the model performance. A variety of optimized models, such as XGBoost, LightGBM, CatBoost, LSTM, Voting Ensemble, and Isolation Forest, are trained to learn the statistical and temporal patterns and tuned with hyperparameters with the help of RandomizedSearchCV. The Voting Ensemble is better than the individual models CatBoost, XGBoost and the traditional models Random Forest, MLP and Naive Bayes according to experiment results (97.70% accuracy and 97.89% F1-score). Model transparency is also enhanced by the combination of Explainable AI techniques (SHAP and LIME), making predictions easier to interpret. Moreover, the suggested hybrid risk-based decision mechanism helps to categorize threats

into actionable levels (LOW, HIGH, CRITICAL) and enhance the real-time response capabilities that helps in the creation of secure and intelligent network systems.

P_ID150

Multi-Class Knee Osteoarthritis Classification Using ResNet-50 on X-ray Images

J Sofia Bobby (Chennai Institute of Technology), Mohana Priya P (Vels Institute of Science, Technology, and Advanced Studies), M Pavani (Sasi Institute of Technology and Engineering), Akhil Gupta (Symbiosis International (Deemed University)), Sathyaraj Sellamuthu (Gnanamani College of Technology), M Muthulekshmi (Saveetha School of Engineering)

sofiabobbyj.bme@citchennai.net, pmohana.se@vistas.ac.in, pavani1416@sasi.ac.in, akhilgupta112001@gmail.com, sathyarajsellamuthu@gmail.com, muthulekshmisrinivasan@gmail.com

Knee arthritis (KOA) is one of the degenerative disorders of the joints that impact significantly on the mobility and quality of life. To achieve successful therapy, the diagnosis must be timely and accurate. This study proposes a deep learning model to classify knee osteoarthritis (KOA) intensity with five classes (Healthy, Doubtful, Minimal, Moderate, and Severe) based on the 10,000 images of knee X-ray on the dataset with ResNet-50. Data processing is done through scaling, normalization, and augmentation of the dataset to enhance generalization of the model. ResNet-50 is fine-tuned using a 70: 15: 15 train-validation-test splits. The experimental results point to the effectiveness of the model, which has an overall accuracy of 92.4% degree of precision, and F1-scores ranging between 89.8% and 93.7%. As can be seen in the confusion matrix, slight misclassifications are mostly between the closely related severity levels, namely Minimal and Moderate. These results highlight the potential of deep learning practices in automated and reliable KOA diagnosis. The proposed framework can act as a complementary tool in the hands of radiologists, as it will lessen the subjectivity and improve the situation in early detection, therefore, improving patient outcomes.

P_ID152

ANN Model for Predicting ICU Patient Mortality from Clinical Data

Jayavarunani V (Bharath Institute of Higher Education and Research), S Hemalatha (St Joseph's College of Engineering), K Karthick (R.M.K. Engineering College), K V Sunil Varma (SRKR Engineering College), C Srinivasan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University), Seelam Siva Rakesh (St. Joseph's College of Engineering)

jaya.varunani@gmail.com, hemaaptc@gmail.com, karthick.kuppan@gmail.com, sunilcst263@gmail.com, srinivasanchelliah@gmail.com, sivarakesh6666@gmail.com

To intervene as early as possible and properly allocate the resources, accurate forecasting of the mortality of ICU patients is needed. The study gives an Artificial Neural Network (ANN) model that has been trained on 4,000 balanced patient records, consisting of 24 clinical and demographic items such as vital signs, lab tests, comorbidities, treatment procedures, and severity assessments, in the Kaggle ICU Mortality Monitor dataset. The ANN structure includes three hidden layers (128, 64 and 32) of neurons with ReLU activation, dropout regularization and a sigmoid final layer. The model was also trained as per 80:20 train-test split where Adam optimizer and binary cross-entropy loss have been implemented throughout 100 epochs. Within the test set, ANN has achieved an accuracy of 99.13, precision of 99.25, recall of 99.00, F1-score of 99.12 and specificity of 99.25. The significance analysis of SHAP features revealed that the most significant predictors are the APACHE score, SOFA score, mean lactate, mean heart rate, and ventilation requirement. The results point out that the constructed ANN is a proficient model that can predict clinical data nonlinearly due to the presence of

significant interactions, which deliver interpretable and reliable results that allow identifying high-risk ICU patients early and enhancing clinical decision-making.

P_ID160

LSTM-Based ICU Patient Vital Signs Monitoring and Early Risk Prediction System

V J Binipaul (Bharath Institute of Higher Education and Research), Pon Harshavardhanan (VIT Bhopal University), M Thangamani (Sasi Institute of Technology and Engineering), RM Sivagama Sundari (Saveetha College of Liberal Arts and Sciences), M Muthulekshmi (Saveetha School of Engineering), Vicky James (St. Joseph's College of Engineering)

binipaul1978@gmail.com, pon.harshavardhanan@vitbhopal.ac.in, thangamanim@sasi.ac.in, sivagamasundarirm.sclas@saveetha.com, muthulekshmisrinivasan@gmail.com, vickyjames520@gmail.com

The maintenance of patient vital signs in Intensive Care Units (ICUs) is of great importance as it provides an opportunity to rapidly notice acute health issues. More traditional systems of monitoring are often based on some form of threshold monitoring, and these approaches can be inadequate to capture more complex temporal relationships within physiological data. This paper introduces a vital signal monitoring and early warning framework of ICU patients, based on an LSTM framework and multi-frequency time-series data. The portfolio contains 61,930 records of 10 patients that involve heart rate, SpO2, respiration rate, blood pressure, temperature, severity ratings, and labels of clinical events. The proposed system home preprocesses and aligns multi-frequency data, applies feature engineering, and utilizes LSTM networks to identify the time specifications to predict and classify risks. The model is trained on an 80: 20 train- test with equal classes of 2000 samples/ risk level. The experimental evaluation shows outstanding performance as the general result is a 99.69 accuracy with precision, recall, and F1-score values exceeding 99% in all categories of risks. The results demonstrate the effectiveness of the proposed approach in accurately predicting the level of risk of patients. Technology enables early clinical decision-making, reduces the reaction time and better patient outcomes in ICU environments.

P_ID161

Artificial Neural Network Model for Predicting Walking Stability on Floor Materials

Mary Ann J (Bharath Institute of Higher Education and Research), Priya Dasarwar (Symbiosis International (Deemed University)), Robin Rohit Vincent (Presidency University), C Srinivasan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University), Ishwarya M V (Agni College of Technology), V Brindha (St. Joseph's College of Engineering)

rocheryan2010@gmail.com, priyadasarwar21@gmail.com, robinrohit.vincent@presidencyuniversity.in, srinivasanchelliah@gmail.com, aidshod@act.edu.in, brindhavedagiri5@gmail.com

Balance is an essential element of preventing falls and slips, especially when walking over different types of floors. In this study, a prediction framework based on Artificial Neural Networks (ANN) is used to classify slip risk, based on biomechanical and surface-related features. The sample includes the 100 individuals who are walking on wood, ceramic tiles, and tatami mats with aspects like walking speed, step length, the response force of the ground, the sway velocity, and the nature of the ground. The proposed ANN model is trained in cross-validation of 5 folds and achieves better classification performance. The model achieves an overall accuracy of 98.67%, with a precision of 98.29%, a recall of 97.74%, and an F1-score of 97.99%. The confusion matrix portrays that there is not much misclassification with lots of predictions going into the correct categories of low, medium and high slip risk categories. The validation accuracy 99% and the loss area values are consistently decreasing, and this shows good learning and low overfitting. The results support

the reliability and strong generalization of the model. The proposed approach is a useful way to predict walking stability and could be used to build safer indoor environments.

P_ID162

Entropy-Guided Cuckoo Catfish Optimizer for Efficient Resource Allocation in Cognitive Radio and Biomedical Healthcare Systems

Subhashini K (Bharath Institute of Higher Education and Research), Rajasekar Rangasamy (Alliance University), Shiney M Abraham (Mangalam College of Engineering), S Murugan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences), R Kamaraj (Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology), Nasreen a (St. Joseph's College of Engineering)

subhashini2040@gmail.com, rajasekar.r@alliance.edu.in, shiney@mangalam.in, smuresjur@gmail.com, kamaraj019@gmail.com, anasreen82002@gmail.com

The allocation of resources efficiently is one of the most important issues of both Cognitive Radio Networks (CRNs) and the contemporary healthcare systems because of the dynamic environments, inherent limited resources, and performance requirements. The current paper suggests an Entropy-Guided Cuckoo Catfish Optimizer (EG-CCO) a new hybrid metaheuristic algorithm that combines the decision-making capabilities of the entropy-driven algorithm with the adaptive search capabilities of the Cuckoo Catfish Optimizer (CCO). The entropy process is a dynamical control mechanism that balances exploration and exploitation thus improving the rate of convergence and quality of solutions. First, the proposed EG-CCO is used in CRNs to allocate resources in a way that maximizes spectrum utilization and limits the interference it causes to the primary users. The model is also applied to a biomedical healthcare case where scarce medical resources like ICU beds, ventilators, and health professionals must be efficiently distributed among patients with different levels of priorities. The results of simulation indicate that the proposed EG-CCO is much better than the traditional approaches. The algorithm attains lower average waiting time, increased resource use, better fairness index, and better high-priority patient satisfaction ratio. These findings confirm the efficacy of EG-CCO as a powerful and scalable optimization platform to support both communication and biomedical uses.

P_ID179

IoT and Supply Chain Logistics Prevention: Using Emerging Technologies to Increase Security and Performance

Nasrin Fatima (Rayat Bahra University, Punjab, India ,), Pooja Sharma, (Rayat Bahra University,Punjab, India,), Sukhjinder Kaur (Rayat Bahra University, Punjab, India ,), Goldi Makhija (Independent Researcher), Zeldi Suryadi (Nusa Putra University)

nasrinfatima700@gmail.com, poojarani@rayatbahrauniversity.edu.in, skaur29100@gmail.com, goldim1309@gmail.com, zeldi.suryadi@nusaputra.ac.id

Internet of Things (IoT) is transforming the supply chain management sector through real-time visibility, increased efficiency and security. In this paper, we investigate how IoT technologies enable such outcomes. IoT devices enable seamless connectivity between products, warehouses, and logistics networks, allowing businesses to manage inventory, forecast demand, and prevent theft or fraud. This paper examines how data-driven intelligence contributes to an efficient, cost-effective transport logistics operations and fewer risks through illustrative case studies. It also suggests ways to improve IoT security in supply chains and tackles the security issues raised by IoT like data leaks and illegal access. Comparative analysis shows that IoT based Supply Chain Management (SCM) solutions improve operational efficiency, security, inventory accuracy, responsiveness, and scalability, while reducing costs, downtime, and power consumption.

Costs are reduced by 30%, achieving 95% efficiency—approximately 26.7% higher than traditional systems. With only one documented security event per year, compared with five in conventional systems, overall security is enhanced. Response time to disturbances drops and inventory accuracy rises as well. IoT solutions additionally provide 400% scalability increase.

P_ID180

A Hybrid Stacking Ensemble Model for Accurate Depression Detection Using Machine Learning

Prabhjot Kaur (Department of Computer Science, Rayat), Sukhjinder Kaur (Department of Computer Science, Rayat Bahra University, Mohali, India,), Venkata Satya Sai Rohit Kuppili (Westcliff University, USA), Dr. Kavita (Department of Computer Science, Rayat Bahra University, Mohali, India,), Lusiana Sani Parwati (Nusa Putra University)

prabhjot161120@gmail.com, sukhjinder.17978@rayatbahrauniversity.edu.in, rohit.kvss@gmail.com, kavita@ieee.org, lusiana.sani@nusaputra.ac.id

A hybrid stacking ensemble approach has been proposed to predict depressive symptoms among university students. The symptoms included like behavioural, demographic, and emotional factors. The dataset downloaded from kaggle.com. Dataset containing 1,602 samples of Bangladeshi students, around 20 features namely age, gender, body mass index (BMI), activity level, sleep quality, anxiety, and loneliness. To clean the data of dataset, extensive preprocessing was performed. The preprocessing steps included replaced the missing numeric entries through median imputation. The features obtained low variance or strong intercorrelation were removed. The skewness and outliers was handled which was managed using Robust Scaler. Most of the time has been observed that the class imbalance. To resolve, the dataset underwent SMOTE-ENN resampling. One more step introduced i.e. new interaction-based attributesAge×BMI, Sleep×Activity, and Anxiety×Lonelinesswere created to capture nonlinear dependencies within the data. The hybrid approach has been introduced. The proposed approach was combination of Random Forest and Decision Tree classifiers as base learners, Logistic Regression serving as the meta-model. The proposed hybrid model secured more than 97% accuracy. This accuracy showed a transparent prediction for early depression detection.

P_ID181

Digital Wellbeing and AI Addiction Mitigation

Damini . (Rayat Bahra University, Mohali,), Kavita Kavita (Rayat Bahra University, Mohali,), Moneyta Dholah Rosita (Nusa Putra University), Zahrah A. Almusaylim (King Abdulaziz City for Science and Technology (KACST))

Daminisahotra19@gmail.com, kavita@ieee.org, moneyta@nusaputra.ac.id, zalmusaylim@kacst.gov.sa

Artificial intelligence is rewriting the new era of human civilization. AI is improving human society, from entertainment sector to medical its changing human life in such a fast pace which is difficult to comprehend. However the advent of AI is also interfering with the human evolution and altering natural growth of human. AI understanding capabilities of natural and artifical pattern is providing enhanced recommendations which ultimately leads to endless scrolling and Inescapable constant notifications which leads to excessive use of electronic device and application leading to degrading physical, mental health, reduced focus and decreased productivity. This paper examines the correlation between digital dependence and AI-related applications, focusing more on how algorithmic approaches make people more likely to use them frequently. It also discusses the present solutions in dealing with the problems brought by digital dependence, including therapies and AI-related solutions. In order for AI applications and solutions to promote long-term digital wellbeing and stimulate good digital habits, it underscores the crucial use of ethics and interdisciplinary strategies in its development.

P_ID182

Comparative Analysis of Deep Learning Architectures for Skin Cancer Lesion Detection and Classification

Kompal (School of Engineering and Technology, Rayat Bahra University Kharar, Punjab), Simran varma (School of Engineering and Technology ,Rayat Bahra University Kharar, Punjab), Sahil Verma (School of Engineering and Technology, Rayat Bahra University, Kharar, Punjab), Daniel Durai Raj (Cromwel Thomas Independent Researcher), Mochammad Arvin Syarifuddin (Nusa Putra University)

kompalthakur1134@gmail.com, vsimran1310@gmail.com, sahilverma@ieee.org, daniel.cromwel@gmail.com, m.arvin@nusaputra.ac.id

Deep learning has taken computer-aided diagno-sis to a new level, as it allows the classification of skin lesions with high accuracy using machines. In this paper, we give a comparative study of the deep learning models, such as convolutional neu-ral networks (CNNs), transfer learning methods, including ResNet, Inception, DenseNet, and Mo-bileNet, and new transformer-based models and multimodal methodologies. The work on bench-mark datasets like the ISIC, HAM10000, PH2, among others, has consistently reported CNNs with accuracy between 91 and 99 per cent, and optimized CNN pipes scoring higher than 98 per cent. MobileNet Lightweight architectures like MobileNet are promising to be deployed in real-time with reasonable performance trade-offs. Hy-brid, ensemble, optimization, multimodal, and transformer models provide additional diagnostic accuracy improvements, and may be able to be enhanced in interpretability and robustness, alt-hough they are still data-intensive and less clini-cally justified. Class imbalance management, find-ing external validation, and clinical explainability continue to be challenges despite recent progress. A mini meta-analysis across seven benchmark studies yielded a weighted mean accuracy of 96.16%, recall of 96.73%, and precision of 96.77%, confirming the stability of deep CNN and hybrid models. Binary classification tasks consist-ently outperformed multiclass models by approxi-mately 3% points, demonstrating dataset sensitivity in clinical settings. The paper highlights CNNs as the best frameworks at present, arguing about the prospects of multimodal and transformer architec-tures as the way to go on building a clinically via-ble skin cancer detection system in the future.

P_ID184

Comparative Analysis of Deep Learning Models for Phishing Detection

Aaqib Bashir Bhat(Rayat Bahra University Mohali, India), Shubpreet Kaur(Rayat Bahra University Mohali, India), Tejinder Kaur(Rayat Bahra University Mohali, India), Sukhjinder Kaur(Rayat Bahra University Mohali, India), Narinder Kumar(Rayat Bahra University Mohali, India), Gina Purnama Insany(Nusa Putra University)

a.bashir@rayatbahrauniversity.edu.in, s.kaur@rayatbahrauniversity.edu.in, tj.kaur@rayatbahrauniversity.edu.in, sukhjinder.17978@rayatbahrauniversity.edu.in, narinder.kumar@rayatbahrauniversity.edu.in, gina.purnama@nusaputra.ac.id

Phishing is the most prevalent form of social engineering attack, in which attackers deceive users through social engineering to extract sensitive information such as passwords, bank information, and credentials. Phishing detection measures using the traditional means of blacklisting and heuristics are generally ineffective against zero-day attacks. With the rise of artificial intelligence in detecting phishing attacks, many researchers began implementing Deep Learning (DL) Models such as Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), BiLSTM, Deep Reinforcement Learning (DRL), Multilayer Perceptron (MLP), and Deep Neural Networks (DNN), on phishing detection. This paper presents a comparison of these DL Models on the basis of accuracy, datasets, feature engineer requirements, strengths, and weaknesses. The paper concludes that RNN is the highest accuracy, but hybrid models and multi-model ensembles are the most promising for real-time phishing detection.

P_ID199

Artificial Intelligence in Education: Transforming Learning and Teaching

Anmol Goyal(Rayat Bahra University), Komalpreet Kaur(Rayat Bahra University)

kavita@ieee.org, sahilverma@ieee.org

In the current generation, artificial intelligence (AI) is quickly becoming a game-changing technology. By saving time, increasing comfort, and boosting the entire learning experience, artificial intelligence (AI) has a substantial impact on education for both teachers and students (Holmes, Bialik, & Fadel, 2019). AI strengthens the bonds between educators and students by allowing students to ask questions at any time. Students can submit questions and get immediate answers with AI-powered apps (Chen, Chen, & Lin, 2020). Diverse viewpoints exist among researchers about AI's potential applications in education. According to some, artificial intelligence (AI) may eventually take the place of traditional classrooms, oversee grading schemes, and assess emotional intelligence (Selwyn, 2019). Teaching methods have already been transformed by the incorporation of AI. For example, intelligent systems that automatically monitor student involvement have taken the role of traditional attendance registers (Zawacki-Richter et al., 2019).Although AI has many advantages, It also has drawbacks, including excessive reliance on technology, privacy issues, lack of teacher preparation, and high cost (Kerr, 2020). Reliable systems, data security, and appropriate usage are essential for long-term adoption. AI can guarantee effective learning outcomes, improve knowledge acquisition, and give correct information when used properly (Popenici & Kerr, 2017).

P_ID200

Fake Face Generation Using Deep Learning

Anubhav Shakya(Rayat Bahra University), Anita Goyal(Rayat Bahra University), Shivangi Gujjar(Rayat Bahra University), Ekpreet Kaur(Rayat Bahra University), Harpinder Kaur(Rayat Bahra University), Sukhpreet Kaur(Rayat Bahra University), Alun Sujjada(Nusa Putra University)

Anubhav.Shakya@rayatbahrauniversity.edu.in, anita.goyal@rayatbahrauniversity.edu.in, shivangi.18602@rayatbahrauniversity.edu.in, ekpreet.19833@rayatbahrauniversity.edu.in, harpinder.19213@rayatbahrauniversity.edu.in, sukhpreet.19714@rayatbahrauniversity.edu.in, alun.sujjada@nusaputra.ac.id

One of the most essential identifying objects in a human is the face, with the help of the fake face we can deal with today's existing problems like the barrier of trust and scamming. The technology of fake face is useful and the field of attending anonymous calls, performing real life activities like video calls with a stranger. During the video call individuals will use my application to generate and give a synthetic face so others side people can't replicate and reuse. The concern in this new adaptation is that some people have necessity to deal with big business clients and the scammers use this necessity in order to perform scams, which is resulting in increasing in suicide rates, threatening the people through different platforms only because of the reason that they have used their own face (The real identity). "Generating Fake Face" is basically designed for the better management of the security and privacy which results in saving millions of lives in today's technological world. I have designed a deep learning model, in order to enhance the security and privacy of an individual or a group of company

P_ID201

Improving Transient Stability in Multi-Machine Power Systems Through Governor Action

Snowber Mushtaq (Rayat Bahra University), Maninder Kaur (Rayat Bahra University), Snowber Mushtaq (Rayat Bhara University, Mohali, India), Iwan Setiawan (Nusa Putra University), Zahrah A. Almusaylim (King Abdulaziz City for Science and Technology (KACST))

snowber.m@rayatbahrauniversity.edu.in, kaur@rayatbahrauniversity.edu.in, kavita@ieee.org, iwan.setiawan@nusaputra.ac.id, zalmusaylim@kacst.gov.sa

The growth of RWE into the modern power systems, where renewable energy sources are being connected extensively, poses a substantial threat to the grid stability. The substitution of synchronous generators with inverter-based resources causes a significant decrease in system inertia, which is one of the key characteristics that determines the natural ability of the grid to maintain its stability against disturbances. This loss of inertia increases the system's vulnerability to large oscillations leading the possibility for a transient instability and wide-area blackouts. This paper attempts to address this critical question by developing and verifying a new adaptive governor control model. Our approach does not share the rigid configuration of traditional fixed-parameter governors, but supervises – via its main control parameters, i.e., the droop and time constant – the grid's effective system inertia from instant to instant. This feature is designed to give a more sensitive and faster response of the governor with decreasing inertia of the simulator, anticipating the more rapid dynamics associated with low actual inertia. The performance of the adaptive governor has been compared with a nominal non-adaptive one over an extensive set of comparative simulations. Results show that the resilience can be significantly improved, up to 24% reduction in rotor angle overshoot was achieved through adaptive control with better damping of oscillations. The work reveals an important insight that a dynamic control policy is necessary to maintaining the resilience of modern grid infrastructures, and thus represents a foundational piece for future distributed control frameworks which would allow power systems with high renewable energy penetration operate securely without sacrificing their operational security.

P_ID202

A Deep Learning & NLP for Fake News Detection: A Comprehensive Analysis of Models

Prabhjot Kaur (Rayat Bahra University Mohali, India), Anmol Goyal (Rayat Bahra University Mohali, Inda), Anita Goyal (Rayat Bahra University Mohali, India), Imam Sanjaya (Nusa Putra University)

prabjot56432@gmail.com, Goyalruby@gmail.com, Abbu.neetu@gmail.com, imam.sanjaya@nusaputra.ac.id

Abstract- The social media has become a chief source of the fake news in the digital era. In this way, it endangers the democratic debate, public trust, and the societal stability. Considering the increasingly complex nature of the misinformation spreading, which is usually facilitated by the automation as well as AI-generated content, there is a need for the strong detection tools that go beyond the traditional linguistic and the statistical methods. This research discovers the use of the Deep Learning (DL) and Natural Language Processing (NLP) to recognise the falsification of the news automatically. Through a Systematic Literature Review method, the current work studies the research articles that have been peer-reviewed and emphasis on deep learning breakthroughs capable of radical changes in semantic and contextual understanding. The study primary focus is on the understanding that is obtained from deep learning architectures such as the CNNs, LSTMs, GRUs, and the transformer-based models like the BERT and RoBERTa. The study is about the usage of metrics to assess the performance like accuracy, F1-score, and recall, on various benchmark datasets such as FakeNewsNet, LIAR, and PolitiFact. Contextual embeddings together with hybrid models such as BERT-GRU or RoBERTa-LSTM used for capturing the deeper semantic dependencies can be strong enough to outperform significantly conventional ML classifiers. However, problems like dataset bias, explainability, and cross-lingual scalability are still

awaiting solutions. The paper underlines that integrating explainable AI (XAI) with hybrid deep learning models and multilingual datasets could be the ideal solution to address issues of trust, generalizability in fake news detection systems.

P_ID203

Hybrid LSTM–CNN Models for Spatiotemporal Weather Prediction

Ishant Bharol (Bahra University Mohali, India), Anita Goyal (Rayat Bahra University Mohali, India), Anmol Goyal (Rayat Bahra University Mohali, India), Alun Sujjada (Nusa Putra University)

bishant607@gmail.com, Abbu.neetu@gmail.com, Goyalruby@gmail.com, alun.sujjada@nusaputra.ac.id

Weather forecasting plays a critical role in other industries such as agriculture, disaster management, aviation and energy planning where proper forecasting will help in making timely decisions and minimize the risks. Atmospheric systems are nonlinear and dynamic Traditional numerical weather prediction (NWP) models, even though ubiquitous, are computationally expensive and do not exhibit nonlinear and dynamic behaviour. In order to overcome these shortcomings, this research suggests a hybrid deep learning model based on Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks to conduct spatiotemporal weather prediction. The CNN component finds spatial characteristics of the meteorological data (satellite images), and the LSTM component considers the temporal relationships of sequential weather patterns. The model is assessed based on performance measures such as accuracy, RMSE, MAE and ROC-AUC. The experimental findings indicate that the hybrid CNNLSTM model is better than the isolated CNN and LSTM models, as it is more accurate (92%), has lower prediction errors, and higher classification (AUC = 0.96). The conclusion emphasizes the usefulness of the integration of spatial and temporal learning in effective prediction. This method can be extended to real-time weather prediction systems and it is planned to work on enhancing the interpretability, computational performance, and integration with physics-based forecasting models in the future.

P_ID204

Artificial Intelligence Based Anime Conversion System for Interactive and Engaging Learning

Harmanpreet Kaur (Rayat Bahra University Mohali, India), Arvind Chauhan (Universal Institute of Management & Technology Universal Groups of Institutions Mohali, India), Mandeep Kaur (IET Bhaddal Technical Campus Ropar, India), Parminder Kaur (CGC University Mohali, India), Simran (IET Bhaddal Technical Campus Ropar, India), Fikri Arif Wicaksana (Nusa Putra University)

harmanrurak078@gmail.com, atulc213@gmail.com, mandeepballu1997@gmail.com, parminderk2111@gmail.com, apsimran140@gmail.com, fikriarifw@nusaputra.ac.id

Learning traditional methods that rely on textbooks do not always keep the students interested and hamper the ability to retain knowledge. This paper presents an Artificial Intelligence (AI)-based platform that transforms textbook information to anime-based learning stories to improve learning. The system combines Optical Character Recognition (OCR), Natural Language Processing (NLP), and generative image models to convert still text to interactive visual tales. A total of 60 students were split into control (traditional learning) and experimental (AI-based learning) to apply an experimental evaluation. The findings show a great enhancement of student engagement, memory retention, concept clarity, and academic performance and a decrease in cognitive load. In particular, the engagement level rose by 45 per cent to 78 per cent, and the retention level rose by 50 per cent to 72 per cent. In the findings, it is possible to indicate that the theories of multimedia learning and cognitive load are supported, which means that visual storytelling along with AI-

driven methods promotes a better understanding and long-term memory. The suggested system is a more interactive, engaging and effective learning approach to contemporary education, which is scalable and innovative.

P_ID205

Robotics, Green Construction, and Regulatory Standards

Deepika (Rayat Bahra University, Mohali – 140104, Punjab, India), Shalom Akhai (Maharishi Markandeshwar Engineering College, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala – 133207, Haryana, India.), Mahapara Abbass (Maharishi Markandeshwar Engineering College,Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala – 133207, Haryana, India), Suman Khanna (Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala – 133207, Haryana, India), Jyoti Sharma (Rayat Bahra University, Mohali – 140104, Punjab, India.), Uzma Abbas (Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana – 133207, India.), Sudin Saepudin (Nusa Putra University)

deepdeepika664@gmail.com, shalom.akhai@gmail.com, mahparaabbas@gmail.com, sumankhanna@mmumullana.org, jbhardwaj38006@gmail.com, uzmaabbas1990@gmail.com, sudin.saepudin@nusaputra.ac.id

Progressively, the construction industry takes a new direction to sustainability, with the inclusion of robotics and automation technologies. Although green building aims at reducing the environmental impact over the entire lifecycle of buildings, the introduction of robotics brings in accuracy, efficiency, and better safety in the construction operations. The overlap of the fields ie multidisciplinary engineering solutions provides possibilities of huge cuts or reductions of the waste, emissions, and resource use. Nonetheless, the implementation of robots systems is predetermined by the shifts in regulatory policies in the area of safety, environmental performance, online regulation, and responsibility. The paper will thoroughly analyse robotics in the field of sustainable construction, build a theoretical framework based on the socio-technical systems and sustainability transition theory, as well as make a comparative study of worldwide regulatory strategies. The paper establishes structural loopholes in the international governance frameworks and suggests a way forward to harmonized automation of the built environment in a more sustainable way.

P_ID206

AI Enabled Intelligent Manufacturing for Sustainable Infrastructure Development

Mehjabi Pravin (Rayat Bahra University, Mohali – 140104, Punjab, India.), Shalom Akhai (Maharishi Markandeshwar Engineering College, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala – 133207, Haryana, India.), Mahapara Abbass (Maharishi Markandeshwar Engineering College, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala – 133207, Haryana, India.), Suman Khanna (Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala – 133207, Haryana, India.), Deepika (Rayat Bahra University, Mohali – 140104, Punjab, India.), Uzma Abbas (Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana - 133207, India.), Mochammad Arvin Syarifuddin (Nusa Putra University)

mehjabipravin1221@gmail.com, Shalom.akhai@gmail.com, mahparaabbas@gmail.com, sumankhanna@mmumullana.org, deepdeepika664@gmail.com, uzmaabbas1990@gmail.com, m.arvin@nusaputra.ac.id

The rapid development of infrastructure and industrial operations have increased worldwide concerns related to resources depletion, environmental degradation as well as inefficient production systems. Development of sustainable infrastructure needs to combine the level of advanced technologies that will be able not only to rationalize resource

utilization but also balance the economy and environment. Intelligent manufacturing systems have utilized AI as a revolutionary device to provide predictive analytics, automated decisions and optimized manufacturing. The combination of AI and manufacturing technologies provides fresh opportunities on the sustainable development of infrastructure through efficiency and waste reduction, better control of the lifecycle, and data-based governance. The paper proposes a conceptualization of AI-enabled intelligent manufacturing systems that can be used to facilitate sustainable infrastructural development. The paper discusses AI application in the optimization of manufacturing processes, predictive maintenance, intelligent material manufacturing, supply chain, and infrastructure lifecycle monitoring. Also, interdisciplinary approaches, including engineering innovation, economic feasibility, legal-compliance, and policy-governance, have been addressed. The suggested framework emphasizes AI-based manufacturing ecosystems to help provide resilient, efficient, and environmentally friendly infrastructure systems. The research gives the conclusion that AI-based intelligent manufacturing will be important in changing the infrastructure development by combining the technological innovation with the sustainability objectives and regulatory governance..

P_ID207

SCG-Optimized Neural Network for Doppler-Resilient Link Adaptation in VANETs

Etienne Alain Feukeu (UNISA)

efeukeea@unisa.ac.za

Vehicular Ad Hoc Networks (VANETs) support safety-critical applications requiring fast and reliable communication under highly dynamic channel conditions. However, conventional rate adaptation algorithms such as Auto Rate Fallback (ARF) and SampleRate struggle with rapid channel variations caused by high mobility and Doppler effects. This paper proposes a neural network (NN)-based rate adaptation approach trained using the Scaled Conjugate Gradient (SCG) algorithm for IEEE 802.11p environments. The model uses Signal-to-Noise Ratio (SNR) and Doppler shift to predict the optimal Modulation and Coding Scheme (MCS) in real time. Performance is evaluated over SNR values of 2–30 dB and Doppler shifts of 250–1000 Hz. Results show improvements of up to 57% in transmission rate and 41.82% in goodput, along with a 54% reduction in transmission duration compared to ARF and SampleRate. Although performance degrades under extreme Doppler conditions, the model remains competitive. These findings demonstrate that incorporating Doppler-aware features into lightweight machine learning models can significantly improve rate adaptation in dynamic vehicular networks, making the approach suitable for real-time safety-critical applications.

P_ID222

A BEHRT-Based Deep Learning Model for Heart-Risk Stratification in Low-Resource Settings

Kholofelo Kgatla (Tswane University of Technology), Nthabiseng Michael Moeti (Tshwane University of Technology), Daniel Hlaudi Masethe (Tshwane University of Technology), Makhulu Relebogile Langa (Tshwane University of Technology)

kgatlakholofelo@gmail.com, MoetiMN@tut.ac.za, MasetheHD@tut.ac.za, relebogilelanga@gmail.com

Cardiovascular disease is a leading cause of mortality, which is accentuated by delays in early detection in low-resource healthcare settings due to specialist shortages and limited diagnostic capacity. Therefore, this work introduces a Hybrid Resource-Optimised BEHRT (HR-BEHRT) deep learning framework for risk stratification of heart disease from structured electronic health record data. The proposed model modifies the BEHRT transformer architecture by reducing the number of parameters and thus the classification head, enabling fast inference on standard CPU hardware. The efficacy of the HR-BEHRT model was assessed using the Cleveland Heart Disease dataset and a longitudinal subset of MIMIC-III, and it was

reported to achieve significantly higher predictive performance than baselines, including Logistic Regression, Random Forest, and LSTM. There was a notable improvement in the F1 score and area under the curve. Attention-based interpretability identified clinically relevant predictors such as elevated troponin, recurrent chest pain, and a history of hypertension, and thus justified clinical trust. Compact architecture and fast inference time make the model fit for deployment in resource-constrained healthcare environments.

P_ID231

Intelligent Cyber Threat Detection Using Artificial Intelligence (AI) -Driven Machine Learning Techniques for Modern Cybersecurity Infrastructure

Ashay Mohile (Meta)

ashaymohile3010@gmail.com

The issues of network intrusion detection have turned into one of the most urgent, as the number of advanced cyberattacks and extremely unbalanced network traffic statistics are rapidly increasing. This paper puts forward an effective hybrid deep learning-based system of threat detection under Long Short-Term Memory and Gated Recurrent Unit (LSTM-GRU) model to effectively categorize the normal and adversarial activities on the network. The dataset used is CICIDS-2018, which comprises large-scale network traffic of various types of attacks and an imbalance in the classes. Extensive preprocessing is carried out such as data cleaning, drop of redundant features, numerical labeling and Z-score standardization. Class imbalance may be addressed by using the Synthetic Minority Over-sampling Technique (SMOTE), followed by feature selection to choose the most informative ones. The processed data is separated into training and testing subsets in the 80:20 proportion. Network traffic sequences with both long- and short-term temporal dependencies have been successfully captured by the hybrid LSTM-GRU architecture. It used the following measures to evaluate the proposed model: accuracy (97.80), precision (98.81), recall (97.40), and F1-score (98). The findings confirm that the proposed approach is superior to the models used in detecting threats.

P_ID234

A Review and Analysis of Insect Classification in Field Crops Using Artificial Intelligence Algorithms With Preprocessing Strategies

Roop Lal (Chandigarh University), sanjay Singla (chandigarh University Mohali Punjab)

roopcse12@gmail.com, dr.ssinglacs@gmail.com

Insect pests inflict large-scale economic losses from 20-40% annual harvest damage, with aggregate global costs exceeding $70 billion, highlighting the need for rapid, dis crimination classification for the sustainability of farming. This literature review compiles the most recent publications (2024 2026) regarding the classification of pests within field crops using AI, with an emphasis on preprocessing. After a systematic review of Scopus, 21 publications were selected. The major benchmark datasets were IP102 (75,000+ images, 102 classes), Insect 1M (1 million images), DLCPD 25 (221,943 images, 203 classes), RP11 (7,026 rice pest images), AP162 (194,700 images), and OIDS 45 (58,585 images). Various preprocessing techniques, namely, image resizing, normalization, and augmentation, noise reduction, and conversion to the HSV color space, were found to increase classification accuracy by 8 to 15%. CNNs were found to deliver a median accuracy of 91.2% on large-scale datasets, while vision transformers (ViTs) and ensemble models demonstrated 93 to 94% with an even larger computational demand. The classical machine learning paradigms (SVM, KNN, ANN) demonstrate 68 to 79% accuracy with heavy reliance on hand-crafted features. Some of the major remaining challenges are domain shifts, class imbalance, and insufficient evaluation protocols. Ultimately, this literature review argues that advanced techniques and

efficient deep learning architectures will result in pest management systems that can be deployed in real-time on edge devices.

P_ID249

SAINT-Based Analysis of Emotional Regulation Mediating Cyberbullying and Adolescent Girls Well-Being

Pradhiba S.P.M (Meenakshi Academy of Higher Education and Research), Padmapriya D (Saveetha Institute of Medical and Technical Science), M Kotteeswaran (Vels Institute of Science, Technology and Advanced Studies (VISTAS)), R Murugesan (CMR University)

pradhiba34@gmail.com, padmapriya.scon@saveetha.com, saikottee@gmail.com, murugesanphd80@gmail.com

This research examines the escalating issue of cyberbullying and its detrimental effects on the psychological health of teenage females in digital contexts. Growing exposure to the internet has made emotional weaknesses worse, therefore it's important to know about defensive mechanisms that may help lessen bad effects. This research aims to investigate the mediating function of emotional regulation in the association between cyberbullying and well-being. The goal is to use sophisticated modelling approaches to analyses structured data and find complicated relationships between psychological factors. To do this, a Self-Attention and Intersample Attention Transformer (SAINT) architecture is used, which is a transformer-based model specifically intended for tabular data, capturing both feature-level and sample-level interactions. The research used a Kaggle dataset including 2,500 adolescent records with 12 characteristics, such as cyberbullying exposure (0–10), emotional regulation index (0–1), anxiety (0–50), depression (0–60), social support (1–5), screen time (1–8 hours), age (13–18), and well-being score (0–100). The results demonstrate that emotional control substantially mediates the association between cyberbullying and well-being, alleviating psychological distress and bolstering resilience in teenage females.

P_ID250

Edge AI Wearable Monitoring Using Accelerometer Data for Herbal Steam Therapy in Cold

kavitha M (Saveetha College of Nursing, SIMATS, Chennai), Kalabarathi S (Saveetha Institute of Medical and Technical Sciences), Padmapriya D (Saveetha Institute of Medical and Technical Sciences), Vijayalakshmi R (Saveetha Institute of Medical and Technical Sciences), Parimala L (Saveetha Institute of Medical and Technical Sciences)

kavithakarthik98@gmail.com, kalabarathi2@gmail.com, padmapriya.scon@saveetha.com, principalnursing@saveetha.com, parimala.scon@saveetha.com

The relieved symptom treatment for cold is the Herbal steam inhalation which requires systematic monitoring and assessment by using advanced techniques. The aim of this work is to develop and evaluate an edge AI-enabled wearable device for monitoring physiological and motion related data using built-in-sensors. For analysis of data in real time with less delay this technique is utilized. Important factors such as demographic information, environmental factors, intervention variables like the amount of Tulsi and Turmeric used and the length of time the steam is applied, and physiological indicators like body temperature, SpO_2, heart rate, and respiration rate before treatment is used in this approach. To assess variations in physiological parameters, level of improvement in therapy a recovery score with data driven analytical approach was utilized. A public dataset of Kaggle was used for training and testing purposes. The proposed system performs better results while predictions with an accuracy of 98.67%, a precision of 98.01%, a recall of 98%, and an F1-score of 98% with AUC of 98.50%. Edge based health monitoring for non-invasive and individual treatment shows the dependability for evaluation and prompt action which improves the use of herbal medicine to treat cold symptoms.

P_ID251

Offline and Edge AI Tutoring in Low- and Middle-Income Countries: Rapid Evidence Synthesis and a Field-Ready Validation Protocol for Energy, Cost, and Inclusion

Ambrose Azeta (Namibia University of Science and Technology), Muyideen Adewale (She and Tech Empowerment Foundation, Abuja, Nigeria, DaraTom Consulting Incorporated, Toronto, Canada), Amina Sambo-Magaji (She and Tech Empowerment Foundation, Abuja, Nigeria, National Information Technology Development Agency, Abuja, Nigeria), Eliazer Mbaeva (Namibia University of Science and Technology, Windhoek, Namibia), Daniel L. Enosegbe (Caleb University), Bashiru A. Ojulari (Kwara State University, Malete, Nigeria)

aazeta@nust.na, mdadewale@aol.com, asambo@nitda.gov.ng, embaeva@nust.na, enosegbedan@gmail.com, bashiru.ojulari@kwasu.edu.ng

This rapid evidence synthesis examines offline and edge AI tutoring for low- and middle-income country (LMIC) schools operating under intermittent connectivity, unreliable power, and low-specification devices. The review focuses on sustainability-related STEM learning, including energy, climate, water, and agroecology, as well as scale-up outcomes such as learning gains, energy use, total cost of ownership (TCO), and gender and inclusion benchmarks. Evidence from ten empirical studies and one conceptual chapter indicates partial feasibility. Pilots report learning gains, large-scale offline assessment deployments show rural–urban parity, and low-bandwidth conversational tutoring demonstrates strong potential. However, no study reports workload-defined energy, comprehensive TCO, or sustainability-specific STEM outcomes. We propose the Offline Edge AI Tutoring Stack (OEATS), a classroom microserver hosting small quantised language models with offline retrieval and assessment, accessed via thin clients over local Wi-Fi. We also propose a field-ready cluster randomised non-inferiority validation protocol with energy and TCO instrumentation and pre-specified inclusion analyses. Together, these provide a defensible pathway for offline AI adoption in LMIC education.

P_ID252

From Promise to Constraint: Infrastructure, Equity, and Governance in Artificial Intelligence for Education

Amina Sambo-Magaji (She and Tech Empowerment Foundation, Abuja, Nigeria, National Information Technology Development Agency, Abuja, Nigeria), Muyideen Adewale (She and Tech Empowerment Foundation, Abuja, Nigeria, DaraTom Consulting Incorporated, Toronto, Canada), Ambrose Azeta (Namibia University of Science and Technology), Muktar Bello (Salford Business School, University of Salford, Salford, United Kingdom), Steven U. Tjiraso (Namibia University of Science and Technology, Namibia.), Umaina I. Muhammad (Africa Centre of Excellence on Technology Enhanced Learning (ACETEL))

asambo@nitda.gov.ng, mdadewale@aol.com, aazeta@nust.na, m.bello4@salford.ac.uk, stjiraso@nust.na, ace22240018@noun.edu.ng

Using AI for education-enhancing adaptive instruction, helping teachers, and improving admin efficiency holds transformative potential. In Nigeria, however, deep and persistent infrastructure deficits, socioeconomic inequality, and fragmented governance structures risk expanding, not reducing, the existing digital divide. This paper presents a PRISMA-guided systematic review of 12 peer-reviewed empirical studies (2020–2025) on AI in Nigerian education. Evidence is arranged around five interconnected themes: (1) infrastructure and connectivity constraints, (2) teacher preparedness and AI literacy gaps, (3) barriers of socioeconomic and cultural nature, including urban–rural and gender divides, (4) policy and governance deficits, and (5) novel opportunities via adaptive learning, low-bandwidth/offline solutions, and targeted capacity building. Based on our findings, we provide a values-driven, equity-first governance framework focusing on electrification and connectivity investment, language-inclusive AI localisation, embedded AI literacy in teacher-preparation paths, and enforceable data protection and algorithmic accountability mechanisms. We place these results

in the discussion of AI adoption in Nigeria and highlight crosscutting effects in the broader context of low- and middle-income countries (LMICs). The paper closes with a statement of limitations and a research roadmap: its focus is on robust longitudinal impact assessments and evidence-based research that is gender-responsive.

P_ID253

INORA: A Low-Cost 3-Channel EEG Acquisition System with Driven-Right-Leg Noise Suppression for BCI Prototyping

Annu Tiwari (IIIm University Greater Noida), Sanjeev Kumar (IIIm University Greater Noida)

annu04t@gmail.com, sanjeev1803t@gmail.com

Electroencephalography (EEG) measures the tiny voltages generated by the scalp from the synchronized activity of the cortex, and it is the mainstay non-invasive technology for brain-computer interfaces (BCI). But the hardware story is not. EEG amplifiers typically cost a few hundred to a few thousand US dollars and usually require an operator, making it difficult for undergraduate teaching labs, BCI hobbyists, and small research teams to get involved. INORA is a three-channel acquisition front-end for neural signal monitoring and initial BCI experiments, targeted specifically at the above markets. Our signal chain uses wet Ag/AgCl electrodes, an AD620 instrumentation amplifier for differential amplification, a TL072 op-amp for analog filtering, an ADS1115 16-bit ADC, and an ESP32 microcontroller to sample and wirelessly transmit the signal at 83 Hz per channel, which is well above the Nyquist rate for the 0.5-30 Hz band of interest. We address common-mode interference with a Driven Right Leg (DRL) feedback loop, and test it head-on with a paired DRL-on versus DRL-off experiment on the same person. The output signals fall within the expected physiological range of 10-100~μV, and the system can therefore be used for resting-state monitoring and prototyping early BCIs. The whole front-end is built from discrete COTS parts on a breadboard, which keeps the design easy to modify and easy to teach from. The complete system is realized at a total component cost of approximately Rs.\ 3,146 ($\sim$USD~33.15), representing an order-of-magnitude reduction relative to commercial research-grade EEG platforms.

P_ID258

Scenery Classification Using Convolutional Neural Networks (CNN)

Allycia Chin Kia-Hui (Taylor's University Subang Jaya, Malaysia), Abdul Salam Shah (Taylor's University Subang Jaya, Malaysia), NZ Jhanjhi (Sunway University), Farzeen Ashfaq (Taylors University), Tehmina KaramatUllah (Taylors University)

0365117@sd.taylors.edu.my, salamshah.sayed@taylors.edu.my, zamanj@sunway.edu.my, farzeen.ashfaq@sd.taylors.edu.my, Tehmina.Khan@taylors.edu.my

The problem of scene classification has been explored in the literature, but the complex nature of datasets and features makes it challenging for most algorithms. To address the challenges, we have proposed a Convolutional Neural Network-based model for image classification to improve the application of deep learning models in the field. The Python programming language was used along with both TensorFlow and Keras frameworks when implementing the CNN model. Additionally, the Intel Image Classification dataset, comprising 17,034 images across the training and test sets, was selected for this research. Multiclass classification focuses on classifying different categories, including buildings, forest images, and glaciers. The other three categories are mountains, seas, and streets. The model implements a standard CNN pipeline, including the most important preprocessing steps (e.g., resizing and normalization). The major improvements in the model's accuracy have been achieved by using data augmentation to improve feature quality. The results show that the proposed CNN model achieved a final test accuracy of

P_ID260

Custom CNN model for Food images classification

Bunta Iwasaki (Taylor's University Subang Jaya, Malaysia), Abdul Salam Shah (Taylor's University Subang Jaya, Malaysia), NZ Jhanjhi (Sunway University), Farzeen Ashfaq (Taylors University), Tehmina Karamat Ullah Khan (Taylors University)

0364578@sd.taylors.edu.my, salamshah.sayed@taylors.edu.my, zamanj@sunway.edu.my, farzeen.ashfaq@sd.taylors.edu.my, Tehmina.khan@taylors.edu.my

The image classification problem is one of the core problems in computer vision and deep learning, and this project aims to build and test an automatic model for the classification of food images. In particular, the classification was targeted to 5 food classes: baby_back_ribs, bibimbap, dumplings, oysters, and waffles, extracted from a large-scale "Food-101" database. In terms of methodology, pre-trained models (such as VGG) were not used because they have too many parameters and are prone to overfitting. However, a new, custom CNN (Convolutional Neural Network) structure was created specifically for this size of task. The model is composed of 5 convolutional blocks and provides efficient feature extraction and lower computational complexity by implementing the Swish activation function, Batch Normalization, Global Average Pooling, and Data Augmentation. The A100 GPU with high-resolution images of 256×256 was efficiently used for training in Google Colab. The results of the final experiment indicate that the model had an accuracy of 91.99% and a loss of 0.6042 on unseen test data, which points to the model's capability in classification tasks in practice. But there was about an 8% difference between the training score (99.7%) and test score (91%), indicating a mild overfitting effect. While some misclassifications occurred due to the similarity in texture, such as those between "Waffles" and "Baby Back Ribs", the general object of the project was achieved, and a model of high generalization was constructed.

P_ID268

Intelligent Feature Optimization Using RPASO for Real-Time IoT Healthcare Monitoring

M A Femina (Mepco Schlenk Engineering College), S P Anbukodi (R.M.K. College of Engineering and Technology), A V N Chandra Sekhar (Sasi Institute of Technology and Engineering), K Thirunadana Sikamani (Karpaga Vinayaga College of Engineering and Technology), C Subalakshmi Priya (Vinayaka Mission's Kirupananda Variyar Engineering College), M Muthulekshmi (Saveetha School of Engineering)

femina@mepcoeng.ac.in, anbu6880@gmail.com, dravncs@sasi.ac.in, sikamanikt@gmail.com, subalakshmipriya@vmkvec.edu.in, muthulekshmisrinivasan@gmail.com

Constant heart monitoring of elderly individuals with chronic cardiac conditions is essential to prevent severe outcomes. The study introduces an intelligent ECG monitoring system with IoT-enabled and integrates wearable sensors, edge computing, and cloud platform to provide the real-time flow of cardiac signals capturing and analyzing. The equipment collected ECG data of six people, with 90-97% quality of the signal, and heart rates ranging between 72 and 110bpm. The time of edge processing was low (7582 ms), which allowed detecting anomalous events fast. There was an automated activation of alarms in people with tachycardia (33%) and bradycardia (17) with 50% of the patients showing no abnormalities, which meant that the events were classified successfully. Technology reduces the delay rate, improves the efficiency of the network, and ensures continuous and secure remote monitoring. High signal integrity and quick reaction times allow quicker therapeutic treatments, and this lowers the hospital visits and improves comfort in the patients. The framework is a scalable, energy-efficient solution to geriatric cardiac care that comprises of IoT enabled sensors, edge computing and cloud storage. The results indicate that the proposed approach helps to enhance real-time surveillance, ensure the safety of patients, and enable upstream management of chronic cardiac disorders.

P_ID269

IoT-Based Intelligent ECG Monitoring for Elderly Patients with Chronic Heart Conditions

R Meenakshi (Chennai Institute of Technology), S Subi (R.M.K. College of Engineering and Technology), Dillibai R (Vel Tech High Tech Dr. Rangarajan Dr. Sakunthala Engineering College), Akhil Gupta (Symbiosis International (Deemed University)), A Annie Lotus (Sona College of Technology), C Srinivasan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University)

meenakshir@citchennai.net, subiads@rmkcet.ac.in, dillibai@velhightech.com, akhilgupta112001@gmail.com, annielotus2017@gmail.com, srinivasanchelliah@gmail.com

Constant heart monitoring of elderly individuals with chronic cardiac conditions is essential to prevent severe outcomes. The study introduces an intelligent ECG monitoring system with IoT-enabled and integrates wearable sensors, edge computing, and cloud platform to provide the real-time flow of cardiac signals capturing and analyzing. The equipment collected ECG data of six people, with 90-97% quality of the signal, and heart rates ranging between 72 and 110bpm. The time of edge processing was low (7582 ms), which allowed detecting anomalous events fast. There was an automated activation of alarms in people with tachycardia (33%) and bradycardia (17) with 50% of the patients showing no abnormalities, which meant that the events were classified successfully. Technology reduces the delay rate, improves the efficiency of the network, and ensures continuous and secure remote monitoring. High signal integrity and quick reaction times allow quicker therapeutic treatments, and this lowers the hospital visits and improves comfort in the patients. The framework is a scalable, energy-efficient solution to geriatric cardiac care that comprises of IoT enabled sensors, edge computing and cloud storage. The results indicate that the proposed approach helps to enhance real-time surveillance, ensure the safety of patients, and enable upstream management of chronic cardiac disorders.

P_ID284

An Integrated Machine Learning and Deep Learning Approach for Crop Recommendation Fertilizer Prediction and Disease Detection

Rupali Dhabarde (School of Engineering and Technology, Shivaji University, Kolhapur), Aditya Sonwane (School of Engineering and Technology, Shivaji University, Kolhapur), Anjali Chimane (School of Engineering and Technology, Shivaji University, Kolhapur), Srushti Kale (School of Engineering and Technology, Shivaji University, Kolhapur), Priyanka Pawar (Shivaji University, Kolhapur), Vijay Manwatkar (Vidya Vikas Arts, Commerce &amp, Science College, Samudrapur,Wardha)

dhabarderupali7@gmail.com, adityasonwane2306@gmail.com, anjalichimane082004@gmail.com, srushtikale3082004@gmail.com, priyankaupawar30@gmail.com, m11.vijju@gmail.com

Agricultural decision-making involves multiple interdependent factors, including soil conditions, environmental parameters, and plant health. This work presents AgroFusionNet, an integrated decision-support framework that combines machine learning and deep learning techniques for crop recommendation, fertilizer prediction, and disease detection. The system utilizes Random Forest models for structured agricultural data and an EfficientNetB3-based convolutional neural network for image-based disease classification. Experimental evaluation on publicly available datasets demonstrates high prediction performance, achieving accuracies of 99.77% for crop recommendation, 93% for fertilizer prediction, and 99% for disease detection. The crop recommendation module and the disease detection module achieved very high accuracy, but the fertilizer prediction module performed comparatively lower, as analysed in this study and explained due to relatively small data set size and high number of output classes in the module, confined to a particular geographical region. In addition to accuracy, this work addresses the practical challenges of implementing such a system in the field, such as the availability of large-scale field validation, the limited interpretation of the models behind

the system, and the absence of an explicit analysis of the computational cost and response latency of the low-resource devices usually available to farmers. These constraints are discussed together with directions for future work such as expanding the dataset in multiple regions, explicating the model and deployment to a mobile. The proposed framework provides a unified and practical solution for precision agriculture, improving decision consistency and resource utilization.

P_ID285

Artificial Intelligence Based Solution for Delayed Discharge in Hospitals

Lalit M Rao (Manipal University Jaipur), Nidhi Kundu (Sri Karan Narendra Agriculture University Jobner, Jaipur), Geeta Rani (Manipal University Jaipur), Vijaypal Singh Dhaka (Manipal University Jaipur)

lalit.229311160@muj.manipal.edu, kundu.nidhi1990@gmail.com, geeta.rani@jaipur.manipal.edu, vijaypalsingh.dhaka@jaipur.manipal.edu

Delayed discharge remains a persistent challenge in healthcare systems worldwide, leading to hospital overcrowding, inefficient bed utilization, increased operational costs, and compromised patient outcomes. This study presents an Artificial Intelligence based Smart Hospital Management System designed to address delayed discharge through predictive analytics, early disease detection, and personalized post-discharge care. The proposed framework integrates three key modules: (i) a Disease Prediction Module, (ii) a Discharge Management Module, and (iii) a Personalized Healthcare Plan Module. Among these, the Disease Prediction Module was fully implemented and experimentally evaluated using symptom-based patient datasets. Decision Tree and Multinomial Naive Bayes classifiers were applied to predict diseases based on reported symptoms. Experimental results demonstrate that the Decision Tree classifier outperforms Naive Bayes, achieving a test accuracy of 92.68% and a mean cross validation accuracy of 94.99%. This modelis effective in capturing interdependencies among symptoms. Feature importance analysis further enhances model's interpretability by identifying clinically relevant symptoms contributing to predictions. The Discharge Management Module, employs Long Short-Term Memory networks to predict patient discharge timelines based on longitudinal clinical data. Next, the Personalized Healthcare Plan Module is designed to generate individualized post-discharge recommendations to improve continuity of care. Thus, the proposed AI-driven framework may prove useful to reduce discharge delays, optimize resource utilization, and enhance patient convinience.

P_ID288

RoBERTa-Based Mental Health Classification with Differential Privacy

Smriti Sett (Amity University, Noida), sarvesh tanwar (amity university), Shruti Keshari (ABES Engineering College, Ghaziabad)

smritisett.83@gmail.com, s.tanwar1521@gmail.com, shruti.keshari08@gmail.com

The popularity of social media sites has led to a glut of text information being produced by users, which has already shown itself to be fertile in terms of information regarding mental health trends. However, due to the extremely sensitive nature of the data, privacy is a significant issue. This paper addresses the challenge of detecting mental health patterns from social media while protecting user privacy — framed as a privacy-constrained multi-class text classification problem across 15 mental health categories. The research investigates whether a transformer-based model can deliver competitive classification performance using a labelled social media dataset with stratified splitting and user anonymization as the data strategy, under formal Differential Privacy constraints. Grounded in RoBERTa-based NLP and Dwork and Roth's Differential Privacy theory, the methodology employs DP-BERT — DP-SGD applied to a BERT-family model — implemented via Opacus with per-sample gradient clipping, Gaussian noise injection, and class-weighted loss to

handle imbalance. The work contributes a single structure that optimises both privacy and classification at the same time, increases the ability to find mental health issues to 15 categories, shows that accuracy and formal privacy assurances can be achieved simultaneously, and provides a feasible Gradio-based deployment that ensures privacy throughout.

P_ID289

AI-Driven Framework for Detecting Segregation of Duties Risks in Enterprise Access Control Systems

Vivek Kumar Polurouthu (PBF Energy/KFORCE), Sekhar Manda (Senior Specialist package Implementation LTM)

vivekkumarpvk@gmail.com, manda.sekhar@gmail.com

Enterprise Access Control Systems are essential for ensuring secure and compliant access management, as complex role structures and overlapping permissions can lead to Segregation of Duties (SoD) violations. Segregation of duties (SoD) is crucial in an organization for fraud prevention, error prevention and non-compliance. Traditional rule-based methods may be ineffective in identifying hidden patterns or dynamic risks, causing security and compliance issues. This study aims to suggest a framework for risk detection for access governance, using artificial intelligence to accurately predict risks with interpretability. The methodology relies on an artificial enterprise access control dataset that has been worked out for the specific purpose of being as close as possible to real-world SoD environments, such as access logs, role/permission matrix, and SoD conflict rules. These data contain information about users' activity and pre-defined conflict relationships and role-based permission assignment, which are used to effectively model enterprise security behavior. The framework consists of data preprocessing, feature engineering, SMOTE-based class balancing, and scaling the features for modeling. These ML models are trained and evaluated and the best model is then integrated with a rule-based scoring system to develop a hybrid risk assessment system. Furthermore, the predictions and visualization of permission dependency are made using SHAP explainability and conflict analysis using graphs. The experimental outcomes demonstrate that XGBoost achieves the highest accuracy of 0.9333, F1 score of 0.9383, AUC-ROC of 0.9819, and is robustly stable in 5-fold cross-validation (0.9780 ± 0.0098 accuracy). This proposed framework does effectively categorize users into four risk levels: Low, Medium, High and Critical, which helps to increase the security, transparency and compliance of access controls in enterprise applications.

P_ID290

Cognitive Healthcare Operating System Using Large Language Models and Digital Twins for Autonomous Disease Intelligene

Lalit Kumar (CGC University, Mohali), Preeti Rana (CGC University, Mohali), Surbhi Dhiman (MMDU), Sunil Chauhan (MMDU), Dinesh Kumar (CGC University Mohali), Ritu Gupta (Chandigarh University)

lalit.cse@gmail.com, ranapreeti106@gmail.com, sdhiman44@gmail.com, chauhan954@gmail.com, dk.dinesh2152@gmail.com, errituguta02@gmail.com

The skyrocketing development of intelligent healthcare systems has led to a growing demand for autonomous, adaptive and explainable clinical intelligence platforms that can support the personalized care of the patient. Studies of traditional healthcare information systems reveal that these systems primarily address aspects of access and retrieval of patient's information, with very limited reasoning capabilities and prediction of possible cases, and little intelligent clinical decision supports. This paper introduces a new solution to enable autonomous disease intelligence and dynamic patient monitoring called Cognitive Healthcare Operating System (CHOS) that combines Large Language Models (LLMs) and Digital Twin technology. The framework integrates multimodal healthcare data such as Electronic Health Records (EHRs), medical imaging, wearable sensor streams, lab reports, and clinical narratives, delivering a unified digital patient view,

ensuring that all information is in sync. The digital twin's predictive disease simulation capabilities and its ability to adapt to clinical interventions will be supported by reasoning modules designed to give clinicians contextual clinical understanding, individualized treatment recommendations, and disease insights that are explainable-based reasoning modules will support contextual clinical understanding, personalized treatment suggestions, and explainable disease insights, while the digital twin will facilitate predictive disease modeling and adaptable healthcare interventions. The framework also embeds explainable AI features, such as confidence-aware reasoning, and privacy-sensitive orchestration of healthcare elements for trusted clinical integration. The experimental evaluation shows better diagnostic accuracy, ability to monitor diseases, clinical interpretability and uniformity in decisions-making than the conventional healthcare system utilizing AI technology.

P_ID297

Single Carrier Modulated Signal Time-Domain Denoising with Deep-Learning Algorithms

Mate Marton Mezei (Technical University of Cluj Napoca), Zsuzsanna Ilona Suta (Technical University of Cluj Napoca), Zsolt Alfred Polgar (Technical University of Cluj Napoca)

Mate.Mezei@com.utcluj.ro, zsuzsanna.suta@com.utcluj.ro, zsolt.polgar@com.utcluj.ro*

Reducing the level of noise superposed on a signal, a process called denoising, is an important issue in many fields of signal processing. The inherent stochastic characteristics of noise present significant challenges for denoising operations. Classical approaches, which predominantly rely on filtering techniques and various transformation methods, exhibit limited efficacy and lack the capacity for generalization across diverse signal types. With the development of AI (Artificial Intelligence) based algorithms, several Deep-Learning (DL) solutions were proposed in technical literature, which have demonstrated highly promising results. This paper analyzes the performance of various DL based denoising solutions of the single carrier modulated data signals. Besides the evaluation of the RMSE (Root Mean Square Error) improvements, the SER/BER (Symbol Error Rate/Bit Error Rate) improvements of the denoised signals are also evaluated, SER/BER being one of the most important parameters of data transmissions. Extensive computer simulations show that significant SER improvements can be achieved in scenarios involving repetition coding and multi-antenna transmissions.

P_ID303

An Integrated Multi-Source Data Architecture For Enhanced Malaria Surveillance And Decision Support: Experience From Zambia's National Malaria Elimination Programme

Jeremiah Mwiinga (Namibia University of Science and Technology), Kaluba Mataka (Zenysis Technologies), Aaron Mwamulimba Mutinta (Clinton Health Access Initiative Zambia), Jeremiah Mwiinga (The University of Zambia)

jmwiinga@nust.na, kkaluba@gmail.com, mulimbamutinta@gmail.com, jeremiah.mwiinga@cs.unza.zm

The National Malaria Elimination Centre (NMEC) in Zambia uses three distinct health information systems to collect malaria programme data, namely the Health Management Information System (HMIS) to collect data on disease and services, the Electronic Logistics Management Information System (eLMIS) to track commodities, and the Malaria Rapid Reporting System (MRRS) to capture community-level data. The lack of data integration across the three systems necessitates that programme managers rely on tedious manual manipulation, limiting timely analysis needed to support evidence-based decision-making. In 2019, the NMEC and Zenysis Technologies, with support from the Global Fund, conducted a comprehensive needs assessment and developed an integrated analytics platform that links the three health information systems via Application Programming Interfaces (APIs). The analytics platform enables holistic, real-time data triangulation by linking disease burden with commodity stocks and coverage, and by developing customised

dashboards and decision-support analytics. The evaluation results reveal an enhanced data-use culture, detection of data quality issues, and improved responses to malaria elimination programmes. This paper highlights the design, methodological process, and results of the integration project, and contextualises it within the broader framework of Zambia's sub-national malaria elimination efforts. Keywords: Data integration, decision support analytics, health information systems, malaria surveillance

P_ID306

The Missing Middle: A Systematic Review of Machine Learning for Municipal-Level Residential Energy Forecasting

Marten Weijer (Minnesota State University at Mankato), Rushit Dave (Minnesota State University Mankato), Mansi Bhavsar (Minnesota State University at Mankato)

marten.weijer@mnsu.edu, rushit.dave@mnsu.edu, mansi.bhavsar@mnsu.edu

Municipal-level energy forecasting is essential for local energy policy, yet it remains almost entirely absent from the machine learning literature. This paper presents a systematic review of 26 peer-reviewed studies published between 2020 and 2026, examining how machine learning methods perform across four spatial scales: building, neighborhood, municipality, and nation. Each empirical study is coded along four dimensions (spatial scale, temporal resolution, modelling approach, and bestperforming model family) to enable a structured cross-scale comparison. The review finds that tree-based ensemble models, particularly Random Forest and XGBoost, perform best in 14 of the 22 empirical studies. Feature importance changes with temporal resolution: outdoor temperature and lagged consumption dominate at short intervals, while building characteristics and socioeconomic variables become the primary drivers at annual resolution. Only three studies operate at the municipal scale, and only one targets annual gas consumption, it excludes climate and building features and provides no interpretability analysis. We formally identify this as the 'missing middle': no existing study has applied a feature-complete model combining climate, building, and socioeconomic variables to annual municipal gas forecasting, and none has used SHAP analysis to explain which features drive consumption differences between municipalities. The Dutch setting, with CBS, BAG, and KNMI data available, is well-positioned to close this gap.

P_ID307

AI-Driven Fraud Detection and Risk Scoring for Mobile FinTech Payment Systems

Venu sannamuri (Fidelity Investments)

sannamuri.venu@gmail.com

The rapid development of mobile payment systems has raised risk of financial fraud. Advanced financial technology (FinTech) fraud detection tools are necessary in this situation. Digital transactions are becoming more and more complicated and large-scale. As a result, one of the most noteworthy issues for modern FinTech systems is fraud detection. The study proposes an efficient machine learning-based method that uses simulated financial transaction data (PaySim) to detect fraud. The data processing approach includes encoding, class imbalance detection using SMOTE, and feature normalization using MinMax scaling. Several classification methods: Logistic Regression (LR), XGBoost (XG), LightGBM (LGBM), and Decision Tree (DT), are applied and optimized with the help of randomized hyperparameter tuning. The main key performance indicators used to evaluate the models include Accuracy (ACC), Precision (PRE), Recall (REC), F1-score (F1), ROC-AUC, MCC, and Kappa. The experiment demonstrates that the Decision Tree model performs best, with 99.79% accuracy and the fewest misclassifications. Balance-related features are identified as critical fraud features through feature importance analysis, and a risk-scoring system is presented to classify transactions at the transaction level. The proposed architecture is well-suited for use in real-time FinTech fraud detection systems because of its high

effectiveness, interpretability, and computational efficiency. The research also means that there is financial implication to organizations in terms of making right decisions in implementing effective fraud identification systems.

P_ID309

Confidence-Aware Federated Explainable Deep Learning Framework for Cross-Platform Cyberbullying Detection

Augustine Omotayo Fatoba (Augustine Ventures), Deborah Olaniyan (University Of The Free State), Julius Olaniyan (Sol Plaatje University)

austinemary4sure@gmail.com, olaniyan.d@ufs.ac.za, julius.olaniyan@spu.ac.za

The increasing prevalence of cyberbullying, online toxicity, hate speech, sexism, and racism across social media platforms has created significant psychological and societal concerns. However, existing centralized cyberbullying detection systems often suffer from privacy risks, limited interpretability, and poor cross-platform generalization. To address these challenges, this study proposed a Confidence-Aware Federated Explainable Deep Learning Framework for Cross-Platform Cyberbullying Detection. The framework integrated Federated Learning (FL), RoBERTa-Large contextual transformer modeling, confidence-aware optimization, and SHapley Additive exPlanations (SHAP) within a unified privacy-preserving architecture. Multiple heterogeneous cyberbullying datasets were utilized as decentralized federated clients to simulate realistic non-independent and identically distributed (non-IID) learning environments. Experimental results demonstrated that the proposed framework outperformed traditional machine learning, recurrent neural, and transformer-based baselines, achieving 96.43% accuracy, 96.11% precision, 95.87% recall, 96.08% F1-score, and 97.02% ROC-AUC. Cross-platform evaluation further confirmed strong generalization capability with an external F1-score of 94.83% and low generalization error of 1.29%. The confidence-aware mechanism improved robustness against ambiguous annotations, while SHAP enhanced model interpretability by identifying influential toxic semantic features. Overall, the findings demonstrated that federated transformer learning combined with explainable artificial intelligence provided an effective, scalable, and privacy-preserving solution for next-generation cyberbullying detection systems.

P_ID310

Zero Trust Architecture-Driven Intelligent Threat Detection Framework Using Behavioral Analysis of Network Intrusion Data

Sundaram Yadav (Texas Tech University)

sundaramy2025@gmail.com

The threats posed by network intrusion are growing more complex and demand smart and scalable real-time detection systems in line with the principle of Zero Trust. This study proposes a hybrid network intrusion detection model, which is a combination of preprocessing techniques such as label encoding, feature engineering, SMOTETomek balancing, XGBoost feature selection, and normalization on the UNSW-NB15 dataset. User, device, location, and time risk features are further contextual elements in the analysis of behavior. Different models such as XGBoost, LightGBM, CatBoost, LSTM, Voting Ensemble and Isolation Forest are optimized to reveal statistical and temporal patterns. The Voting Ensemble model achieves the best results with 97.70% accuracy and 97.89% F1-score, then CatBoost (97.67%) and XGBoost (97.59%), and LSTM at 95.10%. The models have high discriminative capabilities where ROC-AUC reaches 0.998 and low misclassification. Explainable AI (SHAP and LIME) is utilized to improve interpretability by highlighting features. Hybrid threat score is more sensitive than context-based score, which enables more accurate risk assessment. Isolation Forest has 68.63% accuracy and high precision (85.71) of detecting anomalies. The approach based on the Zero Trust policy allows

making decisions based on circumstances, which makes the framework efficient when it comes to the real-time network security.

P_ID315

Postoperative Abdominal Pain Reduction Through Hand and Foot Massage Using IoT and Fog Computing

Shalini S (SIMATS), Padmapriya D (Saveetha Institute of Medical and Technical Sciences), Marydasan Francis (Nightingale College of Nursing), Vijayalakshmi R (Saveetha Institute of Medical and Technical Sciences), Parimala L (Saveetha Institute of Medical and Technical Sciences)

shalini29041998@gmail.com, padmapriya.scon@saveetha.com, daspvrpsc@gmail.com, principalnursing@saveetha.com, parimala.scon@saveetha.com

After abdominal surgery, there can be postoperative abdominal discomfort that reduces the patient's comfort, interferes with mobility, prevents sleep and affects their recovery process. This study proposes a relief mechanism to relieve pain by combining hand and foot massage and Internet of Things (IoT) technology and fog computing. The proposed system collects patient data such as heart rate, body temperature, mobility and pain input using the sensor-based monitoring system. The data collected is treated in real time, close to the patient, by a fog node, which allows real time monitoring and timely intervention by carers. The length of massage, pressure, and frequency of massage change according to the condition of the patient, but don't affect the region of abdominal surgery. The quantitative results show a mean pain score was reduced from 8.0 to 3.9, and reduced pain by 4.1 points. The mean heart rate decreased from 96 to 82 bpm and the relaxation score increased from 4.2 to 8.3. Over five days the completion rate of the massage sessions improved from 72% to 94% and the mobility score was improved from 3.2 to 8.0. According to the data presented, the proposed method allows you to alleviate pain, relax, improve mobility and increase comfort after surgery.

P_ID317

Quantum-Inspired Neuro- Biophysical Twin with Tumor Growth Modeling for Brain Tumor Classification and Prediction

Deborah Olaniyan (University of the free state), JULIUS OLANIYAN (SOL PLAATJE UNIVERSITY), IBIDUN OBAGBUWA (WALTER SISULU UNIVERSITY)

olaniyan.d@ufs.ac.za, JULIUS.OLANIYAN@SPU.AC.ZA, IOBAGBUWA@WSU.AC.ZA

This study proposes a Quantum-Inspired Neuro-Biophysical Twin Model for accurate brain tumor classification and prediction, merging the principles of biophysical tumor growth modeling with advanced quantum-inspired computational strategies. The model synergistically combines Convolutional Neural Networks (CNNs), Vision Transformers (ViTs), and quantum techniques to capture both spatial and contextual features of brain tumors from MRI images. By embedding biophysical knowledge into the learning framework, the model enhances interpretability and robustness in predicting tumor behavior. Segmentation and feature extraction processes allow the model to analyze critical tumor characteristics such as size, location, and intensity. Experimental evaluations on benchmark datasets revealed that the proposed model outperformed existing state-of-the-art deep learning approaches, achieving 100% accuracy, precision, recall, and F1-score, thereby demonstrating its potential as a reliable tool for non-invasive clinical diagnosis and personalized treatment planning.

P_ID319

YOLOv26-EMSA: An Enhanced Multi-Scale Attention Architecture for Potato Insect Pest Detection in Complex Field Environments

Edem Ahialey (University of Cape Coast), Regina Esi Turkson (University of Cape Coast), Abdul-Lateef Yussif (University of Cape Coast), Boluwaji Ade Akinnuwesi (University of Eswatini), Madoda Nxumalo (University of Eswatini)

eddiegold7@gmail.com, rturkson@ucc.edu.gh, ayussif@ucc.edu.gh, bakinnuwesi@uniswa.sz, manxumalo@uneswa.ac.sz

Timely detection of potato insect pests is critical for minimizing crop loss and excessive pesticide use. However, pest detection in outdoor situations is still a challenge due to the small size of insects, vegetation obstruction, complex background and variable lighting. This study proposes YOLOv26-EMSA, an advanced object detection system for the identification of potato insect pests in real-world agricultural environments. The proposed model is built upon the YOLOv26 architecture, with the addition of a novel C2-enhanced multi-scale attention (C2EMSA) module in the backbone, and a mixture-of-experts (MoE) module in the P4/16 detection head. The C2EMSA module combines multi-scale feature extraction and gated spatial-channel attention to improve the representation of complex pest features. The MoE module uses adaptive expert routing to better capture diverse insect pest characteristics and environmental changes. The model was first pre-trained on the IP102 insect pest dataset, and then fine-tuned on a potato insect pest dataset of eight economically important pest species. Experimental results show that YOLOv26-EMSA achieves improved performance over YOLOv5n, YOLOv8n, YOLOv10n, YOLOv11n and YOLOv26n on both datasets. For the potato insect pest dataset, the proposed model achieved a mean average precision at 0.5 Intersection over Union of 81.3 percent and a mean average precision at 0.5 to 0.95 Intersection over Union of 50.7 percent, achieving the highest performance among the compared baselines. The results indicate that YOLOv26-EMSA provides an efficient and lightweight solution for real-time monitoring of potato insect pests and precision agriculture applications.

P_ID322

Agent-Driven Autonomous Resilience Framework for Real-Time Threat Neutralization and Systemic Risk Mitigation in Global Financial Systems

Sagar Bharat Shah (University of Cincinnati)

shah2sb@mail.uc.edu

The growing sophistication of world financial systems and networked digital infrastructures increases vulnerability to fraud, cyber threats, and systemic market risks, necessitating dynamic and smart risk management solutions. The proposed research would introduce one multi-agent architecture of real-time risk detection and mitigation in the areas of financial fraud, cybersecurity intrusion, and stock market prediction, based on heterogeneous data sets of IEEE-CIS, UNSW-NB15 and stock market data. The approach will involve data preprocessing, multi-level feature engineering, and ML models such as LightGBM, XGBoost, Random Forest, Extra Trees, deep neural networks, and stacking ensembles. The system of PSO-based fusion combines the outputs of the agents, and the reinforcement learning and graph-based RL enables to mitigate the risks in real time and to stabilize the system. The results show high performance, with fraud detection accuracy of 96.09, market risk of 89.79, cyber threat of 97.84, and an AUC of 99.65. The fusion model has an AUC of 0.9877 and an F1score of 0.9717, and MARL decreases system risk by 59.34. The comparative analysis shows that the high performance is stable compared with existing methods, such as BERT, ANN, RF, and CatBoost. The global resilience index of 0.7015 shows that the system is moderately resilient and stable under operating conditions that implies the success of the suggested scalable multi-agent system of real-time financial and cybersecurity risk intelligence.

P_ID326

A SAINT-Based Approach for Multi-Class Classification of Liver-Related Conditions

Julius Olaniyan (Sol Plaatje University), Deborah Olaniyan (University Of The Free State), Ibidun Obagbuwa (Walter Sisulu University), Adedeji Emmanuel Adebayo (Auchi Polytechnic, Auchi), Mathew Odighi (Ambrose Alli University, Ekpoma), Blessing Benison Odigie (Benson Idahosa University, Edo)

julius.olaniyan@spu.ac.za, olaniyan.d@ufs.ac.za, iobagbuwa@wsu.ac.za, adedejibayoadedeji@gmail.com, onojiasun.odighi@aauekpoma.edu.ng, bodigie@biu.edu.ng

This study evaluates the performance of the Self-Attention and Inter sample Attention Transformer (SAINT) model for multiclass medical classification tasks using a dataset containing five distinct patient conditions: Blood Donor, Suspect Blood Donor, Hepatitis, Fibrosis, and Cirrhosis. The model's effectiveness was assessed using key metrics, including Precision, Recall, F1-Score, and Accuracy. SAINT demonstrated strong discriminative capabilities across all classes, achieving particularly high scores in both rare and majority classes. For the Blood Donor class, the model recorded a precision of 99.8%, recall of 99.0%, and F1-score of 99.4%, with an overall accuracy of 99.0%. The Suspect Blood Donor class achieved a precision of 87.5%, recall of 93.3%, F1-score of 90.3%, and accuracy of 99.5%. Hepatitis was classified with a precision of 96.2%, recall of 100%, F1-score of 98.0%, and accuracy of 99.7%. For Fibrosis, the model attained a precision of 96.8%, recall of 100%, F1-score of 98.4%, and accuracy of 99.8%. Remarkably, the Cirrhosis class achieved perfect scores (100%) across all metrics. These results affirm SAINT's robust performance and its potential for high-stakes clinical prediction tasks involving tabular data.

P_ID328

Optimizing Cloud Identity and Access Management Policies through an Intelligent Machine Learning Framework

Barinder Pal singh (Deloitte), Sharad Sharma (IEEE Senior Member)

reachbarinder@gmail.com, sharadiitkanpur@gmail.com

Cloud Identity and Access Management (IAM) protects secure adaptive access control because it secures cloud environments that face security threats from incorrect configuration. This research develops a hybrid IAM policy optimization method which utilizes multiple cloud security datasets, including AWS CloudTrail logs, UNSW-NB15 network traffic data, to perform comprehensive security analytics. The method uses advanced preprocessing together with feature engineering and data labeling and data standardization to develop policy debt score (PDS) which measures risk through Graph Neural Networks (GNN) that provide role intelligence. The classification process entails combining multiple ML models (Gradient Boosting, XGBoost, and Random Forest). The best results among these models appear with Gradient Boosting which achieves 90.16% accuracy and 98.63% precision and 92.31% F1-score. A hybrid ensemble-based anomaly detection system together with a Deep Q-Network (DQN) reinforcement learning model enables the development of adaptive policies which manage dynamic risk-based operations through three different actions. SHAP analysis fosters transparency in explainability. The results demonstrate major security performance advancements because there is a 65.73% reduction in permissions and a 69.69% reduction in policy violations. The framework shows its capacity to control misconfigurations while it restricts dangers and demonstrates the feasibility of intelligent IAM policy optimization for future large-scale cloud security environments.

P_ID329

Agent-Based Explainable Governance Framework for Autonomous AI Systems in Enterprise Environments

Rinu Dhanaraj (CVS Helath)

rinugdhanaraj@gmail.com

With digital payment volume growing and card-not-present fraud on the rise year over year, fraud detection systems are tasked with doing two things: spot fraud correctly and provide context to the transaction, in a way that allows auditors and regulators to take action. This paper presents a new Agent-Based Explainable Governance (AXG) Framework that integrates machine learning, explainable AI, and governance techniques into a single inference-time architecture for fraud detection in autonomous enterprise systems. It trained four classifiers Logistic Regression, Random Forest, XGBoost, and LightGBM on the ULB credit card fraud dataset, with Random Forest delivering the highest accuracy (0.9993) and F1-score (0.7973). SMOTE addressed the 99.83% class imbalance, RobustScaler normalized features without leakage, and SHAP explained each prediction at the feature level. Meanwhile, governance rules are derived from relevant policy data to ensure regulatory compliance. The study employed a multi-agent system consisting of detection agent, explanation agent, governance agent, and decision agent. The experimental results showed excellent performance of the framework based on multiple metrics including F1-Score of 0.8303. In terms of generalization performance on a synthetic dataset, the framework showed excellent performance with F1Score and ROC-AUC of 0.8385 and 0.9120, respectively.

P_ID330

Lightweight Malware Classification via Sequential Feature Enrichment: A Five-Stage Pipeline Framework Evaluated on CICIDS-2017

Dipesh Vaya (Poornima University), Rakesh Saxena (Poornima University)

dipesh.vaya88@gmail.com, saxenark06@gmail.com

Malware detection and classification is majorly dependent on high computing based deep learning architectures, which restricts its implementation in real time and edge systems. This work supports five lightweight models that are proposed for malware classification on the CICIDS-2017 dataset. The models are first evaluated independently in parallel and then connected as a sequential pipeline where each stage passes its output to the next. In a standalone evaluation, CFF achieves 93.50% accuracy. When connected as a pipeline, every model performs better than it did independently — CFF reaches 96.25%, and the final pipeline output through WFA achieves 93.44%. The results show that lightweight models arranged in a sequential pipeline can match or outperform computationally expensive deep learning approaches, while running on standard CPU hardware.

P_ID331

TACENet: An Attention-Modulated Data-Efficient Framework for Tea Leaf Disease Classification and Severity Estimation

Md Yasin Zihad (Dhaka University of Engineering & Technology, Gazipur), Khawja Imran Masud (University of North Texas), Md. Mamunur Rasid (Dhaka University of Engineering & Technology, Gazipur), Md Obaidur Rahman (Dhaka University of Engineering & Technology, Gazipur), Sahara Ali (University of North Texas)

mdzihad09876@gmail.com, KhawjaImran.Masud@unt.edu, mamunurduet1029@gmail.com, orahman@duet.ac.bd, sahara.ali@unt.edu

Tea leaf diseases cause substantial yield losses across tea-producing regions, as classification is significant. Deep learning methods primarily optimize model architecture and classification accuracy while giving limited attention to background-induced gradient noise and having limited spatial interpretability. We propose TACENet, an EfficientNet-B4-based framework built around two core ideas: the Convolutional Block Attention Module (CBAM) for feature refinement and Attention-Modulated Class-Importance Sampling (AM-CIS), a sampling strategy that computes gradient-based sample importance from attention-refined features rather than raw inputs. This design aims to reduce background-induced

gradient noise and improve training stability and test accuracy. TACENet jointly performs seven-class disease classification and three-level severity estimation, using asymmetric focal loss for disease classification and label smoothing for severity estimation. Grad-CAM and Grad-CAM++ are used to produce spatially localized visual explanations. On the 5,276-image TeaLeafBD dataset, TACENet achieves 93.18% disease classification accuracy and 97.47% severity estimation accuracy, outperforming ResNet-50 and EfficientNet baselines while converging up to 4 times faster than CBAM-only variants. These results indicate that combining attention-guided feature learning with importance-based sampling can provide an effective approach for efficient and interpretable plant disease recognition.

P_ID332

Optimizing API Communication in Full Stack Systems: A Latency and Throughput Analysis

Satyam Nikhra (Earnest)

nikhrasatyam@gmail.com

Enterprise platforms, e-commerce, real-time collaboration and data-intensive analytics are based on full stack system. The API communication between the front-end, back-end and database layer is essential and influences the latency and the throughput. The paper provides a product to test the efficiency of APIs, including the size of payload, concurrency, serialization strategies, caching strategy, and model of execution. The results of the experiment indicate that the mean latency is minimized to 48.5 ms and the throughput is achieved at over 210,000 requests/s at high load, asynchronous execution, in-memory caching and optimized serialization. The construction allows the quantitative comparison of the P50, P95 and P99 latency values and the number of hits in the cache, showing trade-offs in the responsiveness/resource usage. The practical implication of results to developers and system architectures are the creation of scalable and high-performance full-stack application systems. This study addresses this gap in the research by integrating multiple performance aspects in realistic environments and investigating the robust and efficient design of API communication and system design.

P_ID333

A Systematic Evaluation of Byzantine-Robust Federated Learning in Tactical 5G Networks

Gagandeep Malhotra (Namibia University of Science and Technology), Dharm Singh Jat (Namibia University of Science and Technology)

gagansigs@gmail.com, dsingh@nust.na

Federated learning (FL) allows multiple devices to train a shared model without sending raw data to a central server. This is useful for 5G tactical networks where privacy and bandwidth matter. However, if some devices are compromised, they can send bad updates that damage the shared model—this is the Byzantine threat. Several defence methods exist, such as Krum, Trimmed Mean, and FLTrust, but no clear comparison exists for tactical conditions. In this paper, we survey existing Byzantine-robust methods and test them systematically. We compare six aggregation methods against four attack types on MNIST with both IID and Non-IID data distributions. Our experiments reveal that Multi-Krum provides the most robust defence (97-98% accuracy across all scenarios), while FedAvg and Trimmed Mean fail catastrophically under scaling attacks (9.8% accuracy). Importantly, we find that Non-IID data significantly degrades all methods, with Krum's accuracy dropping from 97.7% to 69.1% under the LIE attack. These findings highlight the need for domain-aware trust mechanisms in heterogeneous tactical deployments.

P_ID335

Digital Twin-Driven Semiconductor Training: A Framework for AR/VR-Based Educational Systems

Meccaya Brock (North Carolina A&T State University), Challa Koundinya (Minnesota Stae University - Mankato), Anamika Das (North Carolina A&T State University), Issa Alhmoud (North Carolina A&T State University), Balakrishna Gokaraju (North Carolina A&T State University), Shyam Aravamudhan (Joint School of Nanoscience & Nanoengineering)

mcbrock@aggies.ncat.edu, koundinya.challa@mnsu.edu, adas1@aggies.ncat.edu, iwalhmoud@ncat.edu, bgokaraju@ncat.edu, saravamu@ncat.edu

The semiconductor industry's rapid growth has exposed a critical skills gap driven by limited access to advanced fabrication facilities, high training costs, and increasing manufacturing complexity. Traditional educational approaches struggle to provide the hands-on experience required for modern semiconductor processes. Digital twin (DT) technology, particularly when integrated with immersive environments, has emerged as a promising approach to address these limitations by enabling scalable and interactive training platforms. Based on analysis, this work proposes the Suitability for Replicating Semiconductor Processes (SRSCP) framework for the design and evaluation of digital twin-based training systems, integrating real-time data pipelines, immersive interaction, and cognitive-aware instructional design. This work identifies critical research gaps and outlines future directions for developing effective, scalable, and domain-specific training solutions aligned with semiconductor workforce development initiatives such as the CHIPS Act.

P_ID336

AI-Forensic: A Multi-Modal Artificial Intelligence Content Detection and Forensic Analysis Platform

Smart Lubobya (Namibia University of Science and Technology), Gabriel Musonda (Zambia University College of Technology), Smart Lubobya (University of Zambia)

slubobya@nust.na, gmusonda@zut.edu.zm, charles.lubobya@gmail.com

Generative AI models have made synthetic images, videos, and text increasingly difficult to distinguish from authentic content, posing significant challenges for digital forensics. Most existing detection methods are modality-specific and offer limited support for confidence estimation or for integrated forensic workflows. This paper presents AI-Forensic, a multimodal platform that unifies detection of AI-generated content across images, videos, and documents within a single investigative environment. It combines modality-specific classifiers, Platt Scaling for confidence calibration, and centralised evidence management. Evaluated on a 256-sample held-out test set, the platform achieved a macro-average F1-score of 0.82 and a calibrated aggregate confidence of 81%, demonstrating its feasibility as a forensic decision-support tool.

P_ID337

Quantifying Greenhouse Gas Emissions Across Soil Types Using Predictive Machine Learning Models

Arnima Pathak (Amity University Greater Noida), Monika Sharma (Amity University, Noida), Devendra Kumar (ABES Engineering College, Ghaziabad)

arnimapathak1011@gmail.com, msharma5@amity.edu, devendra.arya@gmail.com

Agricultural soils release Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O), and the magnitude of these fluxes shifts strongly with soil type, making large scale Greenhouse Gas (GHG) accounting difficult. This study compares five classical Machine Learning (ML) regressors, namely Linear Regression (LR), Support Vector Regression (SVR), Gradient Boosting Machines (GBM), Random Forest (RF) and Extreme Gradient Boosting (XGBoost), for predicting daily CO_2

equivalent (CO_2-eq) emissions across eleven United States Department of Agriculture (USDA) soil orders. A harmonised compilation of 7,914 chamber measurements covering 27 soil, climate and management features was used after cleaning, with the eleven soil order labels one hot encoded. Models were trained with stratified 5 fold cross validation and judged on the coefficient of determination (R^2), Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and a hotspot recall metric defined at a 2 kg CO_2-eq ha^{-1} day^{-1} threshold. XGBoost produced the strongest fit, with R^2 = 0.893, RMSE = 0.254 kg CO_2-eq ha^{-1} day^{-1} and recall of 0.89, while RF followed closely at R^2 = 0.871. The linear baseline reached only R^2 = 0.612, which signals that soil to flux relationships are strongly nonlinear. SHapley Additive exPlanations (SHAP) and gain based importance both placed soil moisture, soil organic carbon and soil temperature at the top of the feature ranking, with the soil order indicators jointly contributing 11.2% of the gain. The findings support tree-based ensembles as a practical and low-cost route to first pass soil GHG estimates and motivate their use for evaluating mitigation strategies such as legume-based rotations. Keywords-greenhouse gas emissions, soil orders, machine learning, random forest, XGBoost, legume rotations, agricultural sustainability

P_ID338

Scalable Data Engineering Framework for Large-Scale Retail Transaction Processing Using Distributed Data Pipelines

Krishna Chaitanaya Chittoor (Independent Researcher)

chittoorkrishna39@gmail.com

The rapid growth of retail data generated from online and offline transactions necessitates scalable and efficient data processing frameworks for accurate analytics and prediction. This paper presents a comprehensive methodology for building distributed data engineering and machine learning solutions to perform big data analytics in a retail transaction processing scenario. The methodology is based on distributed data engineering techniques and covers all stages of big data analytics from data processing (data preprocessing, business rules validation, feature engineering, which involves transactional, temporal, RFM, product, and geospatial features, as well as data preprocessing techniques), through distributed data processing implemented with the help of Pandas hash partitioning and Apache Spark to DAG-based pipeline orchestration. It uses the processed data for training and evaluating several ML models, such as Random Forest, Gradient Boosting, XGBoost, and Decision Tree, for revenue prediction purposes. The experiments show that Random Forest model outperforms other models significantly and provides an R^2 score equal to 0.9983 and very small error metrics. The presented framework also demonstrates good scalability, high efficiency, and quality.

P_ID339

Artificial Intelligence-Driven Defect Prediction and Risk Analysis Framework Based on SDLC Platforms

Aashish Baldwa (George Mason University), Premal Bhatt (Independent Researcher University of Massachusetts Dartmouth), Devang Upadhyay (Independent Researcher North Carolina state university), Pratham Bhatt (Independent Researcher Rutgers University, New Brunswick)

aashishbaldwa@gmail.com, Premal.b.bhatt@gmail.com, Upadhyaydevang004@gmail.com, Prathambhatt7254@gmail.com

Software Defect Prediction (SDP) is a critical component of the Software Testing procedure in the Software Development Life Cycle (SDLC) to guarantee its dependability and quality. A substantial contribution is made to the reduction of resources, time, and effort through the early detection of defects. A new framework for SDP and risk analysis is proposed in this study, which is founded on AI and machine learning/Deep Learning (ML/DL) methodologies. The two public Kaggle datasets, JIRA dataset and Software Defect dataset are merged into one dataset with 49,498 records and 514 features.

Data quality enhancement and class imbalance handling techniques are implemented in order to achieve better data quality: Data preprocessing, Feature engineering, Label encoding, Feature selection, StandardScaler normalization and SMOTE balancing. The proposed framework employed Extra Trees, XGBoost, Multi-Layer Perceptron (MLP) and Long Short-Term Memory (LSTM) models using 5-fold Stratified Cross-Validation to classify the defect. The trials demonstrated that the MLP model attained the best accuracy (99.15%), F1 score (96.87%), and ROC AUC (99.79%). The features selected as key based on SHAP are Status, outlier_score, Votes, and Priority, which are key defect-related features. Furthermore, the framework did software risk prediction and SDLC phase-wise risk analysis for intelligent project risk assessment. In general, the proposed solution is effective and reliable in software defect prediction and software risk management.

P_ID341

Exploring Research Trends in Explainable AI (XAI)

Kalyan Chakravarthi Maddikera (University Of Technology And Applied Sciences), Navyasri Mokkapati (Siddhartha Academy Of Higher Education, Deemed To Be University), Purna Prakash Kasaraneni (Siddhartha Academy Of Higher Education, Deemed To Be University), Himajyothi Kasaraneni (Kakaraparti Bhavanarayana College (Autonomous)), Pradeep Reddy Gogulamudi (Manipal Academy Of Higher Education), Srikanth Mandarapu (Raghu Engineering College)

kalyan.maddikera@utas.edu.om, mnavyasri@vrsiddhartha.ac.in, kpurnaprakash@vrsiddhartha.ac.in, khimajyothi@gmail.com, pradeep.reddy@manipal.edu, srikanth.mandarapu@raghuenggcollege.in

Explainable Artificial Intelligence (XAI) has emerged as a solution for achieving responsible and trustworthy AI due to the demand for transparency and accountability in complex models. The introduction of deep learning and foundation models led to the rapid growth of XAI research. So, there is a need for understanding growth, contributors, and changing themes of XAI research. Despite a limited number of bibliometric studies in XAI, the fast development of XAI practices, especially in the age of large language models, small language models, new regulatory frameworks, and interdisciplinary involvement, requires a more detailed mapping of the field. With this motivation, this paper aims to provide an analysis of XAI studies published between 2020 and 2025. A bibliometric analysis based on Scopus data is conducted to measure several parameters, including the growth of publications, authors and institutions that have the most impact, and countries in the field. The Bibliometrix and VOSviewer tools are used for bibliometric analysis and visualization. The results indicate significant growth in XAI publications since 2020 and good international collaborations. This analysis provides actionable insights for researchers and practitioners.

P_ID343

Semantic Network Modeling and Interactive Visualization of Academic Curricula for Profession Area of Specialization

Kayode Akinola (McPherson University), Ayobami Emmanuel Mesioye (McPherson University), Oluwasanya Oyedele (McPherson University), Olusegun Odugbesan (McPherson University), Kehinde William (McPherson University)

kayodewale87@yahoo.com, mesioyeae@mcu.edu.ng, oyedeleo@mcu.edu.ng, odugbesanoa@mcu.edu.ng, seunkeh@gmail.com

The rapid expansion of the computer science domain has resulted in a fragmented understanding of academic curricula among students, a phenomenon known as the “silo effect.” Existing approaches to curriculum management rely on linear electronic documents and standard Learning Management Systems (LMS), which are limited by their static structure and inability to convey complex semantic dependencies between courses and industry specializations. To address this, this paper introduces an interactive visualization system powered by a curriculum knowledge graph. The approach utilizes a hybrid Natural Language Processing (NLP) pipeline, integrating Regular Expressions (RegEx) for structured data and an

ontology-driven Named Entity Recognition (NER) engine via spaCy for the deterministic extraction of technical skills. Using a dataset of official computer science course outlines and curricula from McPherson University, the system constructs a semantic network rendered through a D3.js force-directed graph. Empirical results demonstrate that the ontology-driven extraction model achieves a 98.5%, 99.5% and 99.2% in precision, recall, and F1-score respectively. This results show that the proposed method significantly outperformed generic keyword matching and standard pre-trained NLP baselines. The implications for the larger society include the reduction of student cognitive load and the promotion of meaningful learning, ultimately producing more adaptive and industry-ready graduates. It is concluded that modeling academic data as an interconnected semantic network effectively bridges the alignment gap between undergraduate education and professional career paths

P_ID344

Application-Aware Comparative Evaluation of V2X Radio Access Technologies for Advanced 5G-V2X Use Cases

Werkineh Yifru (Namibia University of Science and Tecnology (NUST)), Dharm Singh Jat (Namibia University of Scinece and Technology (NUST)), Arpit Jain (Namibia University of Scinece and Technology (NUST))

werkineheshete@gmail.com, dsingh@nust.na, ajain@nust.na

Vehicle-to-Everything (V2X) applications impose heterogeneous communication requirements, ranging from low rate cooperative awareness to perception-oriented message exchange. This paper presents application-aware evaluation of IEEE 802.11p, LTE-V2X Mode 4, and NR-V2X Mode 2 using a harmonized ns-3 and SUMO simulation framework utilizing an ETSI-compliant CAM and CPM traffic. The evaluation considers two service classes: a lane-merge scenario generating CAM traffic and a see-through cooperative-perception scenario generating combined CAM/CPM traffic. 54 total simulation runs covering 18 scenario-density-RAT configurations across three independent seeds are executed. Performance is evaluated using average latency, p99 latency, jitter, goodput, packet delivery ratio, and service-level violation rate. Results show that IEEE 802.11p achieves the lowest latency under the controlled short range setup, with sub-millisecond average delay. NR-V2X Mode 2 provides intermediate latency (∼11 ms average, ∼20-23 ms p99), while LTE-V2X Mode 4 exhibits higher latency (∼16-17 ms average, up to ∼69 ms p99). A deadline-sensitivity analysis across 10 ms, 20 ms, 50 ms, and 100 ms targets demonstrates that RAT suitability depends heavily on the latency constraint. In the tested configuration, IEEE 802.11p satisfies all evaluated CPM deadlines. Conversely, NR-V2X Mode 2 exhibits a high deadline violation rate at 10 ms than other deadlines. Finally, LTE-V2X Mode 4 demonstrates the highest sensitivity and performance degradation under strict CPM deadline constraints.The findings show that RAT suitability is application, density, and deadline-dependent, and provide a reproducible baseline for future adaptive multi-RAT V2X control. Key Words—Advanced V2X application, IEEE 802.11p, LTEV2X, NR-V2X, CAM, CPM, ns-3, SUMO, Application Aware V2X RAT evaluation

P_ID347

Cybersecurity Incidents and Challenges in Operational Technology Within Water Treatment Facilities

Uben Pather (Postgraduate School of Engineering Management, University of Johannesburg), Annlizé Marnewick (Postgraduate School of Engineering Management, University of Johannesburg), Masike Malatji (Graduate School of Business Leadership (SBL), University of South Africa (UNISA))

ubenpather@gmail.com, amarnewick@uj.ac.za, malatm1@unisa.ac.za

The increase in Operational Technology (OT) advancements over the years in water treatment facilities has accelerated their exposure to cybersecurity threats. This study has two objectives: the first is to evaluate the key cybersecurity

threats and challenges affecting OT environments in water treatment facilities. The second objective is to assess how lessons from the past cybersecurity incidents can inform improvements in cybersecurity incident response strategies. A qualitative research approach was used, utilising document analysis of grey literature, including industry reports and cybersecurity advisories. The findings indicate that vulnerabilities in OT infrastructure, particularly internet-exposed assets and poor segmentation between Information Technology (IT) and OT networks, were the most significant contributors to cybersecurity risks. Credential compromise and unauthorised remote access were also identified as the second- and third-most significant vulnerabilities through which threat actors gain access to OT environments. In addition to these vulnerabilities, the results indicate that, in general, Industrial Control Systems (ICS) malware presents a significant threat as it is often deployed after initial access is established. Improvements in access control, system design and monitoring play a key role in strengthening how OT environments handle cybersecurity incidents. In practice, this means better control over ICS, reduced exposure, and prompt identification of suspicious activities within water treatment facilities.

P_ID350

Simulator-to-Real Fault Signature Adaptation for AI-Based Predictive Maintenance of Ship Rotating Machinery

Akash Mohanty (BITS,Pilani,Goa campus), Bharat Kamble (Edgeforce Solutions Pvt Ltd), Debasis Patnaik (BITS,Pilani, Goa Campus), Prabhakaran Hani (Edgeforce Solutions Pvt Ltd), Aryan Gaur (Edgeforce Solutions Pvt Ltd), Kunal Palsodkar (Trials Unit)

jaihindakash@gmail.com, bharat@edgeforce.in, marikesh@goa.bits-pilani.ac.in, majphani@gmail.com, aryan@edgeforce.in, kdpalsodkar@gmail.com

Labelled fault data for ship rotating machinery is difficult to collect, as deliberately creating faults on operational vessels is not feasible. This paper proposes a Simulator-to-Real (Sim2Real) framework for Condition-Based Predictive Maintenance (CBPM) using real data for anomaly detection and simulator data for fault classification. A feature vector of 1,284 dimensions is extracted from nine vibration, three temperature, and three current channels. It is used as input to a deep autoencoder for Health Index (HI) calculation. A soft-voting ensemble of Random Forest, Extra Trees, and Histogram-based Gradient Boosting uses 22 simulator-generated fault conditions (five fault family classes) for the ship asset using dual-normalisation alignment. A File-level simulator test split was used to avoid data leakage, and the ensemble achieved 94.25% accuracy and a weighted F1-score of 0.94. During real-machine testing, 37.23 hours of healthy baseline data calibrated the HI, and 164.32 hours of live testing showed the HI remained within the normal operating range, declining only from 99.56 to 96.40 with no false-positive alerts. Short-term HI forecasting achieved a mean absolute error of 3.645 points - a 33.9% improvement over the naïve mean baseline. This indicates that the proposed system can support Health Index monitoring on shipboard machinery. However, real-machine fault classification accuracy could not be validated because labelled real-fault data were not available.

P_ID357

Security and Privacy-Preserving Frameworks in E-government Systems: A Systematic Review

Arnet Zitha (University of Johannesburg), Noluntu Mpekoa (University of South Africa), Sheethal Tom (Independent Institute of Education, Emeris)

224093749@student.uj.ac.za, mpekon@unisa.ac.za, stom@emeris.ac.za

E-government systems are increasingly important for delivering public services, however, concerns about data security and privacy remain significant barriers to their widespread adoption. The unique contexts of each country require

government entities to understand the security and privacy challenges faced by the sectors transitioning to E-government. This study critically assesses and synthesizes security and privacy-preserving frameworks for E-government systems through a Systematic Literature Review (SLR). Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, data were collected from five databases, covering peer-reviewed publications from 2020 to 2025. The findings reveal that security frameworks are characterized by a multi-layered socio-technical model that integrates internationally recognized standards, blockchain-based architectures, and context-specific enhancements. Privacy-preserving frameworks consistently employ cryptographic techniques, particularly homomorphic encryption and differential privacy, within federated and distributed architectures. Four cross-cutting research gaps are identified: limited evidence of salability, limited cross-sector interoperability, insufficient empirical validation in live administrative environments, and the underrepresentation of systematic and human factors. The review concludes that a multidisciplinary, adaptable approach that balances technological progress with regulatory compliance is essential for developing secure, privacy-preserving E-government systems suitable for diverse populations worldwide.

P_ID364

Benchmarking Pose-Guided Person Image Generation on the CrossAttire Dataset

Biponjot Kaur (Panjab University), Sarbjeet Singh (Panjab University)

biponjot@pu.ac.in, sarbjeet@pu.ac.in

The Pose-Guided Person Image Generation (PGPIG) method finds its use in applications such as fashion editing, virtual try-ons, generating digital avatars, and online stores. Recent works report impressive results on benchmark datasets such as DeepFashion. Still, most existing benchmarks include a small number of relatively simple standing poses, minor occlusions, and clothes of Western style acquired in artificial settings. As a consequence, there is uncertainty about whether the models generalize well for more complex scenarios involving more complicated structures of pose and clothing appearance. This paper performs a benchmark study based on the challenging CrossAttire fashion dataset. It contains both Indian ethnic and Western-style clothes captured in complex standing pose scenarios. Besides the complexity of the benchmark arising due to diversity in clothing, body articulation, self-occlusions, and loose clothing structure also contribute. We evaluate five existing PGPIG models including the Dual-task Pose Transformer Network (DPTN), Progressive Attention Transfer Network (PATN), Cross Attention Based Style Distribution (CASD), Attribute-Decomposed GAN (ADGAN), and XingGAN on this new benchmark. We demonstrate a noticeable drop in model performance on CrossAttire as compared to their results on common benchmark datasets such as DeepFashion. During our evaluation, several issues were identified such as deformed limbs, blur artifacts in the region of clothing, inconsistent textures, and wrong body-part generation in areas of occlusion. These results show that many current PGPIG methods still struggle under realistic fashion conditions containing complex standing pose articulation and diverse clothing structures.

P_ID372

Deep Learning Models for Sugarcane Leaf Disease Detection

Khanyisile Magagula (University of Eswatini), Petros Mnisi (University of Eswatini), Boluwaji Akinnuwesi (University of Eswatini), Samkelo Msibi (University of Eswatini), Petros Mashwama (University of Eswatini), Mphumelelo Ndlovu (Eswatini Sugar Association Technical Services), Stephen Fashoto (Namibia University of Science and Technology), Elliot Mbunge (University of Johannesburg), Olusola Olabanjo (Morgan State University)

khanyisile@aieswatini.com, mnisithunzipetros@gmail.com, moboluwaji@gmail.com, sammsibigreenhead@gmail.com, mashwamap35@gmail.com, mphumelelo@esa.co.sz, gbengafash2@gmail.com, mbungeelliot@gmail.com, solarmic2015@gmail.com

Sugarcane leaf diseases are a major challenge for the sugarcane industry in Eswatini, resulting in significant crop losses and financial setbacks. Early identification is critical, as many farmers lack the expertise to identify these diseases effectively. This study applies deep learning models to classify sugarcane leaf diseases from RGB images collected at Eswatini Sugar Association plantations. A dataset of 1,734 sugarcane leaves with five classes: healthy leaves, mosaic disease, rust disease, red rot disease and smut disease was collected and split into 70% training, 20% validation and 10% test sets. To address sample size limitation, online data augmentation was employed only on the training set. These augmentation techniques included random horizontal flip, random rotation, random blur and random brightness adjustment. Four models were developed and compared. These are: YOLOv8s-cls-pt (the classification variant), CNN (trained from scratch), Self-Attention-ResNet50 (SA-ResNet50) and Squeeze-and-Excitation-ResNet50 (SE-ResNet50). On the test set, SE-ResNet50 achieved the highest accuracy of 99.43%, followed by SA-ResNet50 at 97.70%, YOLOv8s-cls-pt at 96.55% and lastly CNN at 82.76%. SE-ResNet50 outperformed all the other models, showing the benefit of channel wise attention mechanisms for sugarcane leaf disease classification in resource constrained settings.

P_ID376

Smart Irrigation Digital Twin: Integrating Machine Learning and Real-Time Data for Sustainable Agriculture

Victor Emma-Wele (Minnesota State University, Mankato), Koundinya Challa (Minnesota state University, Mankato), Busrat Jahan (Minnesota state University, Mankato), Sai Praveen Dadi (Westcliff University), Venkata Sai Teja Reddy Gajula (Westcliff University), Chandra Jaiswal (North Carolina A&T State University)

victor.emma-wele@mnsu.edu, koundinya.challa@mnsu.edu, busrat.jahan@mnsu.edu, s.dadi.8145@westcliff.edu, v.gajula.9938@westcliff.edu, cpjaiswal@aggies.ncat.edu

Digital Twins (DTs) combined with machine learning (ML) offer transformative potential for precision irrigation in smart agriculture. This paper presents a comprehensive Smart Irrigation Digital Twin framework that integrates IoT sensor data, a synthetic farm dataset (3,000 records covering soil moisture, temperature, humidity, rainfall, crop type, water tank level, and irrigation labels), and ensemble ML models for real-time irrigation decision support. Multiple classifiers were trained and evaluated, with Gradient Boosting emerging as the best performer for predicting irrigation needed. An interactive dashboard provides dynamic visualization, scenario analysis, risk probability mapping, and decision support across crops, field zones, and seasons. The framework draws from recent literature on DTs in smart farming and precision irrigation. It addresses key challenges including data integration, model accuracy, scalability, and usability for resource constrained farming. Experimental results demonstrate strong predictive performance and potential for significant water savings compared to rule-based baselines. DT architecture supports bidirectional synchronization between physical sensors and virtual models, enabling simulation, prediction, and prescriptive actions for sustainable agriculture amid climate variability and water scarcity. Future work includes deep learning for evapotranspiration forecasting and edge deployment.

P_ID377

Using College Basketball Statistics as Predictors of NBA Draft Selection

Jack Lang (Minnesota state University, Mankato), Koundinya Challa (Minnesota state University, Mankato), Sai Praveen Dadi (Westcliff University), Venkata Sai Teja Reddy Gajula (Westcliff University), Chandra Jaiswal (North Carolina A&T State University)

jack.lang@mnsu.edu, koundinya.challa@mnsu.edu, s.dadi.8145@westcliff.edu, v.gajula.9938@westcliff.edu, cpjaiswal@aggies.ncat.edu

Predicting NBA draft selection is a complex evaluation problem that teams invest significant resources in. Many teams still struggle to select the best available player in the draft. Existing approaches rely heavily on subjective scouting and lack a quantifiable statistical foundation. This study addresses that gap by building a machine learning model trained on college performance data to predict draft selection. A dataset of 4,907 player seasons was scraped from RealGM and Basketball-Reference and used to train an XGBoost classifier on the top ten features. Through cross-validation, a ROC-AUC score of 0.845 was found, indicating the model was able to meaningfully distinguish between drafted and undrafted players. There was an even split between traditional and advanced features with FIC ranked as the strongest predictor. College statistics provide a meaningful but incomplete foundation for draft prediction due to missing physical attributes that remain outside of scope of statistical models

P_ID381

Detection and Mitigation of Prompt Injection Attacks in GitHub Copilot: A Security Analysis

Lav Upadhyay (Manipal University Jaipur), Anushka Jain (Manipal University Jaipur), Arnav Rathi (Manipal University Jaipur), Anita Shrotriya (Manipal University Jaipur), Lav Upadhyay (Manipal University Jaipur)

lavupadhyay@gmail.com, anushka.23fe10cse00296@muj.manipal.edu, arnav.23fe10cse00627@muj.manipal.edu, anita.shrotriya@jaipur.manipal.edu, lav.upadhyay@jaipur.manipal.edu

Prompt injection is a vital and emerging attack vector. AI coding assistants like GitHub Copilot to be used alongside adversaries to enter malicious code into developer-controlled code. Reads inputs (README files, code comments and configuration documents) to manipulate code generation, leak sensitive information, and trigger unauthorized actions. Despite the severity of this threat, no prior work has conducted a direct, unified empirical comparison of detection algorithms on a common payload corpus, nor proposed an integrated defense architecture grounded in comparative experimental evidence. This paper addresses both gaps. We implement and evaluate three prompt injection detectors—MELON-lite (contrastive embedding similarity), a two-stage Semantic Pattern Filter, and a locally-hosted Llama-3.2 LLM classifier—against a balanced 200-sample dataset combining PINT benchmark payloads with original Copilot-specific attack vectors spanning eight injection categories. Experimental results demonstrate that no single detector dominates across recall, accuracy, and attack success rate (ASR), with all detectors achieving perfect precision at the cost of high false negative rates, with Unicode-obfuscated payloads proving most evasive across all approaches. Based on these findings, we propose HPIDA (Hybrid Prompt Injection Defense Architecture), a four-layer pipeline that sequences input sanitization, parallel multi-detector ensemble with majority-vote aggregation, cross-agent policy validation, and continuous adversarial benchmarking. Our results provide the first empirically grounded comparison of open-source local LLM classifiers against embedding-based detectors for Copilot-specific injection threats, and establish a reproducible experimental baseline for future defense evaluation.

P_ID382

Comparing TVWS and Wi-Fi Installation Costs in Rural Namibia

Ronald Karon (Namibia University of Science and Technology), Nomusa Dlodlo (Rhodes University), Alfredo Terzoli (Rhodes University)

rkaron@nust.na, n.dlodlo@ru.ac.za, a.terzoli@ru.ac.za

TV White Space (TVWS), though introduced in the early 2000s, is still an emerging technology in many countries, particularly in Africa. TVWS networks utilizes locally unoccupied TV spectrum. At the same time, broadband access remains a challenge in continents like Africa. The National Planning Commission of Namibia targeted broadband coverage of 90% in the country by 2023. This target is unattained. The essential problem there is limited broadband access in the rural areas of the country, attributed to costs. TVWS is now regarded as a possible solution to this problem, replacing other networking technologies for broadband in rural areas, especially Wi-Fi. No cost assessment report, however, exists to assess the cost of TVWS to provide broadband connectivity to rural areas. This paper attempts to address this gap by testing the following hypothesis: "The deployment and operations of TVWS networks are cost effective when compared to Wi-Fi in rural areas of the Kunene region, over a ten year period". The research design employed quantitative technical and cost engineering methods. Additionally, the study adopted a positivist approach as its research paradigm. The hypothesis of the study was tested through broadband simulations for the technical method, while the cost engineering method was executed using Microsoft Excel. The analysis of data consisted of two segments, technical and cost engineering methods. Indoor RadioPlanner 2.1 and RadioPlanner 3.0 tools were used for network simulations. The data collection technique comprised simulations, literature sampling, and document analysis. The rural area of Kunene region was selected as the study area. Wi-Fi emerged as the lowest cost solution for rural areas. The hypothesis was therefore not strongly supported.

P_ID383

A Competency-Based Cybersecurity Training Framework For Air Traffic Safety Electronics Personnel

Richard Abang Owan (University of Johannesburg), Annlizé Marnewick (University of Johannesburg), Masike Malatji (University of South Africa (UNISA))

r_owan@hotmail.com, amanerwick@uj.ac.za, malatm1@unisa.ac.za

The digitalisation of the aviation environment has introduced new and increased cybersecurity risks to the Communication, Navigation and Surveillance/Air Traffic Management CNS/ATM environment. It is up to the Air Traffic Safety Electronics Personnel (ATSEP) who maintain the operationally critical CNS/ATM systems to ensure that they operate resiliently. However, the current state of cybersecurity training for ATSEPs is primarily compliance-driven and does not address their operational needs. This study investigated training gaps to establish evidence-based best practices for enhancing ATSEPs' preparedness against cybersecurity risks, using a mixed-methods approach combining quantitative survey data and qualitative thematic analysis. The results indicate low levels of cybersecurity awareness amongst ATSEPS, no role-specific or simulation-based training currently exists, and a large deficit exists between procedural knowledge of ATSEPs and their operational capabilities. Furthermore, a statistically significant relationship exists between adequate training provided to ATSEPs and their level of preparedness to perform their operational duties. With these results, the study presents the Enhanced Competency-Based Cybersecurity Training Framework (ECBCTF), which aligns with the International Civil Aviation Organisation (ICAO) Doc. 10057, the National Institute of Standards and Technology (NIST) Cybersecurity Framework, and the European Union Aviation Safety Agency (EASA) Part Information Security (Part IS). The ECBCTF incorporates a range of elements, including technical, human, and organisational factors,

into seven empirically developed areas. This research, therefore, contributes to developing a structured, empirically grounded model to strengthen ATSEPs' preparedness against cybersecurity risks in aviation systems.

P_ID384

Federated and Transfer Learning Based Techniques for Privacy-Aware Lung Cancer Detection

Sonal Sharma (MJP Rohilkhand University), Vinay Rishiwal (MJP Rohilkhand University), Mano Yadav (Bareilly College), Udit Agarwal (RBMI Group of Institutions), Charu Singh (Castro Valley), Simon Muchinenyika (Namibia University of Science and Technology)

sonell.sharma@gmail.com, vrishiwal@mjpru.ac.in, mano425@gmail.com, udit078@gmail.com, charusingh2194@gmail.com, smuchinenyika@nust.na

Lung cancer is one of the major causes of death in today's world. Early diagnosis of lung cancer improves patient survival rates. In today's era, low-dose computed tomography (LDCT) to detect early-stage lung cancer increases the chances of survival significantly.Training highly accurate and generalizing deep neural networks requires large amounts of heterogeneous data that are inherently decentralized due to strict data protection policies across different healthcare institutions. The components such as FedProx, Transfer Learning, and EfficientNet are established independently, the primary contribution of this work lies in their domain-specific architectural synthesis. We present a pipeline that adapts 2D ImageNet priors to high-dimensional thoracic volumes via pseudo-3D kernel inflation, explicitly coupled with proximal federated aggregation. Rather than proposing a fundamentally new optimization theorem, this work serves as an empirical integration study. The primary scholarly contribution is the rigorous systems-level evaluation of how these combined paradigms interact to stabilize non-IID volumetric data and eliminate cold-start delays in decentralized medical environments. The solution we use is the EfficientNet-B4 model pre-trained on the ImageNet dataset and modified mathematically to detect three-dimensional nodules. To address the challenges associated with data independent and Identically Distributed (non-IID) and heterogeneity among hospitals, we use FedProx as a superior method of aggregating weights. Experiments demonstrate that our federated transfer learning-based architecture provides up to 94.8% accuracy and 0.971 AUC for the LIDC-IDRI and LUNA16 data sets, being just 1.5% off the maximum accuracy of a fully centralized model.

P_ID385

Intelligent Osteoporosis Monitoring Through IoT and CNN-Based Non-Invasive Analysis

Dhanya K Vijaya (Bharath Institute of Higher Education and Research), Priya Dasarwar (Symbiosis International (Deemed University)), Rajeswar Mahidar P (Sasi Institute of Technology and Engineering), R Kavitha (Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College), S Murugan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences), V Vidya Lakshmi (R.M.K. Engineering College)

kusumam24@gmail.com, priyadasarwar21@gmail.com, prmahidhar@sasi.ac.in, kavijeya914@gmail.com, smuresjur@gmail.com, vidyalakshmi2024@gmail.com

Osteoporosis is a skeletal disorder that is degenerative characterized by reduced bone mineral density and myriad susceptibility to fractures particularly in the elderly. It is very important to identify in time and follow-up to prevent severe outcomes and improve the prognoses of patients. This study proposes the use of Internet of Things (IoT) and Convolutional Neural Network (CNN) to monitor bone health with a non-invasive approach to osteoporosis diagnosis and monitoring. Physiological and biomechanical data (i.e., motion patterns, gait characteristics and pressure distribution) are collected by wearable IoT sensors. The collected data is submitted to a cloud-based platform on which a CNN model

assesses the characteristics and classifies bone health conditions as being the case of Normal, Osteopenia, or Osteoporosis. A dataset of 6,000 samples which consisted of 2,000 samples each in the classes and the 80:20 ratio of training and testing was used to evaluate the system. It has been experimentally observed that the proposed CNN model achieves a classification accuracy of 99.50 which may be taken as an indication of its effectiveness in identifying different stages of bone health problems. The results confirm that the proposed technique is a reliable, non-invasive, and continuous monitoring option in the early diagnosis of osteoporosis and improved treatment of bone fragility.

P_ID387

Performance of InceptionV3 Model for Crack Detection in Reinforced Concrete Structures Under Varying Illumination Conditions

Sesham srinu (University of Namibia), Philemon Arito (University of Namibia), Nokuphila Dlamini (University of Namibia)

ssesham@unam.na, parito@unam.na, dphilamfundo@gmail.com

Condition assessment of Reinforced Concrete (RC) structures such as bridges is predominantly conducted through visual inspection. Visual inspection is laborious, time consuming, accident-prone and highly susceptible to human error including inspector subjectivity. Advanced machine/deep learning-based tools offer significant potential for the accurate detection and characterisation of visual defects such as cracks in RC structures. Numerous studies have extensively employed deep learning models, particularly Convolutional Neural Networks (CNNs), to overcome the aforementioned limitations, often without explicitly considering model complexity. This study evaluates the crack detection performance of a lightweight CNN model: InceptionV3. The performance of InceptionV3 has been compared with other commonly used models - ResNet50 and VGG16 - under varying illumination conditions. The models were evaluated using the Middle East Technical University (METU) concrete crack dataset comprising 40,000 images. Notable differences among the models were observed in terms of training complexity and performance metrics, including accuracy. All three models achieved a mean crack detection accuracy of 95% under low-illumination conditions. InceptionV3 outperformed VGG16 and ResNet50 in terms of computational complexity while achieving comparable accuracy to the larger models under varying illumination conditions. The computational time complexity of InceptionV3 is approximately 3× and 5× lower than ResNet50 and VGG16, respectively. InceptionV3 is a feasible CNN model for crack detection in RC structures due to its low training time and inference complexity.

P_ID388

Securing Digital Document Storage and Verification through Blockchain and Homomorphic Encryption

Ms. Shivani Pandey (MIET, Meerut), Vinay Rishiwal (MJP Rohilkhand University, Bareilly), Mano Yadav (Bareilly College, Bareilly), Yash Sharma (Eminence technology, Punjab), Chirag Singh (Iowa State University of Science and Technology), Arpit Jain (NUST)

shivani.pandey0992@gmail.com, vrishiwal@mjpru.ac.in, mano425@gmail.com, yashsharma22003@gmail.com, chiragsj@iastate.edu, ajain@nust.na

With the digitization of documents the need for secure, transparent, and efficient document management grows in every domain, which reflects a clear demand for systems that maintain privacy and provide decentralized trust. In this paper a dashboard using blockchain technology with homomorphic encryption for securing digital document and its verification has been proposed. The dashboard provides role of administrators, auditors, and authorized users to upload, manage, verify and monitor documents. Documents are encrypted with homomorphic encryption before storing on cloud, which allows secure processing without decrypting document. Blockchain transactions record document hashes, metadata and

timestamps, while smart contracts validate these records to ensure traceability and integrity. User will have access control over document, and audit logs track activity for ongoing compliance. By integrating homomorphic encryption with blockchain, this system offers strong document verification, decentralized trust, and better privacy protection. It provides a scalable solution for secure digital document management in both academic and business environments. The proposed model has been evaluated and compared with existing model on performance metrics Security, Immutability, quantum resilience and throughput.

P_ID389

Designing a Digital Identity Prototype for Marginalised Indigenous Communities in Namibia

Minikuee Kasaona (NUST), Shilumbe Chivuno-Kuria (NUST), Arpit Jain (NUST)

200636200@nust.na, schivuno@nust.na, ajain@nust.na

Digital systems are now part of everyday life, yet many Indigenous communities in Namibia are still being left out. The San and Ovahimba people continue to face significant difficulties in accessing and using digital identity services. This study looked into their experiences and explored how these systems can be made more inclusive and better suited to how they actually live. Using a mixed-methods approach grounded in participatory design, information was gathered through semi-structured interviews, focus groups, field observations, and user acceptance testing (UAT) with 21 participants from the Hai||om San and Ovahimba communities. Findings show that participants learned better through hands-on activities and group work, and that speech-to-text functionality, multilingual support, and icon-based navigation made the system much easier and more engaging to use. The study concludes that working with communities to design digital systems builds trust and makes the technology more meaningful to Indigenous users. The findings offer practical guidance for policymakers, developers, and civil society organisations working toward a more inclusive digital Namibia and the broader sub-Saharan African context.

P_ID390

Development of a Secure and Optimised Digital Signature Framework For E-Commerce Financial Transactions

Ambrose Azeta (Namibia University of Science and Technology (NUST)), Odunayo Osofuye (Covenant University), Ogochukwu Nwamata (Covenant University), Ariyo Osofuye (Covenant University), Josephina Muntuumo (Namibia University of Science and Technology), Oluwaseun Adedeji (Tai Solarin University of Education)

aazeta@nust.na, odunayo.osofuye@covenantuniversity.edu.ng, ogochukwu.nwamata@stu.cu.edu.ng, a.osofuye@capitalsage.ng, jmuntuumo@nust.na, adedejiob@tasued.edu.ng

E-commerce platforms faced a dual security and performance challenge. Widely deployed authentication methods including passwords, PINs, and one-time passwords (OTPs) remained vulnerable to phishing, session hijacking, and SIM-swap attacks. Existing optimization solutions were architecturally designed for blockchain workloads and did not address the synchronous, low-latency requirements of e-commerce checkout flows. This study designed and evaluated an Optimized Adaptive Digital Signature Framework that eliminated redundant cryptographic operations through per-batch public key caching, dispatching verification dynamically across single, batch, and parallel processing modes. The framework was benchmarked against RSA-2048, Digital Signature Algorithm (DSA)-2048, and Base ECDSA using a two-phase approach: a controlled benchmark with 50 unique users across six batch sizes (four runs, averaged), and a full simulation with 5,000 unique users processing 10,000 transactions across 142 variable-size batches drawn from the Institute of Electrical and Electronics Engineers (IEEE)-CIS Fraud Detection Dataset. Usability was evaluated with 30 participants across five Likert-scale dimensions following five predefined payment tasks on the live prototype. The

controlled benchmark recorded a 1.20× speedup and 20.5% throughput improvement at the standard 100-transaction production batch (76% key reuse, 76 parse operations eliminated). The full simulation produced 0.95× overall under high user diversity, 1.17× during peak batches (151–250 tx), and remained 2.14× faster than DSA-2048 across 10,000 transactions. Verification accuracy was 100%. Memory overhead was +0.04 MB. Usability recorded an overall mean of 4.38/5.00 (n = 30), with System Responsiveness achieving the highest dimension score (4.54) and zero Disagree responses across all participants

P_ID392

Closed-Loop Dynamic Validator Node Scaling in Private Substrate Blockchains Using Takagi-Sugeno Fuzzy Inference

Thandile Nododile (University of the Western Cape), Ayinde M. Usman (University of the Western Cape), Clement N. Nyirenda (University of the Western Cape)

3692513@myuwc.ac.za, ausman@uwc.ac.za, cnyirenda@uwc.ac.za

Private blockchain networks operate with fixed node configurations that cannot adapt to changing workload conditions. When too many nodes serve a light workload, resources are wasted, when too few nodes face heavy demand, block production slows and finalisation degrades. The right number of validator nodes is hard to determine, as it depends on multiple overlapping factors that shift over time. This paper presents a Takagi-Sugeno (TS) fuzzy inference system that reads live blockchain parameters, namely block production time, block size, and active node count, and outputs a continuous efficiency score alongside a scaling recommendation: Scale Up, Maintain, or Scale Down. The controller uses triangular membership functions across three linguistic variables, evaluated through a complete 27-rule base with product t-norm aggregation. A central methodological contribution is an empirical recalibration of the membership functions, anchoring the linguistic terms to the observed operating range of the testbed rather than to theoretical extremes. The system is evaluated on a 10-node Substrate blockchain network storing real smart water meter data hashes from the Queensland Government open data portal. Statistical analysis across validator configurations of 4, 7, and 10 active nodes confirms that the controller produces distinct operational profiles that correctly reflect each configuration's provisioning state. In a closed-loop experiment, the controller autonomously adjust validator participation in both directions, activating validators under rising load, removing them under over-provisioning, and converges to the same stable equilibrium bidirectionally. Against three threshold-based baselines, it exhibits substantially fewer scaling oscillations while maintaining comparable block production times. The results demonstrate that TS fuzzy inference can support autonomous validator management in private blockchains, with scaling behaviour that threshold approaches cannot match.

P_ID396

Integrating Automatic Speech and Image Recognition to Assist Individuals with Visual and Auditory Impairments: A Deep Learning Approach

Rester Goliati (Malawi University of Science and Technology), Bennett Kankuzi (Malawi University of Science and Technology), Menard Phiri (Malawi University of Science and Technology)

5230048@must.ac.mw*, bkankuzi@must.ac.mw, mphiri@must.ac.mw

Although many existing tools are useful for individuals with visual and auditory impairments, most of them focus on only one form of support at a time. In real environments, however, people do not experience sound and vision separately. Speech, movement, objects, hazards, and background noise often occur together, and useful assistance requires these signals to be interpreted in a coordinated way. This paper presents a deep learning based multimodal assistive

architecture that brings together Automatic Speech Recognition and Scene Captioning and Recognition through a Multimodal Recognition and Reasoning layer. The system captures audio and visual input in parallel, processes them through dedicated recognition pipelines, aligns their outputs, applies confidence based reasoning, reduces audio feedback interference, and delivers information through accessible feedback channels including text, audio, tactile, and Braille compatible output. The prototype achieved a Word Error Rate of 14.8 percent, Character Error Rate of 7.2 percent, object recognition accuracy of 89.3 percent, scene recognition accuracy of 85.6 percent, BLEU four score of 0.38, METEOR score of 0.42, Multimodal Recognition and Reasoning alignment success of 91.5 percent, mean response time of 1.7 seconds, audio feedback false triggers of 4 per 100 runs, and a System Usability Scale score of 81.2 from 15 participants. The main contributions of this paper are threefold: introduces a reasoning layer that aligns ASR and SCR outputs using timestamps, confidence scores, and contextual relevance, incorporates audio feedback interference correction to reduce the risk of the system responding to its own spoken output, and evaluates the prototype using component-level, system-level, and user- centered measures, including recognition accuracy, response time, multimodal alignment, feedback stability, and usability.

P_ID397

Grover's Quantum Search Algorithm for Byzantine Node Detection in Scalable Multi-Node Sensing Networks

Sesham Srinu (University of Namibia), Jovita Mateus (Namibia University of Science and Technology), Kenneth Gideon (University of Namibia), Tiyeho Mathews (University of Namibia)

ssesham@unam.na, jmateus@nust.na, kgideon@unam.na, mtiyeho@unam.na

Multi-node spectrum sensing (MSS) in cognitive radio networks (CRNs) enables reliable detection of spectrum opportunities using secondary/cognitive radio nodes while protecting licensed users communication link. The Federal Communications Commission (FCC) mandates that secondary users complete sensing channels within approximately 2 ms. In MSS, all secondary users in the cooperative network transmit sensing reports to a fusion center, where Byzantine node detection (BND) is performed to identify adversarial nodes. However, this additional processing at fusion center introduces further delay that violates strict sensing time requirements. Numerous statistical and Machine learning techniques have been proposed to find out an efficient and fast Byzantine node detection method. Though they are not efficient as the network scales. This work evaluates the impact of Byzantine node penetration in CRNs by varying the proportion of Byzantine nodes from 5% to 25% for scalable MSS networks. This study compares classical machine learningbased BND methods (K-Nearest Neighbour (KNN) and Isolation Forest) with a Grover-based quantum-inspired search algorithm. The proposed Grover-based method accelerates Byzantine node search by leveraging quantum amplitude amplification, reducing computational complexity to O(√K). Simulation results show that KNN exhibits linear scalability, while Isolation Forest follows O(K log2 K) complexity due to ensemble tree construction. In contrast, the Grover-based approach exhibits superior scalability for large networks. At K = 1000, KNN and Isolation Forest require approximately 1.5 ms and 2 ms, respectively, while Grover search requires 0.95 ms. At K = 10000, the corresponding times increase to 15 ms ms and 31 ms, whereas Grover remains significantly lower at 3 ms. Overall, the results show that Grover's Quantum-inspired algorithm offers a low-latency solution for MSS networks.

P_ID398

A Novel Machine Learning Approach Using Concept Clustering to Enhance Early Case Assessment in Electronic Discovery

Julius Silaa (NUST), Lusilao-Zodi Guy-Alain (NUST), Attlee Gamundani (NUST), Pilisano Masake (NUST)

jsilaa@nust.na, gzodi@nust.na, agamundani@nust.na, pmasake@nust.na

Technology-Assisted Review (TAR) has transformed electronic discovery (eDiscovery) by streamlining document processing, yet advanced concept clustering techniques tailored for Early Case Assessment (ECA) remain largely underexplored. Traditional legal workflows frequently struggle with weak semantic sensitivity, limited interpretability, and inadequate noise handling when processing massive volumes of electronically stored information (ESI). To address these operational gaps, this study presents an ensemble machine learning pipeline that integrates transformer-based sentence embeddings (SBERT) with non-linear dimensionality reduction (UMAP) and density-based topic modeling (HDBSCAN). This chunk-based architecture is designed to handle scalability constraints while preserving semantic integrity via centroid-based merging. Evaluated on the heterogeneous Enron corpus and the NamEmails benchmark dataset, the pipeline demonstrates robust and stable performance, generating distinct thematic clusters alongside explicit metadata and content noise filtration. Quantitative evaluation reveals competitive Davies-Bouldin indices and high cluster assignment confidences for dominant issues, even amidst negative Silhouette scores typical of complex enterprise corpora. Ultimately, this approach establishes a reproducible, auditable, and operationally feasible framework for legal triage. It significantly reduces reviewer burden during the critical introductory stages of litigation, while outlining viable pathways for future human-in-the-loop and explainable AI integration.

P_ID400

Comparative Study of Multi-Agent Actor-Critic Algorithms in Parameterized Action Reinforcement Learning

Ubayd Ali Bapoo (University of the Western Cape), Clement Nyirenda (University of the Western Cape)

2934126@myuwc.ac.za, cnyirenda@uwc.ac.za

Parameterized action reinforcement learning has shown strong performance in environments requiring both discrete action selection and continuous parameterization. Prior work established the effectiveness of single-agent actor-critic algorithms — Greedy Actor-Critic (GAC), Soft Actor-Critic (SAC), and Truncated Quantile Critics (TQC) — on benchmark parameterized action tasks, but their extension to multi-agent settings remains largely unexplored. This paper presents a comparative study of shared-experience multi-agent extensions of these algorithms: Multi-Agent Greedy Actor-Critic (MAGAC), Multi-Agent Soft Actor-Critic (MASAC), and Multi-Agent Truncated Quantile Critics (MATQC). Rather than following the centralized training, decentralized execution (CTDE) paradigm, the proposed framework uses multiple independent actor-critic agents that share a replay buffer while maintaining separate policy and value networks. We evaluate the algorithms on the Platform-v0 and Goal-v0 benchmarks against their single-agent counterparts, using three-, five-, and ten-agent configurations to assess scalability. Performance is measured by average evaluation return and training time across ten independent runs, with one-way ANOVA and Tukey HSD post-hoc tests used to assess statistical significance. Results show that the multi-agent framework consistently improves Greedy Actor-Critic performance, while MASAC and MATQC show comparatively modest gains over their single-agent versions. Increasing the number of agents beyond five yields limited additional performance while substantially raising computational cost, particularly for MAGAC. These results highlight a trade-off between learning performance and computational efficiency, offering insight into the scalability of shared-experience multi-agent actor-critic methods for parameterized action reinforcement learning.

P_ID403

StemMate: A Retrieval-Augmented Generation Architecture for Curriculum-Grounded STEM Education

Josephina Muntuumo (Namibia University of Science and Technology), Isabel Tchikenge (Namibia University of Science and Technology), ilkka Jormanainen (University of Eastern Finland), Jacob Nielsen (University of Southern Denmark), Gabriel Nhinda (Namibia University of Science and Technology), Markku Tukiainen (University of Eastern Finland)

jmuntuumo@nust.na, tchikengeisabel@gmail.com, ilkka.jormanainen@uef.fi, jani@mmmi.sdu.dk, gnhinda@nust.na, markku.tukiainen@uef.fi

Namibian secondary-school STEM pass rates are low—Mathematics 38%, Physical Science 41%, and Biology 45%—and are further affected by shortages of qualified teachers, limited laboratory resources, and uneven access to quality curricular materials, particularly in rural regions. At the same time, learners increasingly rely on general-purpose large language models for homework support, but these tools are not aligned with the Namibian Senior Secondary Certificate (NSSC) curriculum and often generate off-syllabus or hallucinated explanations. This paper presents StemMate, a Retrieval-Augmented Generation (RAG) chatbot built with LangChain, LLaMA 3.3 70B (ChatGroq), and ChromaDB, grounded exclusively in approved NSSC Grade 10–12 textbooks, syllabuses, and past NIED examination papers. Following a six-phase Design Science Research methodology, the system was evaluated in a three-condition randomised controlled trial (N = 90) comprising StemMate (n = 30), an ungrounded Vanilla LLaMA 3.3 70B baseline (n = 30), and a traditional Textbook-Only control (n = 30). StemMate significantly outperformed both baselines on post-test learning gains ($F(2, 87) = 9.118$, $p < .001$, $\eta 2 = .173$), with mean scores of 70.39 versus 59.92 (Vanilla, padj < .001, d = 0.98) and 62.28 (Textbook, padj = .006, d = 0.88), and also greatly reduced out-of-context hallucinations (M = 0.17 vs M = 2.17). Error-instance analysis showed that curriculum grounding removed off-syllabus drift and citation fabrication, leaving symbolic mathematics rendering as the main technical limitation. These findings suggest that curriculum-grounded RAG can offer a scalable, low-cost way to provide more reliable STEM learning support in resource-constrained African school systems.

P_ID404

A Secure Network Architecture for IoT Devices in Smart Spaces

Elritz Kaahangoro (University of Namibia), Anton Limbo (University of Namibia)

ekaahangoro@unam.na, alimbo@unam.na

The usage of IoT devices has increased in different aspects of our daily lives. However, the security of these devices has not kept pace with their rollout, leading to various security drawbacks, such as firmware vulnerability, credential management, and weak encryption mechanisms for the data and transmission mediums used in communicating with the devices. Therefore, this paper presents a secure network architecture that ensures the safe transmission of data to and from IoT devices, while also securing the IoT device authentication by using secure authentication protocols. The focus of the secure architecture, presented in this paper, is to secure IoT devices in any smart space, as well as the accompanying data of these devices. Design Science Research Methodology (DSRM) was employed in this research to design and develop the architecture in five phases: Analysis, Design, Implementation, Testing and Deployment. DSRM provided the structured foundation for artefact development and validation, while Agile supported rapid iteration, testing, and refinement of features. This hybrid approach allowed the artefact to evolve dynamically while preserving its core objectives. The resulting architecture was then implemented using Raspberry Pis with different IoT functionality, such as automating the electrical circuits for light bulbs, fan and live video stream from a camera. The use of Secure Shell (SSH)'s Public-Key Cryptography ensured the safe transmission of data between the Raspberry Pis in the smart space, as well as with the user devices controlling the IoT devices.

P_ID405

Infobesity and Fake News Mitigation on WhatsApp and Telegram : A Retrieval-Augmented Generation Approach

Rooney Kalumba (University Don Bosco of Lubumbashi), Kahenga Ngongo (University Don Bosco of Lubumbashi), Bayongwa Bulialugo (UDBL), Jovita Mateus (Namibia University of Science and Technology, Windhoek)

22ki129@esisalama.org, fkahenga@udbl.ac.cd, jbayongwa@udbl.ac.cd*, mnyakukweni@gmail.com

Infobesity and fake news are two interconnected phenomena amplified by social media platforms, particularly WhatsApp and Telegram. This work proposes a flexible framework designed to mitigate both issues by enforcing the accuracy of responses, intelligently managing the fact-checking process and its outputs, and integrating automatic signaling to classify content. The framework also addresses the increasingly common practice of sharing images containing written comments by leveraging targeted crawling to build subject-related datasets, Optical Character Recognition (OCR) to extract information, content similarity scoring, and Retrieval-Augmented Generation. An initial testbed has been implemented in the Democratic Republic of the Congo context, processing over 13,000 articles. At this stage, French constitutes the majority of the corpus, with English and Swahili included in smaller proportions. Early results indicate that the framework has the potential to reduce both information overload and misinformation dissemination, while remaining adaptable to diverse sources and languages.

P_ID408

A Smart IoT-Based Autonomous Robotic System for Pothole Detection and Filling

Dzinaishe Mpini (Midlands State University), Maxmillan Giyane (Midlands State University), Sindiso Mpenyu Nleya (National University of Science and Technology), Amos Tendai Mushinye (Midlands State University), Kevin Moyo (Midlands State University)

mpinid@staff.msu.ac.zw, giyanem@staff.msu.ac.zw, sindiso.nleya@nust.ac.zw, R217306Z@students.msu.ac.zw, moyokevin@staff.msu.ac.zw

Road users and local authorities worldwide face frustrating and persistent problems caused by potholes. They often cause accidents, damage vehicles and drain taxpayers' funds through costly repetitive repairs. The traditional way of assigning a team to check roads for potholes physically and patch them after a report by the public has been made has proven to be slow and expensive. Technological advancement has made it possible to detect potholes through sensors and cameras, though most systems deployed cannot patch them. This project was designed to close this research gap. A robotic pothole filling prototype was designed and developed to autonomously detect and fill potholes. The prototype uses an accelerometer to sense the jolt of hitting a pothole, and a Light Detection and Ranging (LiDAR) sensor to measure the shape and its depth with precision. Upon confirming a pothole, the prototype automatically positions itself and dispenses a measured amount of cold-patch filler into the pothole cavity. No human intervention is required throughout the process. The system then sends live updates to the cloud dashboard for remote monitoring which includes the location of the patched pothole and repair logs. The system correctly identified 94% of potholes and completely patched them in approximately 16 seconds on average in controlled track tests with five standardized potholes. A separate machine learning (ML) model, trained for future visual verification achieved 95.5% accuracy on image classification but was not integrated into the live prototype due to hardware limitations. These findings demonstrate that an affordable, automated repair system is technically feasible. Nevertheless, the findings are preliminary, testing was only done with limited indoor conditions with few potholes, and the performance of the system on real roads, or with different pothole shapes, or in varying weather conditions remain unproven. The built prototype, however, gives a practical foundation for

changing the reactive way of road maintenance towards proactive and data-driven management. The move will potentially save public funds, time, and most probably lives.

P_ID410

Design of an Energy-Efficient and Reliable MAC Protocol for Distributed Asset Monitoring in Wireless Sensor Networks

Seun Khumalo (Tshwane University of Technology), Emmanuel Migabo (Tshwane University of Technology), Antonie Smith (Tshwane University of Technology), Shengezi Du (Tshwane University of Technology)

khumalo.seun@gmail.com, MigaboME@tut.ac.za, smithaj@tut.ac.za, DuS@tut.ac

This paper presents a Dynamically Adjusted Preamble MAC (DAP-MAC) protocol designed to improve energy efficiency and communication reliability for heterogeneous traffic loads in Wireless Sensor Networks (WSNs). WSN and IoT applications, such as food transportation monitoring, demand consistent accuracy and operational efficiency while facing significant energy constraints, reliability challenges, and variable network conditions. Existing contention-based asynchronous MAC protocols support low-duty-cycle operation but suffer from prolonged preamble transmissions, resulting in excessive energy consumption. The proposed DAP-MAC reduces sensor node energy consumption by enabling the sender to align its wake-up schedule with the receiver's listening slot, whereby the receiver shares its listening schedule piggybacked onto the preamble acknowledgement (PACK). The sender further mitigates oscillator drift by leveraging timing information from previous communication instances to approximate and compensate for drift relative to the receiver's clock pattern. This adaptive preamble approach reduces unnecessary preamble overhead for consecutive communications, thereby improving sensor node energy efficiency and communication reliability. Simulation results comparing DAP-MAC against XX-MAC and EX-MAC demonstrate a higher Packet Delivery Ratio (PDR), improved throughput, and lower sensor node power consumption across varying slot durations, traffic loads, and network sizes.

P_ID411

Machine Learning-Based Meteorological Drought Prediction for Namibia Small-Scale Farmers in Khomas Region

Singwell Hondonga (Namibia University of science and Technology), Munyaradzi Maravanyika (Namibia University of Science and Technology)

singwellh@gmail.com, mmaravanyika@nust.na

Abstract- Meteorological drought poses a persistent threat to small-scale rain-fed farming in the Khomas Region of Namibia, yet existing early warning systems provide only generalized assessments of current conditions with insufficient lead time for proactive farm-level planning. This paper presents a two-stage machine learning framework for multi-horizon drought prediction in the Windhoek area. Daily CHIRPS rainfall and OpenWeatherMap historical meteorological data are integrated into lagged, rolling, and cyclical calendar features capturing historical climate variability. In Stage 1, horizon-specific XGBoost and Seasonal Naïve regressors forecast rainfall, temperature, and vapour pressure deficit at 1, 3, 6 and 12- month horizons, with outputs transformed into the 90-day Standardized Precipitation Evapotranspiration Index (SPEI-90) and classified into drought severity categories. In Stage 2, Random Forest (RF), Extreme Gradient Boosting (XGBoost), Seasonal Naive (SN), and Persistent Naïve (PN) classifiers are evaluated using time-series cross-validation with the Synthetic Minority Oversampling Technique (SMOTE). RF achieved F1-scores of 0.8329, 0.7027, 0.6369 and 0.6402 across the 1, 3, 6, and 12-month horizons, respectively. These findings demonstrate that multi-horizon machine learning can provide timely and actionable drought intelligence to strengthen climate resilience among small-scale farmers in semi-arid Namibia.

P_ID412

Design and Implementation of an IoT-Based SMART Real-Time Carbon Emission Monitoring System

Smita Francis (NUST), Victoria Shafombabi (NUST), Rut Shiwambi (NUST), Shilongo Mwiwa (NUST), Dino Almirall (NUST), Gideonna Awases (NUST), Wassorson Nzangu (NUST), Sashan Pareekshit (NUST)

sfrancis@nust.na, vshafombabi@nust.na, rshiwambi@nust.na, smwiwa@nust.na, almirall.dino@mailfence.com, gideonna03@gmail.com, miangowass03@gmail.com, psachan@nust.na

Global Warming and its impact on the climate change has introduced increasingly stringent environmental policies such as the Paris Agreement and the EU's Carbon Border Adjustment Mechanism., which has led to the e urgent need for accurate, real-time, and scalable carbon emission monitoring Traditional monitoring methods, for example the Continuous Emission Monitoring Systems (CEMS), are often expensive, limited in coverage, and slow to report the changes observed which leads to , creating a critical research gap for cost-effective and intelligent alternatives. This paper presents the design, implementation, and testing of a SMART real-time carbon emission monitoring system based on Internet of Things (IoT) technologies. The system adopts a four-layer architecture comprising sensing, edge processing, communication, and cloud analytics. Low-cost non dispersive infrared (NDIR) CO_2 sensors are integrated with low-power microcontrollers (ESP32) and support hybrid wireless communication using Wi Fi and LoRa, while the ThingSpeak cloud platform provides real time data storage, visualisation, and alerting. Experimental results demonstrate that after linear regression calibration, the sensor nodes exhibit a root mean square error (RMSE) of 11.2–11.8 ppm at ambient CO_2 levels, with a coefficient of determination (R^2) of 0.996. End to end latency noted is 179 ms for LoRa and 245 ms for Wi Fi. It was also noted that LoRa reduced power consumption by 94.2% compared to Wi Fi, significantly extending battery life. The system achieves a packet delivery ratio above 96% at extended ranges and reliable cloud ingestion with less than 0.5% packet loss. The proposed solution offers a scalable, cost effective, and accurate framework for continuous carbon monitoring, supporting industrial compliance, smart city initiatives, and data driven environmental policy decisions.

P_ID413

Tamper-Evident Self-Sovereign Identity and Hash Anchoring for Local Authority Revenue Collection in Botswana

Cleverence Kombe (University of Botswana), Wilson Bakasa (University of Botswana), Moemedi Lefoane (University of Botswana)

kombec@ub.ac.bw*, bakasaw@ub.ac.bw, lefoanem@ub.ac.bw

Local authorities collect revenue through cash desks, card terminals, bank deposits, and online services, but digital payment capture alone does not prove that a payer, cashier, terminal, account, and receipt were all valid at the time of payment. This paper presents a working Botswana prototype for privacy-preserving and auditable local authority fee collection. The prototype combines Self-Sovereign Identity (SSI), Verifiable Credentials (VCs), Decentralized Identifiers (DIDs), Point of Sale (POS) payment sessions, Ed25519 signatures, nonce-bound proof presentation, Secure Hash Algorithm 256-bit (SHA-256) receipt hashing, and hash-only blockchain anchoring. The council database remains the operational source of truth, while the ledger stores only receipt identifiers, hash profiles, timestamps, and cryptographic hashes. The evaluation covers functional correctness, negative security tests, latency, throughput, concurrent sessions, and baseline comparison against database-only logging and hash-only anchoring. In 100 sequential prototype runs, mean end-to-end latency was 29.513 milliseconds (ms) and 95th percentile (p95) latency was 42.129 ms under local SQLite and JavaScript Object Notation (JSON) ledger conditions. A concurrency test from 1 to 50 simulated POS sessions completed without functional failures and reached about 20 transactions per second in this local setup. The results show that a council can add tamper-evident auditability without publishing Omang numbers, names, property details, or business data on-chain.

P_ID414

Cost-Aware WAN Modernisation: A Hybrid Phased Transition Model from MPLS to SD-WAN for South African SMMEs

Ntshuxeko Makondo (Council for Scientific and Industrial Research)

ntshuxekomakondo@gmail.com

As these enterprises increasingly adopt cloud-hosted applications, the traditional Multiprotocol Label Switching (MPLS) based Wide Area Networks (WANs) struggle to support the growing cloud-bound traffic due to inefficient backhauling, limited visibility, reduced agility, and escalating operational costs. As a result, Software-Defined Wide Area Networking (SD-WAN) has transitioned from an emerging technology to a viable solution offering application-aware routing, transport abstraction, local Internet breakout, and centralised policy management. However, a full transition to SD-WAN may pose financial and operational risks for cost-constrained SMMEs. Therefore, this paper proposes a hybrid WAN modernisation cost-aware approach that integrates MPLS Segment Routing with Traffic Engineering (MPLS-SR-TE) and Software-Defined Networking (SDN) overlays. The proposed architecture maintains high-performance MPLS forwarding planes while introducing central TE via the ODL controller. The SDN controller maximises visibility into network topology, dynamically calculates optimal routes, and enables efficient traffic distribution across the MPLS backbone without requiring a complete network replacement. The proposed model was implemented using a multi-vendor MPLS backbone emulated on the Emulated Virtual Environment-Next Generation (EVE-NG) platform, and Ubuntu hosts generate corporate traffic across the network. The experimental evaluation compares the widely adopted traditional MPLS-SR-TE architecture with the proposed architecture with an SDN controller under congestion conditions. The results show significant improvements in network performance, including a reduction in packet loss from 12.5% to 0.1%, a reduction in jitter from 18.4 ms to 1.2 ms, a reduction in latency from 48 ms to 22 ms, and an increase in TCP throughput from 10 Mbps to 15 Mbps. These results show that integrating central SDN control with MPLS-SR provides SMMEs with a cost-effective WAN modernisation path.

P_ID417

An Attention-Centric Real-Time Defect Detection and Classification Framework for High-Density PCBs Using YOLOv12

Jyoti chauhan (College of technology and engineering udaipur), Kalpana Jain (Department of Computer Science and Engineering, College of Technology and Engineering, Udaipur, Rajasthan, India)

jc190027@gmail.com, kalpana.jain@mpuat.ac.in

Automated Optical Inspection (AOI) remains an operational bottleneck in microelectronics manufacturing, where the competing demands for processing throughput and sub millimeter localization accuracy create a persistent trade-off in computational efficiency. This study addresses the challenges of surface defect detection and multi-class classification within high-density Printed Circuit Board (PCB) assemblies, focusing on a standardized six-class taxonomy: missing hole, mouse bite, open circuit, short, spur and spurious copper. While traditional deep-learning paradigms predominantly reliant on Convolutional Neural Networks (CNNs) suffer from structurally restricted local receptive fields and struggle to capture long-range topological dependencies, this study proposes a framework utilizing an attention-centric YOLOv12 architecture optimized for resource constrained edge execution. To handle the extreme aspect ratios inherent to linear cir cuit tracks, we introduce an architectural modification termed Anisotropic Trace Boundary Weighting (ATBW) directly into the bounding box regression block. Unlike its purely convolutional predecessors, the backbone leverages Area Attention (A2) and the Residual Efficient Layer Aggregation Network (R-ELAN) for multi-scale feature extraction of geometric edge deviations and connectivity failures. To evaluate the robustness of the framework, a high-resolution corpus comprising 5,000 unique base sub-blocks was established by augmenting the standard PKU-PCB benchmark with real-world fabrication line anomalies. Experimental results demonstrate that the proposed model outperforms previous

benchmarks, including YOLOv10 and YOLOv11. The framework achieved a mean average precision (mAP50) of 96.18% ± 0.21%, an mAP75 of 69.44% ± 0.31% and an F1-score of 0.95 across the six-class defect taxonomy.

P_ID418

Maximizing Accuracy in Long-Time Horizon Predictions of Variables in Complex Systems

Michael Walters (Clemson University), Ganesh Kumar Venayagamoorthy (Clemson University)

mawalte@clemson.edu, gkumar@ieee.org

Complex systems are becoming ever more prevalent in our world today, driven by increasing internet of things (IoTs), data availability, and cyber-physical computing capabilities. The modern electric power grid (EPG) is a complex system of systems. Photovoltaic (PV) systems have emerged as a critical, yet highly dynamic complex system when operating in real-time. The inherent power generation variability of PV systems introduces significant challenges for EPG stability and real-time control, motivating the development of advanced modeling approaches. In this paper, an advanced multi-stage prediction (MSP) algorithm is proposed to minimize long time horizon prediction errors with iterative short time predictions. The proposed MSP algorithm using transformers enables prediction units to be treated as building-blocks, iteratively performing and cascading predictions to realize multiple integer-scaled long prediction horizons. Additionally, through recursive assessments, the inherent accuracy of short time horizon predictions may be further enhanced with error correction capabilities. A generalized framework for the proposed MSP algorithm is presented, and implementation is demonstrated for PV system modeling through power generation predictions at multiple future time horizons. Typical results show that the proposed MSP algorithm achieves lower errors for sufficiently long-time horizons and for days with the largest PV generation variability, compared to single stage predictions.

P_ID424

Enhancing Data Integrity in Healthcare Applications Using Multi-Factor Authentication

Vasantha Kohila K R (Bharath Institute of Higher Education and Research), Baskar P (Bharath Institute of Higher Education and Research), K Periyarselvam (GRT Institute of Engineering and Technology), R Santhanakrishnan (Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology), S Murugan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences), Naveen Kumar S (St. Joseph's College of Engineering)

vasanthacommunity@gmail.com, bassbabupa@gmail.com, periyarselvam.k@grt.edu.in, santhanamkrishnar@gmail.com, smuresjur@gmail.com, msdnaveen4s@gmail.com

The rapid adoption of digital technologies in healthcare applications has significantly improved the management and accessibility of patient information. It however also presents serious security issues especially in ensuring the data integrity as well as preventing unauthorized access. The given research is dedicated to the improvement of the data integrity within the healthcare systems with the help of multi-factor authentication (MFA) and the complex use of the cybersecurity methods. Data integrity is the ability to keep patient records accurate, consistent and undamaged during storage and transmission that is vital to making effective clinical decisions. The proposed solution will involve both strong authentication methods, such as passwords, one-time passwords (OTP) and biometric verification, to limit the unauthorized access to sensitive data. Moreover, cryptographic hash and digital signatures are integrity checking algorithms used to ensure that no unauthorized changes are made. Role-based access control and audit logging is also part of the system to keep a record of user activities and hold user accountable. With the combination of MFA and data integrity methods, the proposed model greatly facilitates the decrease of the risk of data leakage, data integrity, and identity-defined attacks in healthcare settings. Such practice does not just bolster security but also aids in the process of

building trust, reliability and adherence to healthcare data protection standards. The results provide a guiding insight on the need to apply multi-layered security measures to help protect vital patient data in the contemporary healthcare application.

P_ID497

Autonomous Agri-IoT: An IoT based Next-Generation Intelligent Farming Ecosystem

Sunita Yadav (MJP Rohilkhand University Bareilly), Vinay Rishiwal (MJP Rohilkhand University Bareilly), Udit Agarwal (RBMI Group of Institutions Bareilly), Mano Yadav (Bareilly College Bareilly), Dharm Singh Jat (Namibia University of Science and Technology), Edward Nepolo (namibia University of Science and Technology)

sunitayadav@mjpru.ac.in, vrishiwal@mjpru.ac.in, udit078@gmail.com, Mano425@gmail.com, dsingh@nust.na, enepolo@nust.na

Precision agriculture increasingly requires intelligent, privacy-aware, low-latency and self-adaptive systems that can transform heterogeneous farm data into timely management actions. This paper presents Autonomous Agri-IoT, a next-generation intelligent farming ecosystem that integrates field sensing, edge intelligence, federated learning-aware decision support, and autonomous actuation to enable smart irrigation and farm-response optimisation. The framework is designed to support multiple agricultural scenarios, including irrigation monitoring, drought detection, flood control, greenhouse automation, pest and disease detection, and precision fertilization. The performance results show that the proposed framework improves prediction accuracy to 91-95%, compared with 79-87\% in traditional Agri-IoT systems, as the number of IoT nodes increases from 50 to 250. It also reduces network overhead from 22-78% to 12-38%, improves scalability from 63-82% to 86-94%, and lowers response time from 28-81 ms to 14-34 ms. These results indicate that the proposed framework provides a more scalable and efficient solution than traditional IoT systems for intelligent agricultural monitoring and resource optimization.

P_ID498

Layer-Oriented Analysis of Security Challenges in IoT

Gaurav Vats (amity), Sarvesh Tanwar (Amity Institute of Information Technology, Amity University Noida, India), pankaj Sharma (ABESEC,Gzb)

gaurav.vats@gmail.com, s.tanwar1521@gmail.com, pankaj.sharma@abes.ac.in

The Internet of Things has expanded quickly in recent years but security problems remain a major concern. Several major large-scale attacks have been reported during the last few years. It shows that IoT still remains vulnerable to cyber threats. These incidents indicate that strong security mechanisms or frameworks are still needed. This paper explains the major details of IoT security challenges from each layer of the system. It also studied latest attack trends and research findings to identify common threats. Some of them are Man-In-The-Middle attacks or Botnet based attacks. The paper also explains why IoT devices are regularly targeted. This includes weak authentication methods, outdated firmware and limited built-in security protections. The findings of this study can support researchers, industry experts in understanding IoT security risks. This may help in developing safe and more secure IoT environments.

P_ID499

Intelligent Fermentation Process Control Using Cloud–Edge Architecture with Digital Twin–Driven Deep Reinforcement Learning

Kamal Hiran (Sir Padampat Singhania University), Darshana Soni (Sir Padampat Singhania University), Manish Mittal (Brainware University), Suhani Agrawal (Sir Padampat Singhania University), Ruchi Doshi (Universidad Azteca), Rohit Mittal (Manipal University Jaipur)

Kamal.hiran@spsu.ac.in, darshana.soni@spsu.ac.in, manish77mittal@yahoo.co.in, suhani.agrawal@spsu.ac.in, ruchi.doshi@univ-azteca.edu.mx, rohit.mittal@jaipur.manipal.edu

Fermentation processes must be advanced as it is critical to the growth of biotechnology, pharmaceuticals, and biofuel industries, though the dynamic, nonlinear, and stochastic nature of biological systems makes the application of traditional control approaches difficult. In this work, we present a new approach based on cloud-edge computing, in conjunction with hybrid machine learning and advanced deep reinforcement learning, including a shock-resistant Proximal Policy Optimization agent, to optimize fermentation sustainably and in real time. By leveraging distributed Internet of Things and sensor networks, we will collect high-frequency monitoring data from fermentation bioreactors via continuous measurements of pH, temperature, dissolved oxygen, and substrate concentration. With the high-fidelity digital twin, we will be able to train agents in controlled virtual environments, which can then be deployed in real time for DRL optimization using multi-objective reward functions to maximize ethanol yield, minimize energy consumption, reduce carbon emissions, and minimize production time. The cloud-edge architecture will deploy lightweight model agents to users globally that can quickly adapt to local production conditions. At the same time, the cloud will aggregate user datasets to optimize policy across cloud-edges and continuously refine it. The work done that involved testing with industrial datasets and simulation demonstrated that this type of integrated approach had better performance than existing PID and static methods, leading to approximately 12 - 15% more ethanol produced, 30% reduction in environmental footprint improvements, with better uptime on equipment, and improved control performance with action accuracy of more than 85%. This type of integrated framework is a step towards smart, autonomous biomanufacturing in the Industry 4.0 era.

P_ID500

A Hybrid Deep Learning Framework for Autism Spectrum Disorder Detection Using Eye-Tracking

Pooja Polshetwar (Shah & Anchor Kutchhi Engineering College), Pooja Polshetwar (Somaiya University Vidyavihar), Neetin Desai (Somaiya Vidyavihar University), Sudha Gupta (Somaiya Vidyavihar University)

pooja.duddalwar@sakec.ac.in, pooja.polshetwar@somaiya.edu, neetin@somaiya.edu, sudhagupta@somaiya.edu

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that impacts social interaction, communication, and behavioral patterns. Early diagnosis of ASD remains challenging due to the large dependency on traditional, time-consuming clinical assessments and the limited resources of specialized clinicians. Recent advancements in artificial intelligence (AI) and eye-tracking methodology have shown promising capabilities to support ASD screening. This research proposes a hybrid deep learning strategy for ASD detection using eye-tracking scanpath images and participant-level metadata. The dataset is publicly available on Figshare eye-tracking dataset repository containing 547 images, including 219 images from ASD participants and 328 images from typically developing (TD) participants, which was referred to in this work. The eye-tracking images were processed using a ResNet50-based deep learning architecture for visual feature extraction, while demographic features from metadata were integrated through feature level fusion. To ensure reliable evaluation and prevent subject-level data leakage, group-based train-test splitting was employed using participant identifiers. Experimental results show that the deep learning model achieved 70.91% accuracy, whereas the

proposed hybrid framework improved classification accuracy to 81.15%, which interprets the effectiveness of multimodal fusion. Confusion matrix and ROC curve analyses further validate the discriminative capability of the proposed approach. The findings suggest hybrid methos is efficient in ASD screening and may support AI-assisted diagnostic systems for early intervention.

P_ID506

HyCoSNet: A Clinical-Guided Asymmetric Network for Preoperative Glioma Survival Prediction

Yu Qiao (Taylor's University, Malaysia), Sayan Kumar Ray (Taylor's University, Malaysia), Md Akbar Hassain (Auckland University of Technology), NZ Jhanjhi (Sunway University)

0369944@sd.taylors.edu.my, sayan.ray@taylors.edu.my, ahossain@eit.ac.nz, zamanj@sunway.edu.my

The marked heterogeneity of glioma prognosis continues to hinder precision oncology, underscoring the need for reliable preoperative risk stratification to inform clinical decision-making. Current deep learning (DL) models frequently adopt symmetric architectures or simplistic multimodal fusion schemes. They overlooked the fundamentally different radiological roles of MRI sequences and underutilized the guiding value of clinical priors during feature extraction. To overcome these limitations, we introduce HyCoSNet, a clinical-guided asymmetric hybrid DL model. Motivated by the observation that T1-weighted contrast-enhanced (T1c) scans emphasize focal tumor cores whereas FLAIR sequences capture the broader peritumoral environment, we design a dual-stream asymmetric backbone: a convolutional neural network branch specialized for fine-grained local textures in T1c, and a Swin-Transformer branch tailored for long-range contextual modeling in FLAIR. To move beyond static fusion, HyCoSNet integrates a Bi-Directional Cross-Attention module that enables adaptive, modality-aware information exchange. To bridge imaging and tabular domains, we further develop a Clinical-Aware Spatial Gating module and a Feature-wise Linear Modulation (FiLM) block. It leverages patient-specific attributes (e.g., age, molecular markers) to reweight spatial attention patterns and modulate feature channels, thereby embedding clinical priors directly into the visual encoding process. Evaluated on the UCSF-PDGM and UPenn-GBM dataset, HyCoSNet attains an AUC of 0.7829 for binary overall-survival prediction and consistently outperforms state-of-the-art multimodal baselines. By jointly harnessing local–global radiological cues and clinically informed modulation, HyCoSNet establishes a robust paradigm for trustworthy preoperative survival analysis.

P_ID507

Environmental Trigger Discovery for Extreme Acute Myocardial Infarction Risk: An Adaptive Temporal Pattern Mining Framework

Dandan Zhou (Taylor's University), Sayan Kumar Ray (Taylor's University), Daotong Guo (Affiliated Hospital of Jining Medical University), Garry Singh (Manukau Institute of Technology Auckland, New Zealand), NZ Jhanjhi (Sunway University)

0371557@sd.taylors.edu.my, sayan.ray@taylors.edu.my, 294398021@qq.com, Garry.Singh@manukau.ac.nz, zamanj@sunway.edu.my

Acute myocardial infarction (AMI) remains a leading cause of cardiovascular mortality worldwide, and environmental factors such as meteorological indicators and air pollutants are recognized as important triggers of AMI events, which, if identified early, could support timely warnings, proactive medical resource allocation, and reduced mortality. However, existing studies mainly focus on single-factor linear associations, such as temperature extremes or PM2.5 exposure, while overlooking the complex interactions among multiple environmental risk factors, and their findings often vary substantially across regions, limiting the development of systematic frameworks for translating surveillance data into

region-specific early warning criteria. To address these limitations, we developed an Adaptive Temporal Pattern Mining (ATPM) framework that processes multi-source data through five sequential stages with population-specific discretization and yearly-specific stratification to accommodate regional and temporal variations. Validated on 6,857 AMI admissions and five years of environmental data from a regional medical center in temperate China, comparative Apriori analysis identified 30 exclusive trigger patterns (mean confidence: 71.9%) explaining 53% of extreme high-risk episodes. The strongest trigger combined winter cold stress (temperature < 10.8◦C) with multi-pollutant synergy ($NO_2 \geq 33.4$ μg/m3, $PM_{10} \geq 95.4$ μg/m3, $O_3 < 55.7$ μg/m3), achieving 95.1% confidence. K-means clustering independently validated two of three atmospheric profiles: winter stagnation (20%) and multi-pollutant synergy (18%), confirming these as genuine atmospheric syndromes triggering extreme AMI risk. The ATPM framework provides directly implementable early warning criteria and an adaptable methodological paradigm for environmental health informatics.

P_ID508

Gated Unpaired Multimodal Fusion for Cervical Cancer Detection using Colposcopy Images and Risk Factors

Nasrin Sultana (Taylors University), Sayan Kumar Ray (Taylors University), Tehmina Karamat Ullah Khan (Taylors University), NZ Jhanjhi (Sunway University)

nasrin_cse@cu.ac.bd, sayan.Ray@taylors.edu.my, tehmina.Khan@taylors.edu.my, zamanj@sunway.edu.my

Cervical cancer is still a critical public health issue, and detection at an early-stage is essential for improving survival outcomes. Multimodal approaches that integrated patient clinical data with cervical images have the potential to enhance early-stage detection. However, existing multimodal methods typically rely on paired data, which is often not available in clinical settings. In practice, these data are frequently recorded separately, incompletely, or at different time points, limiting the applicability of conventional fusion methods. To address this problem, a gated unpaired multimodal fusion model is proposed that integrates colposcopy images with unpaired risk factor data without requiring patient-level pairing between the two modalities. Both modalities are first processed by separate modality-specific encoders, after which the generated features are mapped into a shared representation space through a learnable projection layer. This space is subsequently aligned using class-conditional prototype learning. The aligned representations are then fused through a learnable gating mechanism that adaptively controls the contribution of risk-factor information during prediction. On a cervical cancer unpaired dataset, the model achieves an accuracy of 78.75%, a sensitivity of 78.72%, a specificity of 78.79%, a precision of 84.09%, an F1-score of 81.32%, and an AUC-ROC of 88.07%. Contrasted to an image-only baseline, these results represent improvements of 5.0%, 2.7%, 8.3%, 5.1%, 3.9%, and 2.8% across all metrics, respectively. These results show that unpaired risk factor data can significantly improve the detection of cervical cancer. Also provide a useful and scalable framework for multimodal learning in real-world clinical data settings.

P_ID510

Smart Farming and Precision Agriculture Transforming Agriculture through Technology: LoRaWAN Based IoT Device for Monitoring and Control Solutions

Sanjeetha Gowthaman (Madras Institute of Technology), Bhuvaneswari P T V (Madras Institute of Technology), Parameswaran Ramesh (Madras Institute of Technology), Bino J (St. Joseph's Institute of Technology), Anis Begum S (Madras Institute of Technology), Shabana Parveen M (Sri Sai Ram Engineering College)

gsanjeetha@gmail.com, ptvbmit@annauniv.edu, parameswaran0789@gmail.com, stephenbino@gmail.com, anis.mit2019@gmail.com, shabanaafsar08@gmail.com

Precision agriculture, also known as smart farming, uses drones, artificial intelligence (AI), and the Internet of Things (IoT) to revolutionize conventional farming. This study investigates how improved monitoring and control solutions provided by IoT devices and LoRaWAN networks transform agriculture. Even remote farms benefit from IoT's ability to enhance resource management for particular crops by giving farmers access to real-time data. LoRaWAN's low-power, long-range connectivity guarantees dependable data analysis and communication. An intelligent LoRaWAN-based Internet of Things monitoring device is discussed in the study. concentrating on performance assessment, Isolation Forest anomaly detection, and linear regression and random forest algorithm-based temperature prediction modeling ultimately improving smart farming's sustainability, production, and efficiency.

P_ID513

Ethical and Intelligent Procurement: How AI Reduces Risk, Bias, and Inefficiency in Global Supply Networks

Srinivasan Narayanan (Independent Researcher)

seeniscm@gmail.com

Global supply networks have become increasingly complex due to the involvement of multiple suppliers, geographic regions, and diverse regulatory requirements. Traditional procurement systems often struggle to manage this complexity effectively, resulting in inefficiencies, delays, and biased decision-making. Achieving risk-conscious, efficient and fair procurement has thus become a burning issue for organisations that are functioning at the global scale. To overcome these problems, this paper suggests the intelligent and ethical procurement system based on AI. The proposed framework is a combination of predictive analytics, automated decision support, and bias detection systems to enhance the process of supplier selection and overall procurement. The proposed approach not only enhances operational efficiency but also ensures that procurement decisions align with ethical standards and best practices. Experimental results and case studies demonstrate that the AI-based system significantly outperforms traditional methods, the proposed model achieves an overall classification accuracy of approximately 96%, demonstrating strong performance in supplier selection. In addition, the system contributes to a significant reduction in transactional errors and exhibits high reliability in identifying and classifying supply chain risks, thereby enhancing decision-making efficiency and robustness. Overall, the study underscores the critical role of AI in enabling ethical, intelligent, and highly efficient procurement systems for modern organisations.

P_ID515

Antenna Design for Regional National Satellite System :A Review Report in Indian Perspective

Navneet Agrawal (CTAE, MPUAT,Udaipur), Anshu Gaur (CTAE, MPUAT,Udaipur), Dharm Singh Jat (Namibia Univ. of Sc. & Technology), Himangi Agrawal (Nirma Institute of Technology, Nirma University), Suriti Gupta (CTAE, MPUAT)

navneet.agrawal@mpuat.ac.in, anshugaur01@gmail.com, dsingh@nust.na, himangi2807@gmail.com, suriti82@yahoo.co.in

Today's era is driven by satellite navigation systems, and every nation requires its own reliable positioning and secure navigation services. The invention of the Global Positioning System (GPS) has ushered in a new technological era. Owing to its large population and growing technological demands, India requires an indigenous navigation system. Extensive research is being carried out on NavIC, the Indian Regional Navigation Satellite System (IRNSS), operating in the L-band (1176.45 MHz) and S-band (2492.08 MHz) . This paper summarizes various antenna designs meant for RNNS based on key antenna characteristics like patch dimensions, polarization techniques, and fractal features. Furthermore, the authors

have provided technical insights for the development of a compact and efficient dual band circularly polarized NavIC antenna system for both the L-band and S-band frequencies.

P_ID516

Computational Formulation of Explainable Genomic AI for Breast Cancer Risk Prediction

Dilip Sisodia (Bhagwant University, Ajmer)

sisodia.dilip@gmail.com

Early and accurate strategies for breast cancer risk predictions are essential since breast cancer is one of the major causes of cancer related death in women across the globe. In recent years, sequencing technology of the next generation (NGS) has generated large amounts of genomic data that is easily processed. Despite the success of machine learning and deep learning methods in predicting cancer genomes, there are a lot of systems that are black-box, less interpretable and do not have good integration for analyzing genomic variants. A computational formulation of an Explainable Genomic Artificial Intelligence (XGAI) framework for prediction of breast cancer risk based on the features extracted from genomic variants is presented in this paper. The proposed architecture will be made up of genomic variant processing, computational feature engineering, machine learning, deep learning, XAI and clinical risk interpretation. Structured representations of genomic variants through sequence driven annotations and AI-compatible representations of genomic variants through variant impact score and pathogenicity score, mutation burden and gene-level variant frequency modeling. The models are made interpretable and computationally transparent by using mathematical representations for risk scoring, logistic prediction, convolutional learning, transformer attention mechanisms, and SHAP (explainability). The framework enables identification of variants of the genome with a biological meaning that drive breast cancer risk, and offers a clear framework for precision oncology applications in decision support. The proposed work will not be aimed at developing new mathematical models, but will provide a single computational formulation that will combine both genomic intelligence and explainable artificial intelligence and predictive analytics in a single architecture.

P_ID520

Multilevel Routing for Data Transmission in IoT-Based Supply Chain Networks

Theophilius Alpha Yambasu (Rayat Bahra University), Kavita Kavita (Rayat Bahra University), Sukhjinder Kaur (Rayat Bahra University), Goldi Makhija (Rayat Bahra University), Muhammad Ikhsan ThohirMuhammad Ikhsan Thohir (Nusa Putra University)

theophiliusyambasu@gmail.com, kavita@ieee.org, skaur29100@gmail.com, goldim1309@gmail.com, ikhsan.thohir@nusaputra.ac.id

IOT is a distributed network which has the privileges of connecting and disconnecting the sensor nodes. ETL at node level is minimal as well as are located in long ranges. Thus, the energy consumption (EC) problem arose in IoT. And furthermore, this in-memory analytics at the IoT sink must do it locally and also able to send the data to these remote locations. Recent work: In recent work, the design saves the network life using energy efficient protocols (EEP) namely as VGDRA Virtual group dynamic Readdressing. In this protocol, the sink node periodically moves close to the CHs to gather these data. From this basic idea, the expected paper at present work is a modify VGDRA protocol which generated from cache nodes and use of CH (cluster head) to carried information from the source towards to cache nodes. Finally with the sink nearby at the cache node can now collect data. The simulation is done using MATLAB for the proposed protocol. The comparison then goes on other parameters such as Number of Dead nodes, No. Of Live nodes and then No of packets send to sink.

P_ID521

Prompt injection in "Agentic" Enterprise Workflow: Defending Against Dialogue Injection via Instruction-Data Isolation

Allu Sudarshana Murthy (Lovely Professional University), Amandeep Singh (Lovely Professional University), Gurbinder Singh Brar (Lovely Professional University), Zahrah A. Almusaylim (King Abdulaziz City for Science and Technology (KACST))

udarshanamurthyallu@gmail.com, Dr.amanrajput1@gmail.com, maatibrar@gmail.com, zalmusaylim@kacst.gov.sa

The rapid integration of Large Language Models (LLMs) into enterprise infrastructure has precipitated a paradigm shift from passive conversational interfaces to autonomous, stateful agentic workflows. These agents possess the programmatic capability to orchestrate high-privilege operations via enterprise Application Programming Interfaces (APIs) and databases. However, this autonomy introduces a critical cybersecurity vulnerability: indirect prompt injection via context contamination. When agents ingest untrusted external data---such as third-party documents, emails, or web scraping results adversarial payloads can structurally hijack the agent's execution trajectory. Building upon recent analyses of the Dialogue Injection Attack (DIA) paradigm, this paper investigates the severe implications of structural context manipulation within multi-turn agentic execution loops. We mathematically demonstrate that adversaries can bypass standard input-only guardrails by embedding fabricated chat templates into enterprise data, effectively manipulating the agent's internal memory state and precipitating a modern iteration of the ``confused deputy'' problem. To mitigate this critical vulnerability, we propose an Instruction-Data Isolation (IDI) framework. This zero-trust middleware architecture utilizes a state-graph execution environment and an isolated ``Shadow Guard LLM'' to intercept, parse, and verify the functional intent of proposed tool calls against an immutable security policy prior to API invocation. Extensive empirical evaluations indicate that the proposed IDI layer reduces the Attack Success Rate (ASR) of structural dialogue injections by 99.5%, while maintaining computational latency overheads acceptable for real-time enterprise deployment.

P_ID522

Symptom-Based Disease Prediction System Using Machine Learning with Integrated Health Guidance

Gurbinder Singh Brar (Lovely Professional University), Gnanesh Banka (Lovely Professional University), Harsh Kumar (Lovely Professional University), Vindhyasri Gurrapu (Lovely Professional University)

maatibrar@gmail.com, Gnaneshbanka2005@gmail.com, Harshpth193@gmail.com, vindhyasrigurapu@gmail.com

Delayed and inaccurate disease identification continues to impose significant burdens on healthcare systems worldwide, particularly in regions where specialist access is constrained and early intervention is most consequential. Patients who attempt self-diagnosis through unreliable channels face compounding risks: late-stage presentations, inappropriate self-medication, and missed opportunities for preventive care. This paper presents a Symptom-Based Disease Prediction System—a machine learning pipeline that accepts patient-reported symptoms as input and delivers probable disease diagnoses together with comprehensive, structured health guidance. The guidance spans five domains: clinical disease descriptions, specific precautionary measures, recommended medications, dietary plans, and appropriate physical activity regimens. The core predictive engine employs a Support Vector Classifier (SVC) with a Radial Basis Function kernel, trained on a curated healthcare dataset comprising 4,920 records spanning 41 disease categories and 132 binary symptom features. The SVC is evaluated against four established baseline algorithms—Random Forest, K-Nearest Neighbors, Decision Tree, and Naive Bayes—under identical experimental conditions. The proposed SVC achieves 97.8% classification accuracy with a macro-averaged F1-score of 97.3%, demonstrating statistically consistent superiority over all baselines. Five-fold cross-validation confirms a mean accuracy of 97.4% with low variance, ruling out overfitting. A post-prediction recommendation engine retrieves domain-specific guidance from five curated auxiliary datasets through

indexed key-value lookups, completing the full pipeline within 0.38 seconds on average. Expert evaluation of recommendation quality returned mean scores exceeding 4.2 out of 5 across all guidance categories.

P_ID524

Optimal Task Scheduling using Cuckoo Search and Neural Network from Cloud Data Centres

Kamalpreet Kaur (Lovely Professional University), Sahul Goyal (Lovely Professional University), Rachit Garg (Lovely Professional University), Gurbinder Singh Brar (Lovely Professional University)

kamalpreet.cse98@gmail.com, er.sahul.goyal@gmail.com, rachit.garg.in9@gmail.com, maatibrar@gmail.com

The various technologies in cloud computing, including ultra-modern networking, virtualisation, integration, transport, load balancing, and other elements, are the most attractive and require special attention. The utmost significant goal is to sustain the quality of service (QoS) while scheduling tasks and sharing packages to bound execution time. In this paper, the authors apply Cuckoo Search (CS) optimisation to improve community search and task scheduling in a cloud computing environment. This iterative search provides a green campaign plan combined with neural graphs for vacation planning. All performance, provider-level violations, and customer power consumption are evaluated using a critical test and are limited to a maximum of 1,000 Tasks, 100 applicants. The performance of the simple programmer optimised for CS was determined in terms of efficiency.

P_ID527

Hidden Assumptions in IoT Anomaly Detection: A Critical Review of Machine and Deep Learning Approaches

Sofia Sofia (Engineering, Lovely professional University), Arun Malik (Engineering, Lovely professional University), Isha Batra (Engineering, Lovely professional University), Zahrah A. Almusaylim (King Abdulaziz City for Science and Technology (KACST))

sofia.singla97@gmail.com, arunmalikhisar@gmail.com, isha.batra2487@gmail.com, zalmusaylim@kacst.gov.sa

The emergence of IoT technologies has completely improved the requirement of smart anomaly detection frameworks for the protection of entire environment from abnormal activities and other cyber threats. Existing studies have utilized deep learning and machine learning approaches for the improvement in detection accuracy. On the one hand, frameworks are achieving best performance with the help of benchmark structured datasets whereas on the other hand they are completely relied on high computational availability, stable network conditions, balanced learning environment and clean datasets. Due to these issues, this study presents a clear and critical review of multiple existing and recent anomaly detection frameworks evaluating the performance based on hidden assumptions. Further, a comparative analysis has conducted on existing frameworks by using structured assumption-based analysis, assessment with the help of Assumption Severity Score. Moreover, accuracy versus ASS relationships, year-wise hidden assumption trends and assumption contribution analysis have conducted to discuss the dependency under controlled experimental conditions. These findings have revealed that the research gaps, and future requirements while deployment of IoT network for anomaly detection.

P_ID528

A Comprehensive Study of Glycemic Event Prediction Models: Trends, Challenges, and Opportunities for IoT Integration

Ruhi Saxena (ruhi.saxena2011@gmail.com), Arun Malik (Lovely Professional University, Phagwara, Punjab, India Lovely Professional University, Phagwara, Punjab, India), Isha Batra (Lovely Professional University), Zahrah A. Almusaylim (King Abdulaziz City for Science and Technology (KACST))

ruhi.saxena2011@gmail.com, arunmalikhisar@gmail.com, isha.batra2487@gmail.com, zalmusaylim@kacst.gov.sa

In the rapidly evolving landscape of diabetes management, glycemic event prediction has emerged as a transformative approach that shifts care from reactive to proactive strategies. This comprehensive review examines the current state of glycemic prediction models, their methodological foundations, performance benchmarks, and integration with Internet of Things (IoT) technologies. IoT integration enables comprehensive monitoring ecosystems that combine continuous glucose data with contextual information from wearable devices, creating unprecedented opportunities for personalized diabetes management. Despite significant advances, challenges persist in model generalizability, edge computing implementation, clinical validation, and security frameworks. This review provides a roadmap for researchers, engineers, and healthcare professionals working at the intersection of artificial intelligence, IoT, and diabetes care.

P_ID529

HOG–ELA Fusion Framework for Cyber Threat Detection in Digital Image Forensics

Kamalpreet Kaur (Lovely Professional University Phagwara, India), Rachit Garg (Lovely Professional University Phagwara, India), Gurbinder Singh Brar (Lovely Professional University Phagwara, India), Zahrah A. Almusaylim (King Abdulaziz City for Science and Technology (KACST))

kamalpreet.cse98@gmail.com, rachit.garg.in9@gmail.com, maatibrar@gmail.com, zalmusaylim@kacst.gov.sa

This paper explores a traditional computer vision method for spotting image tampering, with a focus on identifying copy-move and splicing forgeries. It uses handcrafted features combined with standard machine learning techniques to get the job done. In contrast to data-intensive deep learning techniques that often require substantial computational power and vast annotated datasets, the approach here emphasises lightweight, interpretable modelling suited for constrained environments. This study emphasises efficiency, interpretability, and adaptability for real-time and resource-constrained forensic applications. The proposed system performs preprocessing steps such as resizing and grayscale conversion, followed by dual-feature extraction using Histogram of Oriented Gradients (HOG) and Error Level Analysis (ELA). HOG captures edge and structural variations, while ELA reveals compression inconsistencies introduced during tampering. These feature vectors are concatenated to form a comprehensive representation of each image. The classification stage utilizes a Random Forest algorithm, tuned using a parameter grid search, and supported by preprocessing stages such as feature normalization and dimensionality reduction via PCA. The model is developed using the CG-1050 forensic image set, which categorizes samples into authentic and manipulated classes. We evaluated the system's performance using several key metrics, including ROC-AUC, precision, and F1-score, to provide a well-rounded view of its tampering detection performance. The results demonstrate that the system achieves high tampering detection accuracy with low inference time and strong generalization capability. This lightweight, interpretable forensic pipeline offers a practical, scalable solution for combating image-based cyber threats, with potential applications in social media validation, digital evidence verification, and misinformation mitigation.

P_ID543

Design Principles for AI-Driven KPI for Work-Integrated Safety Training in Immersive Learning Environments: An Action Design Research Project

Jesse Katende (University West), Amir Haj-Bolouri (University West), James Katende (Namibia University of Science and Technology)

jesse-oluwafemi.katende@hv.se*, amir.haj-bolouri@hv.se, jkatende@nust.na

Immersive learning environments (ILEs) are increasingly utilized for authentic, work-integrated safety training. At the same time, artificial intelligence (AI) is gaining recognition for improving assessment through key performance indicator (KPI) systems. However, the responsible design of AI-driven KPI systems in these immersive, safety-critical learning environments remains underexplored. This is particularly important when performance measurement needs to be fair, transparent, context-sensitive, and educationally meaningful. This study addresses that gap through an Action Design Research study grounded in fire safety training data from SJ's immersive virtual reality programme in Sweden. Drawing on interviews, surveys, and observations, the study develops six design principles for the responsible future design of Artificial Intelligence-driven Key Performance Indicator systems in work-integrated safety training: situational alignment, fairness, transparency, privacy, human oversight, and continuous improvement. The paper aims to translate existing high-level responsible AI concerns into context-sensitive design principles for immersive, safety-critical, work-integrated training rather than proposing new responsible AI values. In doing so, the study shifts attention from Artificial Intelligence as a tool for performance monitoring to Artificial Intelligence- supported Key Performance Indicator design as a socio- technical design problem. The findings provide a grounded basis for future Artificial Intelligence-enabled immersive training systems and offer practical guidance for adaptation in African higher education institutions and other resource-constrained, practice-oriented learning contexts.

P_ID545

AI-Based Leadership Transforming Managerial Decision Making and Market Innovation in the Digital Age

Saranya J (Guru Nanak College (Autonomous)), S Athilinga Senjith (Guru Nanak College (Autonomous)), Anugragha S S (Crescent School of Business), I Shanmugapriya (Rajalakshmi School of Business), M Kotteeswaran (Vels Institute of Science, Technology and Advanced Studies (VISTAS)), D Leelavathi (Guru Nanak College (Autonomous))

saranyagnc02@gmail.com, senjith.s@gurunanakcollege.edu.in, anugraghaphd@gmail.com, shanmugapriyamba09@gmail.com, saikottee@gmail.com, deenadayaluchetti@gmail.com

Artificial Intelligence (AI) has reshaped the way management decisions are made, and innovations evolve in the digital business landscape. The impact of AI-based leadership systems on organizational performance, efficiency and innovation capacity is explored in this research. The recommended framework integrates machine learning, predictive analytics, NLP, and automation capabilities to support strategic management capabilities and boost intelligent company operations. In departments that incorporated technology, quantitative study revealed an accuracy increase of 89% in their decisions using AI, alongside a 85% increase in operational efficiency and 92% in staff engagement. The study found that company investments in AI are on the rise, growing from USD 20 million in 2020 to USD 79 million in 2025, a stark example of digital transformation in various industries. Furthermore, these AI-powered approaches to innovation and automated business processes demonstrated significant consumer engagement and business response. The findings suggest that AI-enhanced leadership plays a vital role in enhancing productivity, enabling data-driven decision-making, and strengthening competitive advantage in today's workforce. However, there are still challenges in the field of implementation costs, data privacy, and competencies. In the digital age, AI technologies offer scalable opportunities for organizational growth and business innovation.

P_ID546

Automated Breast Cancer Classification from Mammography Images Using CNN Model

K Sudha (Velammal Institute of Technology), Bhuvaneswari G (Saveetha Engineering College)

ksudha161276@gmail.com, bhuvankerani@gmail.com

Breast cancer is one of the leading causes of death among women worldwide and early detection is vital to improving survival rates. Breast cancer screening using mammography is widely adopted, however, the interpretation of mammography images by the human eye can be time-consuming and prone to errors. In this paper, an automated breast cancer classification approach is presented, which employs Convolutional Neural Network (CNN) model to overcome these limitations. The proposed framework classifies mammography image as normal, benign and malignant. The image is prepared and augmented using image preparation and augmentation methods to enhance the quality of the image and increase the generalisation of the model. Unlike the previous human feature engineering, CNN can automatically discover important tumor-related features. A set of 6000 mammography images with 2000 images in each class is divided into training, validation and test sets of 70:15:15 proportions. The experimental evaluation shows that the proposed CNN model achieved an accuracy of 99.78%, precision, recall and an F1 score of 99.67%. The analysis of the confusion matrix showed that there was very little misclassification, and perfect identification of the malignant cases. In the recommended method, radiologists can use mammography image processing to precisely and efficiently detect breast cancer.

P_ID547

Lightweight Blockchain-Based Security Architecture for 6G Edge–Cloud Computing

G Dhanalakshmi (Panimalar Engineering College), K Ramkumar (Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology)

gdhanalakshmipecit@gmail.com, ramkumar1975@gmail.com

Rapid advancements in 6G edge-cloud computing have led to several cybersecurity challenges due to the massive number of devices, distributed data processing, and the need for ultra-low latency. This study proposes a lightweight blockchain-enabled security architecture to ensure secure, reliable, and scalable communication in the distributed 6G edge-cloud networks. Specifically, the proposed framework combines the use of lightweight blockchain technologies, smart contract-based access controls, consensus-based transactions, distributed ledgers, and intelligent threat detection approaches. The performance evaluation of the proposed lightweight cybersecurity solution involved the use of Kaggle 6G-AI-EdSecure Network Traffic Dataset. The dataset included 10,000 labelled network traffic records, where both normal and malicious activities were included. Malicious activities comprised DDoS attacks, malware attacks, IP spoofing, phishing, port scanning, and data leakages. Consequently, the proposed lightweight cybersecurity solution attained a remarkable performance with 98.2% accuracy, 98.7% intrusion detection rate, 98.3% accuracy in transaction validation, 98.5% accuracy in threat detection, and a 98.9% rate of attack mitigation, while the average end-to-end delay is minimum at 143 ms and the average false positive ratio is low at 1.7%. Overall, this study is novel in the use of blockchain cybersecurity, smart contracts, and edge-cloud intelligent computing.

P_ID548

Efficient Secure Data Transmission in Wireless Sensor Networks Using ChaCha20 Encryption

R Aiyshwariya Devi (R.M.K. College of Engineering and Technology), K Ramkumar (Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology)

aiyshwariyadevi@gmail.com, ramkumar1975@gmail.com

Wireless Sensor Networks (WSN) demand efficient and secure means of data communication due to their nature being resource-limited as well as vulnerable to possible cyberattacks. In this study, there is an introduction of efficient data transmission framework based on the lightweight ChaCha20 encryption algorithm to improve security, integrity, and data transmission reliability in the WSN environment. The primary aim of the proposed architecture is to provide highly reliable and energy-efficient secure communication systems. The methodological steps of the framework include data acquisition and processing, encryption by the ChaCha20 algorithm, creation of the packet, routing of multiple hops, validation of packets, and finally decryption by the base station. The evaluation of performance was done using simulated Wireless Sensor Network data set which included packet delivery ratio, encryption time, throughput, energy utilization, and delay parameters. It has been found that the developed framework achieved an average packet delivery ratio of 96.5%, average throughput rate of 782.34 kbps, average energy utilization of 1.239J, and an average delay of 138ms.

P_ID549

Real-Time Flood Detection and Warning System for Smart Disaster Management Using IoT and Cloud Computing

P Murugan (Vels Institute of Science, Technology and Advanced Studies (VISTAS)), Aarthi Suresh (Vels Institute of Science, Technology and Advanced Studies (VISTAS)), K Famitha Begum (Vels Institute of Science, Technology and Advanced Studies (VISTAS)), E Brindha Devi (Vels Institute of Science, Technology and Advanced Studies (VISTAS)), B Sanjeevan (Vels Institute of Science, Technology and Advanced Studies (VISTAS)), Sudha K (Velammal Institute of Technology)

hodbba@velsuniv.ac.in, aarsur89@gmail.com, famithabegum.sms@vistas.ac.in, brindhasimbu99@gmail.com, sanjeevbala17@gmail.com, ksudha161276@gmail.com

Floods are one of the most devastating natural catastrophes of all time capable of devastating human lives, public assets, agriculture and infrastructure. Satellite-based disaster management is all about timely identification and notification, which helps in diluting the impact of catastrophes and in making emergency response more effective. In this book, a real-time flood detection and warning system with Internet of Things (IoT) & Cloud computing technology for Intelligent Disaster Management is introduced. The proposed scheme uses water level, rainfall, temperature and humidity sensors to continuously monitor the environment having flooded areas. The Raspberry Pi Pico W processor is used to process the data from the sensors and remote monitoring, and alert activities are achieved wirelessly via the NRF24L01 communication module. When any abnormal situation is detected, the system alerts with buzzer sound, it displays the monitoring data in real-time on an LCD display. The results of the experiments have shown that the proposed system achieves a 97% accuracy in the issued flood warnings and the latency time for a flood warning dissemination is found to be the lowest as 82ms while transferring data through the process. The system is equipped with consistent wireless monitoring and reliable production systems in different outside environments. This proposed architecture provides a low-cost, scalable and efficient solution for real-time flood monitoring and early-warning generation, and intelligent catastrophe management in high-risk urban and rural areas.

P_ID550

Breast Cancer Diagnosis using Naive Bayes with AES-Based Data Security

Ajitha Kumari G (Bharath Institute of Higher Education and Research), S Sujatha (Saveetha School of Engineering), Suriyakala K (ULTRA College of Engineering and Technology), R Sathya (SRM Institute of Science and Technology), S Hariharasudhan (Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology), Lavanya A (St. Joseph's College of Engineering)

ajitharaghu01@gmail.com, sujathasmvr@gmail.com, suriyakalacse1@gmail.com, sathyaraman76@gmail.com, spharihar an@gmail.com, lavanyaachuthamani06@gmail.com

Breast Cancer is one of the most common and life-threatening diseases affecting women worldwide. Better diagnostic opportunities are important for better treatment success and improved mortality rates. For accurate prediction of breast cancer, this paper proposes a secure breast cancer diagnosis system by implementing Naive Bayes Classifier algorithm and for security purpose of sensitive patient data is proposed Advanced Encryption Standard (AES) algorithm. The Naive Bayes classifier is an algorithm for analyzing medical data and classification of tumour images as benign or malignant, given a set of medical attributes. AES encryption is used to protect patient information, ensuring that all records are encrypted before they're transmitted or stored, to maintain privacy and security. This proposed system is capable of enhancing the accuracy of the prediction, it is having less complexity of computation, also adding information security in health care applications. This comprehensive solution can be effective in providing a secure and efficient way to conduct an intelligent and accurate breast cancer diagnosis system. From the experimental results, the proposed Naive Bayes with AES security model is found to have better prediction accuracy of datasets with lesser encryption/decryption time as compared to the existing machine learning methods.

P_ID552

Cloud-Based Deep Learning Architecture for Remote Sports Biomechanics and Kinematics Analysis

R Gayathri (Bharath Institute of Higher Education and Research), N Mohankumar (Symbiosis International (Deemed University)), Kottu Veeranna Babu (Sasi Institute of Technology and Engineering), B Suganya (Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology), S Sujatha (Saveetha School of Engineering), Seelam Siva Rakesh (St. Joseph's College of Engineering)

gayathri9121r@gmail.com, nmkprofessor@gmail.com, veerannababu.kottu@sasi.ac.in, drsuganyab@veltech.edu.in, sujathasmvr@gmail.com, sivarakesh6666@gmail.com

An understanding of the biomechanics and kinematics of selected sports is of paramount importance to the optimisation of performance, development of technique and aspects of injury prevention. The traditional method of motion analysis relies on apparatus used in a laboratory that is expensive and difficult to utilize in real-time training situations. The aim of this research is to develop a remote sports biomechanics and kinematics deep learning system by leveraging deep neural networks (DNNs) and cloud. The system integrates wearable sensors and video motion capture with cloud computing to offer extensive data storage, high storage capabilities, and remote access. Athlete movement data is uploaded into the cloud where DNN analyse body position, motion of various joints, velocity and acceleration to derive important biomechanical properties. The network achieves 99.68% on the final test (validation) with the class-wise sensitivity varying from 98.67% to 100% and specificity ranging from 99.66% to 100%. The analysis of the confusion matrix shows that the amount of error made between five main categories of movements: "Squat, Jump, Push-Up, Punch, Run/ Stride" is not significant. Tackling athlete performance analyses and kinematic assessments remotely, the cloud platform enables timely feedback and scalable monitoring of athletes, creating a reliable and cost-effective solution for remote player performance analysis.

P_ID553

XceptionNet-Based Doppler Ultrasound Analysis for Intelligent Muscle Cramp Prediction in Haemodialysis Patients

Shalini S (SIMATS), Padmapriya D (Saveetha Institute of Medical and Technical Sciences (SIMATS)), Marydasan Francis (Nightingale College of Nursing), Vijayalakshmi R (Saveetha Institute of Medical and Technical Sciences (SIMATS)), Parimala L (Saveetha Institute of Medical and Technical Sciences (SIMATS))

shalini29041998@gmail.com, padmapriya.scon@saveetha.com, daspvrpsc@gmail.com, principalnursing@saveetha.com, parimala.scon@saveetha.com

Objective: Muscle cramps are the most prevalent and painful complications seen in hemodialysis patients and have considerable impacts on treatment compliance, physical comfort, and general quality of life. The main objective of this research is to build an intelligent framework for predicting muscle cramps in hemodialysis patients based on Doppler ultrasound and clinical dialysis parameters using XceptionNet. Methods: The suggested framework employs preprocessing, normalization, augmentation, feature extraction, and deep learning classification based on XceptionNet for smart muscle cramp prediction. Depth-wise convolution operations help in effectively extracting complex non-linear correlations between various parameters involved in haemodialysis while keeping the computational complexity low. Doppler Ultrasound Imaging and various physiological parameters related to dialysis are studied to extract features related to muscle cramps. Findings: The experimental evaluation showed accuracy of 99.25%, while AUC of 99%. It proved to be more effective in predicting and classifying intelligent muscle cramps detection amongst hemodialysis patients. Novelty: The novel research approach uses the combination of clinical dialysis data alongside deep separable convolution learning using the XceptionNet model to perform predictive analysis for early onset of muscle cramps. This system ensures increased feature discrimination, efficiency and prediction accuracy for use with haemodialysis monitoring and kidney healthcare application using the Kaggle Haemodialysis Realtime Hospital dataset.

P_ID556

Edge-Assisted IoT Electrical System Control for Enhanced Industrial Energy Efficiency

V Muthukumar (Sri Sairam Engineering College), Sagar B S (REVA University), S Krishna Reddy (Sasi Institute of Technology and Engineering), Akhil Gupta (Symbiosis International (Deemed University)), S Murugan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences), Sadasivam M (St. Joseph's College of Engineering)

muthexv@gmail.com, sagar.bs14@gmail.com, krishnareddy.sangati@sasi.ac.in, akhilgupta112001@gmail.com, smuresjur@gmail.com, sivamurali1232002@gmail.com

Industrial energy efficiency is a key issue in contemporary production, since unregulated electrical loads may result in excessive energy use and heightened operating expenses. This paper presents an Edge-Assisted IoT Electrical System Control framework that combines IoT sensors with edge computing to provide real-time monitoring, adaptive load management, and intelligent actuation of industrial machinery. The system persistently gathers electrical parameters, analyzes data locally at edge nodes, and implements control techniques to enhance energy efficiency while ensuring the ongoing functioning of essential equipment. Experimental research indicates that the proposed approach significantly improves reaction time, minimizes energy waste, and optimizes load distribution. Monitoring at the equipment level indicated that high-energy machinery may be planned dynamically, leading to a decrease in total energy consumption of 15–20% compared to traditional cloud-based or non-optimized methods. Edge nodes facilitated swift command execution, with response times averaging 15–20 milliseconds, so assuring real-time load adjustment. Visualization technologies provide site managers with practical information for proactive energy management. The findings validate that edge-assisted IoT control is an efficient, scalable, and dependable approach for improving industrial energy efficiency, minimizing operating expenses, and facilitating sustainable smart factory operations.

P_ID557

Real-Time Gait and Balance Evaluation in Post-Stroke Patients Using Edge-Based IoT Systems

J Christina Linsey (Bharath Institute of Higher Education and Research), Akhil Gupta (Symbiosis International (Deemed University)), Rajmohan M (Rajalakshmi Institute of Technology), R Meenakshi (Chennai Institute of Technology), S Murugan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences), Hari Prasath M (St. Joseph's College of Engineering)

cjchristinalinsey@gmail.com, akhilgupta112001@gmail.com, rajmohan.m@ritchennai.edu.in, meenakshir@citchennai.net, smuresjur@gmail.com, hariprasath210903@gmail.com

The stroke management involves continuous and intensive assessment of gait and balance with the aim of reducing the risk of falls and improving the outcomes. The conventional clinical evaluations are usually limited by subjectivity and seldom monitoring. The study introduces a real-time gait and balance assessment system of post-stroke patients based on an edge-based Internet of Things (IoT) infrastructure. The system involves wearable sensors and embedded edge devices to capture and analyze the biomechanical measures, such as the stride length, gait velocity, and postural stability in real time. The proposed system achieved a processing time of 120 ms, and a data transmission time of 80 ms, which led to rapid feedback. Its overall success was 92% of recognizing gait disorders and 89% of recognizing balance instability. The changes in the gait velocity were as follows: 0.72 m/s to 0.90 m/s and the postural sway, which was 4.8 cm, decreased to 3.2 cm, which is evidence of functional improvement. The results confirm that the system provides a reliable, low-latency, and continuous monitoring. It can be used to transform data-based rehabilitation, early intervention, and improved clinical decision-making and ultimately improve recovery, and quality of life in post-stroke patient populations.

P_ID560

Mantis Search Optimization for Robust and Secure Relay Selection in Autonomous Mobile Environments

A V harshikabhaskar@gmail.com (Sri Muthukumaran Institute of Technology), Roshini M (Aditya College of Engineering), R Sathya (SRM Institute of Science and Technology), Vijayalakshmi R (Easwari Engineering College), S Murugan (Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences), Sathishkumar V E (Sunway University)

harshikabhaskar@gmail.com, mohammedroshini@gmail.com, sathyaraman76@gmail.com, vijayalakshmir.me@gmail.com, smuresjur@gmail.com, sathishkumarveerappampalayam@gmail.com

Autonomous Mobile Environments like Mobile Ad Hoc Networks, Vehicular Ad Hoc Networks and unmanned area vehicle-assisted communications networks need effective relay selection algorithms to deliver reliable, energy-efficient, and secure communication. Conventional methods of selecting the relay usually have high computing complexity, are susceptible to attacks, and lack the ability to adapt to dynamic changes in the topology. This paper proposes a novel Mantis Search Optimization-based Secure Relay Selection (MSO-SRS) framework inspired by the hunting and adaptive behaviors of praying mantises. To select the proposed approach incorporates exploration, exploitation, and adaptive survival methods to find the best relative relay nodes according to the quality of links, remaining energy, the value of trust and mobility prediction. Trust-aware evaluation and anomaly detection are used to increase security. According to simulation findings, the proposed MSO-SRS has a much higher packet delivery ratio, lower delay, higher energy efficiency and lessens malicious node participation in contrast to current solutions like PSO, ACO, and GA-based routing methodologies.

P_ID564

Kalman Filter-Based Noise Reduction and Reinforcement Learning-Driven Efficient Routing in WSNs

L N Jayanthi (Saveetha University), Vijayalakshmi R (Easwari Engineering College), R Velayutham (Einstein College of Engineering), Mahesh A (Sri Sairam College of Engineering), Nilamadhab Mishra (VIT Bhopal University), Mohankumar N (Symbiosis International (Deemed University))

djayanthibabu@gmail.com, vijayalakshmir.me@gmail.com, rsvel_kumar@yahoo.co.uk, legacymahesh@gmail.com, nmmishra77@gmail.com, nmkprofessor@gmail.com

Wireless Sensor Networks (WSNs) are necessary in several applications, such as ecological observing, industrial automation, and smart cities. The sensor data contains a particular amount of noise or unnecessary data, thus, reducing noise is an important factor in WSN. However, their effective deployment is often limited by noisy sensor data and poor routing, which harm data quality and reduces network lifetime. This research introduces a Kalman Filter-Based Noise Reduction and Reinforcement Learning-Driven Efficient Routing (KFRL) in WSNs. Here, the Kalman Filter (KF) algorithm filters data at every sensor node before being communicated to the optimal forwarder. Simultaneously, a Reinforcement Learning (RL)-based routing mechanism chooses optimal forwarder nodes based on link quality, residual energy, and delay metrics. These selected optimal forwarder-based data communication to increase the throughput and network lifetime. RL algorithm is a lightweight learning method that minimizes the routing load in the WSN. Simulation results show significant gains in minimizing energy consumption, and extend network lifetime overall network efficiency, highlighting the potential for scalable next-generation WSNs.

P_ID565

Blockchain-Based IoT Network for Secure Telemedicine Consultations in Respiratory Disorders

V Yasodha (Bharath Institute of Higher Education and Research), R Velayutham (Einstein College of Engineering), Sandra Johnson (R.M.K. Engineering College), V Vijaya Baskar (Sathyabama Institute of Science and Technology), R Kamaraj (Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology), Mohankumar N (Symbiosis International (Deemed University))

yasodhakalaiselvan2000@gmail.com, rsvel_kumar@yahoo.co.uk, sjn.ad@rmkec.ac.in, v_vijaybaskar@yahoo.co.in, kamaraj019@gmail.com, nmkprofessor@gmail.com

The increased need to get medical services at a distance increased the application of telemedicine in the management of respiratory conditions. The study presents an Internet of Things (IoT) network that can be used to develop secure and effective telemedicine consulting with the help of a blockchain. The sensors of IoT constantly receive physiological information, oxygen saturation, respiratory rate, and heart rate, and these data are preprocessed at the edge to reduce the latency time and maximize its transmission efficiency. Blockchain integration guarantees decentralized and unmodified data storage, whereas smart contracts guarantee secure access control. The quantitative analysis reveals that the proposed system achieves the accuracy of monitoring at 98.5% and has a latency ranging between 120 ms and 150 ms and a throughput between 230 kbps and 250 kbps. The processing time of encryptions and decryptions are kept at 2030 ms, which ensures that their computation overheads are nonexistent. The system has 99.9 percent data integrity and the highest maximum attack detection rate of 99.2. In addition, the response time is limited to 3.5-4.5 seconds, and it makes it easy to make rapid clinical decisions. The proposed model is a safe, scalable, and high-performance model that offers a solution to real-time respiratory telemedicine applications.

P_ID566

AI-Powered Cloud Analytics System for Early Detection of Patient Health Deterioration

M Kesavan (Chennai Institute of Technology), K Madhavan (Chennai Institute of Technology), Sravani Donepudi (Sagi Rama Krishnam Raju Engineering College), Y Ebenezer (Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology), Monisha R (St.Joseph's. College of Engineering), C Srinivasan (Saveetha University)

kesavanmanikannan@gmail.com, madhavank@citchennai.net, donepudisravani@gmail.com, yebenezer2@gmail.com, monishar.ieee@gmail.com, srinivasanchelliah@gmail.com

The rising need for preventive healthcare has resulted in the creation of intelligent systems that can forecast patient health decline prior to the onset of catastrophic situations. This research introduces an AI-driven cloud analytics solution aimed at the early identification of patient health deterioration using real-time physiological data. The system integrates Internet of Things (IoT) sensors and cloud computing to perpetually gather, process, and analyze essential vital signals, including heart rate, blood pressure, and oxygen saturation. A Random Forest (RF) machine learning (ML) model is used to detect anomalous patterns and forecast probable health hazards with considerable precision. The cloud-based platform facilitates scalable data storage, swift processing, and remote access for healthcare personnel. The system uses AI-driven analytics to provide early warnings, facilitating prompt medical treatments and decreasing the probability of serious consequences or hospital remissions. The proposed methodology improves clinical decision-making, facilitates ongoing patient monitoring, and advances predictive and preventive healthcare by using cloud and ML technology effectively.

P_ID567

Predicting Residential and Commercial Energy Costs Using Random Forest for Sustainable Energy Planning

H Shamina (Rathinam Business School), T Satheesh Kumar (Bannari Amman Institute of Technology), R Indumathy (PSG College of Technology), G Manokaran (Sree Saraswathi Thyagaraja College), A Jayanthi (Hindusthan College of Engineering and Techonology), Monisha R (St.Joseph's. College of Engineering)

hshamina@gmail.com, tsksatheesh@hotmail.com, indumathykamalraj@gmail.com, vgmanokaran@gmail.com, thirujayanthi2@gmail.com, monishar.ieee@gmail.com

Precise forecasting of energy expenses is crucial for effective energy management in both residential and business domains. This study introduces a predictive modelling methodology using Random Forest Regression (RFR) to forecast monthly energy expenses based on building and customer attributes. The study employs the Residential and Commercial Energy Cost Dataset from Kaggle, comprising synthetic data for 5,000 users from diverse areas. Critical attributes such customer classification, building dimensions, resident count, and geographic location are examined to assess their influence on energy expenses. The RFR model is developed and evaluated to identify nonlinear correlations and determine feature significance in forecasting cost fluctuations. Comparative assessments are performed to verify the model's predicted precision and resilience. The findings indicate that RFR has significant accuracy and generalization potential, rendering it appropriate for practical energy forecasting applications. This study enhances data-driven energy planning, allowing policymakers and consumers to optimize energy usage, manage expenses, and promote sustainable energy management practices.

P_ID568

Secure Data Transmission in WSNs Using RC4 Encryption and Rabin–Karp Pattern Verification

R Sathya (SRM Institute of Science and Technology), Mahesh A (Sri Sairam College of Engineering), K C Sharmili (Saveetha University), Priya Dasarwar (Symbiosis International), B Suresh Chander Kapali (Agni College of Technology), Sathishkumar V E (Faculty of Engineering and Technology, Sunway University)

sathyaraman76@gmail.com, legacymahesh@gmail.com, sharmilikc@gmail.com, priyadasarwar21@gmail.com, suresh.kapali83@gmail.com, sathishkumarveerappampalayam@gmail.com

Applications for wireless sensor networks (WSNs) are many and include smart agriculture, healthcare, military surveillance, and environmental monitoring. Yet, guaranteeing secure data communication in WSNs remains to be a significant difficulty due to their low processing capacity and energy restrictions. The reliability of sensor data might be threatened by malicious attacks such as data modification, packet injection, and illegal access. This work introduces a secure data transmission using Rivest Cipher 4 (RC4) encryption and rabin–karp pattern verification (RRK). This work utilizes RC4 method confirms the privacy of transmitted data by providing lightweight and effective encryption that is suitable for sensor nodes with restricted resources. In the meanwhile, the rabin–karp string pattern matching algorithm confirms data integrity and classify illegal changes in sent packets. The proposed approach minimizes computing overhead and energy usage while improving data security. When compared to conventional encryption solutions, simulation results demonstrate that the proposed approach enhances the data integrity detection accuracy, decreases data delay, and maintains better throughput performance.

P_ID572

GenAI-Enabled Enterprise Architecture Framework for Workday Transformation and Optimization

Venkatarami Redy Nallappagari (Oakland)

nvn1227@gmail.com

Increasingly, enterprise digital transformation projects have been making use of intelligent enterprise architecture frameworks in order to ensure effective organizational processes, cloud applications, workforce management solutions, and business governance. Traditional enterprise architecture frameworks tend to rely on manual analyses, static governance models, and fragmented decision-making procedures, all of which negatively impact organizational transformation. This research attempts to overcome these issues by proposing the Generative Enterprise Architecture Optimization Framework (GEAOF). GEAOF is designed to utilize the benefits of Generative Artificial Intelligence technologies to improve enterprise architecture management and Workday transformation processes. The framework comprises six components, including Enterprise Data Integration, GenAI Knowledge Engine, Process Intelligence Analyzer, Architecture Optimization Module, Workday Transformation Controller, and Performance Governance Unit. The proposed solution was tested experimentally on datasets varying from 1000 to 5000 records, compared to GAI-ERP and MAO. The analysis of results shows that the developed model GEAOF has attained 98.3% Architecture Optimization Accuracy, 97.2% Process Efficiency Improvement, 97.5% Transformation Success Rate, 97.3% Resource Utilization Efficiency, 98.0% Recommendation Confidence Score, 98.7% Governance Compliance Accuracy, 98.2% Workday Integration Effectiveness, and 98.5% Enterprise Optimization Index.

P_ID573

A Resilient Error Handling and Monitoring Framework for Large-Scale Workday Integration Landscapes

Madhulika Gajjala (Montefiore Medical Center)

madhulikagajjala37@gmail.com

Large-scale Workday integration landscapes are being increasingly implemented in contemporary organizations for linking up human capital management, financials, payroll, analytics, and third-party cloud applications. Conventional monitoring methods have been mostly reactive and offer little assistance in proactively detecting faults and automating recovery processes. The IREDRMF – Intelligent Resilient Error Detection, Recovery, and Monitoring Framework provides an architecture that overcomes the limitations of traditional techniques with a series of innovative capabilities that will help enhance the reliability, availability, and resilience of the Workday integration landscape. Based on the experiment, it is demonstrated that IREDRMF can achieve higher performance in some operational metrics compared with other models, including: reliability of integration, accuracy of anomaly detection and root cause determination, efficient system recovery capability, monitoring certainty, availability of system, and low latency processing of transactions. Specifically, IREDRMF could provide up to 96% integration reliability, 97% anomaly detection accuracy, and 99.4% system availability with reduced latency processing of transactions compared with current models. These findings highlight the success of applying predictive analytics and automatic recovery techniques on workday integration monitoring systems.

P_ID574

AI-Driven Predictive Monitoring for Workday Integrations: Enhancing Reliability and Operational Efficiency

Madhulika Gajjala (Montefiore Medical Center)

madhulikagajjala37@gmail.com

Workday integrations constitute an essential component for modern corporations in providing smooth communication among HR management systems, payroll software, finance applications, cloud computing, and external business applications. In the light of increasing interconnectivity between corporate digital systems, the problem of ensuring high efficiency of integration processes has emerged. Existing solutions to the problem of monitoring the performance of such integrations mainly utilize reactive techniques that allow identifying problems after a negative impact on service delivery has been identified. These techniques usually lead to extended periods of downtime, service delays, decreased performance, and higher cost of maintenance. The proposed solution is an intelligent framework, called IPIMROF, aimed at predicting Workday integrations' failures. The proposed framework leverages the capabilities of predictive analysis, anomaly detection, reliability analysis, resource optimization, and continuous learning techniques to improve the observability of integration process. The architecture incorporates six intelligent modules such as the Data Collection Engine, Predictive Analytics Module, Integration Health Evaluator, Anomaly Detection Unit, Reliability Optimization Controller, and Continuous Learning Repository. For the purposes of experimental analysis, the performance of the proposed technique (IPIMROF) was compared against Bayesian Signal Temporal Logic (BSTL) and cSysGuard techniques based on various performance metrics. It was revealed that IPIMROF demonstrated an outstanding performance achieving 99% prediction accuracy, 98% anomaly detection rate, 98% failure prediction ability, 99.7% system availability, and 98% operational efficiency with minimal response time equaling to 128 ms.

P_ID575

Policy Versioning and Rollback Strategies in Hybrid Networks: Managing Change in Distributed Infrastructure as Code Environments

Sai Raghu Ram Gummadidala (iSolve Technology Inc)

rrgummadidala@gmail.com

Along with progress in the development of hybrid cloud network infrastructure, there is a number of issues associated with managing the changes in configurations across distributed infrastructures. The frequent update cycle along with complex interaction between various elements leads to mismatches, reduced efficiency, and unexpected downtime events. Traditional solutions in terms of managing the changes and implementing the rollback procedures do not allow addressing all issues caused by the complicated nature of today's infrastructures. In order to address these challenges, this research introduces a new solution called the Version-Aware Policy Management and Rollback Framework (VPMRF). The proposed solution makes use of policy versioning, real-time impact analysis, dependency management, and automated rollback process implementation. Declarative infrastructure-as-code templates, CI/CD pipelines, and continuous monitoring solutions make it possible to implement the consistent distribution and synchronization of policies within hybrid infrastructures, which include SD-WAN and cloud infrastructures, among others. The unique attribute of the VPMRF framework is the intelligent rollback decision making component that monitors several performance-related aspects, such as latency, fail rate, and throughput. In addition to this, the approach adopts a technique of version dependency analysis and conflict management in order to prevent any kind of cascading effect in making policy changes. In testing how effective the framework performed compared to other models, for example, Bdacs and Asynchronous Checkpointing Framework, it was discovered that VPMRF framework had better results as far as such things as rollback time, availability, efficiency of recovery, and consistency were concerned. This proves that there is more system reliability, fast failure recovery, and scaling of systems in multi-cloud environments.

P_ID576

A Topology-Adaptive Federated Learning Architecture for Privacy-Preserving Model Aggregation across Non-IID, Resource-Constrained Nodes

Nishanth Narendra (University of the Cumberlands)

nishanth.narendra@gmail.com

Topology-Adaptive Federated Learning Architecture (TAFLA) Federated learning (FL) technology has been found to be one of the best options for implementing the concept of distributed machine learning, thus ensuring cooperation and learning while preventing any exchange of user's private data across different stakeholders. Nevertheless, typical federated learning frameworks face some problems in the context of application to highly heterogeneous Non-IID federated networks because of instability, excessive costs of communication, dynamical nature of the communication topology, possible attacks on privacy, and constrained computational capacity of clients. Against this backdrop, we have developed the new Topology-Adaptive Federated Learning Architecture (TAFLA), which utilizes the principles of dynamic optimization of communication topology, adaptive synchronization scheduling, topology-driven aggregation, and resource-aware client selection to make it easier to implement the machine learning process in a federated setting. The acquired results revealed that the developed TAFLA framework provided better model accuracy of 96.1%, lessened the communication cost by 27%, ensured higher stability in the network topology by 15%, provided lower synchronization delay by 31%, and also exhibited better aggregation robustness when compared to other state-of-the-art federated learning solutions like AdDPNFL and AutoCFL. The designed TAFLA framework ensures a more efficient and scalable

federated learning solution for modern intelligent IoT, edge computing systems, smart healthcare applications, and decentralised artificial intelligence architectures.

P_ID577

VORTEX-MED: A Hybrid Quantum Machine Learning Framework for Predicting Chronic Disease Indicators

Manasvi Garg (Prosper ISD)

gmanasvi1000@gmail.com

Non-communicable diseases (NCDs) are some of the major health issues experienced across the globe, which requires early detection and proper prediction of chronic disease indicators (CDCs). Conventional machine learning methods have extensively been used to predict diseases, but they have their challenges whereby they do not work with high-dimensional healthcare data or nonlinear relationships and fail to scale. To overcome these weaknesses, this paper will introduce a new framework of Quantum Machine Learning (QML)-based framework, VORTEX-MED, which combines the classical and quantum computational paradigms to enhance predictive modeling. The suggested pipeline is a hybrid one that involves data preprocessing, feature engineering, feature fusion using Singular Value Decomposition (SVD), quantum encoding, Variational Quantum Circulating (VQC), and Pauli-Z measurement to extract quantum features. The model is tested using a healthcare dataset including demographic and clinical as well as lifestyle variables like age, BMI, blood pressure, glucose level, cholesterol, and behavioral variables. It measures performance based on such metrics as accuracy, F1-score, modularity, and execution time and compares the performance with classical models (such as logistic regression, random forest, SVM, KNN, and K-means). The experimental findings show the given QML framework performs competitively, with an accuracy of 76.54 and F1-score of 77.23, being better than a number of classical models at the same time in terms of their balanced prediction and generalization. Random Forest is found to be a little bit more accurate, but the given quantum model is more stable and tolerant to complicated interactions between features. Also, according to the modularity analysis, the QML method is good at representing structural relationships in healthcare data.

P_ID578

PreVisit AI: Retrieval-Augmented Generation for Patient Readiness in Clinical Encounters

Rolande Umuhoza (Minnesota State University, Mankato), MANSI BHAVSAR (Minnesota State University, Mankato), Rushit Dave (Minnesota State University, Manakto)

rolande.umuhoza@mnsu.edu, mansi.bhavsar@mnsu.edu, rushit.dave@mnsu.edu

Healthcare systems face increasing pressure from rising patient volumes and shrinking consultation times, making effective patient–clinician communication essential for high-quality care. Many patients still arrive at appointments unable to clearly describe symptoms, recall relevant history, or articulate concerns, contributing to miscommunication, diagnostic inefficiency, and pre-visit anxiety. We introduce PreVisit AI, a conversational system designed to support structured, knowledge-based patient preparation. The system uses a retrieval-augmented generation architecture built on sentence-level embeddings, a Chroma vector store, and a curated clinical knowledge base spanning common primary-care domains. We evaluate the system using a synthetic query set across three experiments: retrieval performance at varying chunk sizes and depths, response quality compared with a non-retrieval baseline, and prompt-style analysis. Results show that retrieval-augmented generation consistently outperforms the baseline, with 256-character chunks and k=3 yielding the strongest retrieval performance, and empathetic prompts receiving the highest

patient-oriented scores. These findings suggest that conversational AI can meaningfully improve pre-visit communication and may help reduce disparities for patients with limited health literacy.

P_ID579

I-SLTS: IoT Enabled Smart Letter Tracking System

Murugesan M (Madras Institute of Technology, Anna University), Kannan A (Madras Institute of Technology, Anna University Chennai, India), Hari Prasath S (Madras Institute of Technology, Anna University Chennai, India), Naresh S (Madras Institute of Technology, Anna University Chennai, India), Anis Begum S (Madras Institute of Technology, Anna University Chennai, India), Vidhya N (Madras Institute of Technology , Anna university, Chennai.), Parameswaran Ramesh (Sathyabama Institute of Science and Technology, OMR, Chennai, India), Bhuvaneswari PTV (Madras Institute of Technology, Anna University Chennai, India)

muruganathamsspl@gmail.com, kannan3502@gmail.com, shari4030mit@gmail.com, nash61120021981@gmail.com, anis.mit2019@gmail.com, vin.vidhya612@gmail.com, parameswaran0789@gmail.com, ptvbmit@annuniv.edu

In large organizations, such as universities, traditional paper-based document routing and letter tracking systems within such organizations suffer tremendously from a lack of real-time transparency in the document status, processing delays, and risks of misplacing letters physically. This research presents a secure, cloud-synchronized, and cost efficient letter tracking system that combines the physical mail process in an entire letter life cycle by implementing the IoT. The proposed method implements the initiation of the ESP32 module with a GM805-L high-speed optical scanning module, using dynamically generated QR codes as physical-to-digital document mappings. Supabase's scalable real-time database, PostgreSQL, serves as the primary data layer, implemented by a Flask-based back end that uses SQL Alchemy ORM. Concurrent letter path monitoring occurs in both student and admin dashboards with split roles. In the hardware edge node decodes with an optical speed of 0.42 seconds and successfully updates a database in 1,000 consecutive test cycles with a rate of nearly 100% (99.4%), thus cutting down by 78% administrative retrieval times. Hashing with PBKDF2 and preventing remote access to cloud services ensure data security. Data security is protected by hashing with PBKDF2 and cloud services remote access prevention. The proposed document tracking system can be used in the academic environment, corporate office, government records division, and within an enterprise to track internal document routing.

P_ID580

I-CRA: IoT Enabled Smart Classroom and Resource Automation System

Sowmiya N (Madras Institute of Technology), Antony Pearlson Jeyam J (Madras Institute of Technology), Hrishikesh D (Madras Institute of Technology), Kirrthana A (Madras Institute of Technology), Sai Shravya P (Madras Institute of Technology), Sanjeetha Gowthaman (Madras Institute of Technology), Parameswaran Ramesh (Sathyabama Institute of Science and Technology), Bhuvaneswari P T V (Madras Institute of Technology)

sowmiyaniresh@gmail.com, jeyam1307@gmail.com, hrishikeshhr14@gmail.com, kirrthi2703@gmail.com, shravs375@gmail.com, gsanjeetha@gmail.com, parameswaran0789@gmail.com, ptvbmit@annauniv.edu

Efficient classroom management in educational institutions is facing greater challenges in a campus that has multiple academic blocks. Most institutions continue to use fixed schedules and manual verification procedures that can mean that classrooms are occupied when not needed, lights and fan are needlessly being used in the classrooms, and clashes in classroom availability. These problems are addressed by digitizing the classrooms, where traditional monitoring is replaced by a smarter and more reliable monitoring system, with real-time classroom updates provided by IoT based digitization. The proposed Smart Classroom and Resource Automation System aims to continuously measure the

occupancy of classrooms and the utilization of resources by utilizing the automated senses and wireless communication. The system is based on ESP32 microcontrollers, IR sensors, LoRa communication modules and IoT technology which detect the occupancy, process the data and communicate to the centralized dashboard on which the status of classroom is displayed immediately. The system was able to provide an accurate occupancy monitoring system, long range communication and a reduction in manual effort, scheduling conflicts and energy wastage. This solution is well suited for schools, colleges, university, library, lab, seminar room, office, and smart building to optimize resource management and facilitate the creation of smart infrastructure.

P_ID581

A Hybrid Approach to Flight Phase Segmentation Using Expert Rules and Deep Learning

Murtaja S. Jalawkhan (College of Computer Science and Information Technology, University of Kerbala, Karbala, Iraq), Radhwan Dakhil (College of Information Technology Engineering, Al-Zahraa University for Women, Karbala, Iraq), Mohsin Hasan Hussein (College of Computer Science and Information Technology, University of Kerbala, Karbala, Iraq), Mohamed M. Albydhany (Information Technology Division, Karbala Technical Institute Al-Furat Al-Awsat Technical University Karbala, Iraq)

murtaja.s@uokerbala.edu.iq, Radhwan.adnan@alzahraa.edu.iq, mohsin.h@uokerbala.edu.iq, mohammed.majeed.ikr9@atu.edu.iq

Accurate flight phase segmentation is a critical prerequisite for a wide range of aviation applications, including Flight Operations Quality Assurance (FOQA), fuel efficiency modeling, and aircraft performance analysis. This paper presents a knowledge-guided, two-stage methodology in which an interpretable expert rule system provides weak-supervision labels for training sequence models, and — crucially — all systems are evaluated against an independent reference that is free of circularity: the flight-phase channel recorded on board by the Aircraft Condition Monitoring System (ACMS), available in the NASA DASHlink Flight Data Recorder (FDR) archive. Using 80 flights (134 flight hours) from four aircraft of the same type, we first quantify the true agreement of the expert rules with the ACMS reference, redesign the rules with aviation-justified logic (squat-switch air/ground discrimination, vertical-rate thresholds, and contextual takeoff/rollout detection) to reach 95.6% accuracy and 91.7% macro-F1 over six phases, and then train LSTM, GRU, 1D-CNN, Random Forest, and HMM students on the rule labels under leakage-free, flight-grouped 5-fold cross-validation with an additional fully held-out aircraft. Learned students match the teacher's accuracy while using fewer input signals and localize phase transitions substantially better (mean boundary error 8.6 s vs. 14.4 s), and they generalize to the unseen aircraft as well as the rules themselves. We further provide per-class metrics, transition-quality metrics, feature ablations, and confidence-based selective prediction. The results support a well-evidenced conclusion: rule-generated labels are an effective substitute for manual annotation, and sequence students can exceed their teacher on transition timing, though not uniformly across all metrics.

P_ID584

Explainable AI-Based Smart Applications Using Apache Hadoop Architecture

K Balachander (R.M.K. College of Engineering and Technology), K Ramkumar (Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology)

balaads@rmkcet.ac.in, ramkumar1975@gmail.com

With an increase in smart application use, it becomes important that there should be an analytics system capable of ensuring efficient data processing and transparent decision-making. An Explainable AI-Based Smart Applications system

is introduced to deliver transparent, efficient, and real-time analytics through the Apache Hadoop architecture. The main aim through the development of our proposed model is to improve the efficiency and scalability of the performance and processing of smart applications services through the incorporation of Hadoop-based big data technologies and explainable artificial intelligence. The methodological framework in this study involves real-time data ingestion, use of HDFS for storage purposes, map reduce processing, feature importance analysis, decision transparency analysis, and scalable cluster management. The experimental analysis of this research was conducted using the Kaggle Traffic Prediction Dataset containing 48,120 instances with such parameters as DateTime, Junction, Vehicles, and ID recorded at four traffic junctions. Based on experimental analysis results, our approach can achieve a maximum data processing speed of 109 MB/s, storage efficiency of 90.2%, decision transparency of 97.3%, processing efficiency of 98.1%, ingestion efficiency of 97.6%, and scalability efficiency of 98.2%.

P_ID586

ADT-W: A GPU-Free AI Model for Segmentation of Overlapping and Touching Chromosomes in Karyotype Metaphase Images

Deepanshi Joon (Chandigarh University), Rakesh Kumar (Chandigarh University), Meenu Gupta (Chandigarh University), Harsh Jangid (Independent Researcher Coozmoo Digital Solutions Houston)

abjoon90@gmail.com, rakesh77kumar@gmail.com, meenu.e9406@cumail.in, harshjangid1015@gmail.com

Human being's nature of claiming a child with physical deformities as curse is not actually a curse but chromosomal defects. Which occurs due to some extra or less chromosomes in a pair while karyotyping, which lead to syndromes like turner syndrome, down syndrome and so on. And to find which syndrome is that proper segmentation of chromosome and pairing is required, which is known to be karyotyping. Hence this segmentation of chromosomes comes with limitation of chromosome overlapping or touching of different chromosomal segments. Further huge GPU hardware and annotated masks are required. But this problem has been solved in this paper as it presents Adaptive Distance- Transform Watershed (ADT-W), a GPU free pipeline, which combines non-local means denoising with a fused Otsu and adaptive Gaussian thresholding stage, contrast-limited adaptive histogram equalization, a Euclidean distance transform and area regularised watershed, multi-seed, lightweight morphometric rule that deals with overlapping clusters. On a Kaggle Chromosome karyotype public dataset (G-banded) is available on which ADT-W isolates 180 instances per spread with ad mask –watershed agreement (IoU) of 0.70 and 24.2% boundary to foreground ratio while running in 0.281 on CPU. Further, compared with existing models, ADT-W attains 0.84 competitive Dice. In this model refinements for more complex syndrome overlap could be done in future.

P_ID589

XGBoost-Enabled Smart Beamforming Management for Efficient 6G IoT Communication

G Manokaran (Sree Saraswathi Thyagaraja College), A Jayanthi (Hindusthan college of Engineering and Techonology), H Shamina (Rathinam Business School), T Satheesh Kumar (Bannari Amman Institute of Technology), R Indumathy (PSG College of Technology), N Mohankumar (Symbiosis International (Deemed University))

vgmanokaran@gmail.com, thirujayanthi2@gmail.com, hshamina@gmail.com, tsksatheesh@hotmail.com, indhumathykamalraj@gmail.com, nmkprofessor@gmail.com

The fast advancement of sixth generation (6G) communication necessitates sophisticated solutions to effectively handle extensive Internet of Things (IoT) connection with high efficiency and minimal latency. This work presents a smart beamforming management system using XGBoost to enhance signal transmission in dynamic 6G situations. The model

utilizes network, ambient, device, and computer vision information to forecast optimum beamforming configurations. The system is assessed using the 6G IoT Intelligent Management Dataset, exhibiting robust classification proficiency. The quantitative findings indicate an accuracy of 98.50%, precision of 99.16%, recall of 99.04%, F1-score of 99.09%, and specificity of 95.83%. The confusion matrix reveals little misclassification, including of 8 false positives and 7 false negatives. The ROC curve attains an AUC value of around 0.98–0.99, indicating exceptional model separability. The suggested architecture significantly optimizes beamforming judgments, minimizes latency, and improves signal quality. The amalgamation of XGBoost with intelligent beamforming yields a scalable, adaptable, and high-performance solution for next generation 6G IoT communication systems.

P_ID590

Decoding Emotions Beyond Text: A Hybrid VADER-RoBERTa Approach To Sentiment Analysis

Mudita Sharan (Invertis University), YDS Arya (Invertis University), Gaurav Agarwal (Invertis University), Akash Sanghi (Invertis University)

muditasharan09@gmail.com, vc@invertis.org, gaurav.a1@invertis.org, sanghiakash@gmail.com

X (earlier known as Twitter) and different social media platforms use textual content to express their feelings and opinions in real time. Nevertheless, sentiment analysis of X (earlier Twitter) is still facing a lot of challenges due to the reason of sarcasm, informal language, emoticons, and the use of hashtags. The approaches such as VADER, which is a lexicon-based approach, provide better efficiency in computational manners but lack in the actual meaning of the text and often not understanding sarcasm, while the approaches such as RoBERTa provide higher efficiency, also increasing the efficiency of computation. However, this paper is a hybrid model which combines and integrates VADER and RoBERTa for accuracy, balancing understanding of emoji and sarcasm and providing better efficiency of the system. The system proposed is accomplished by using a MySQL database with a web application known as Flask-based, allowing identity verification, keyword-driven social media analysis, and results presentation. The dataset used is 1.8 million tweets and shows the hybrid model gives the accuracy of 89.5\% for the performance assessment. The outcome suggest the hybrid model is suitable for broad sentiment analysis systems, consisting of opinion analysis done in political field, brands evaluation and trend evaluation.

P_ID599

Federated AI Architectures for Privacy-Preserving Genomic and Healthcare Data Processing

Srinivas Goud Thadakapally (University of Cumberlands)

sthadakapally5579@ucumberlands.edu

The exponential increase in the development of technologies associated with genomic sequencing, EHRs, and intelligent healthcare has led to an enormous amount of highly confidential data. While there has been an impressive level of achievement with AI and machine learning algorithms in disease prediction, genomic risk assessment, and personalized medicine, centralized learning methods for achieving such goals still pose considerable privacy, security, and policy risks due to the In order to tackle these issues, a novel framework referred to as Federated Privacy-Preserving Genomic Healthcare Intelligence Framework is proposed. In this regard, this framework makes it possible for the organizations to work together to come up with predictive models while maintaining utmost privacy of genomic and clinical data. Experimentation was conducted using HFLF and CEC-FL architecture as comparison frameworks. In this regard, the outcomes showed that FPP-GHIF performed better than both HFLF and CEC-FL with an accuracy of 98.4%, precision of 97.8%, recall of 97.3%, F1 score of 97.5%, privacy preservation score of 98.8%, and scalability score of 98.1%. Moreover,

the framework ensured a communication cost of 82 MB and 81 minutes training time respectively, which was more effective than the current existing frameworks.

P_ID612

A Machine Learning Framework for Identifying and Classifying Road Accident Hotspots to Enhance Traffic Safety

Hemant Yadav (Florida State University), Bibek Yadav (Student Florida Agricultural & Mechanical University)

hemantydv8848@gmail.com, bibek1.yadav@famu.edu

Road crashes have been a leading cause of fatality in the world and over 40,000 deaths have been reported in the United States in the last four decades. In order to improve road safety and take preventative action, areas of highest accident potential, or “hotspots,” need to be identified. This study uses the US Accidents (2016-2023) dataset, which contains over 7.7 million records from 49 states, to identify and forecast accident-prone areas using machine learning. The proposed framework uses advanced data preprocessing, feature encoding, feature normalization, and Extreme Gradient Boosting (XGBoost) algorithm to precisely determine the high-risk zones. Data consistency and stability have been achieved through the methodology's one-hot encoding of categorical data, its missing data handling and its normalization using the Standard Scaler. The ensemble-trained XGBoost-SVM model had highest accuracy of 91.27% and F1-Score of 95.07% as compared to other models like RF, SVM, CNN, and ANN. The results highlight the surprising degree of consistency and effectiveness. The study demonstrates that artificial intelligence in road safety analytics frameworks can deliver data-driven insights to policymakers and transport authorities, thereby making the United States' accident risk management, infrastructure planning, and road safety measures more efficient.

P_ID613

Considerations for proposing a Postgraduate Cyber security qualification

Jan Eloff (University of Pretoria)

jan.eloff@up.ac.za

Globally, there is an increasing need for cyber security professionals in both industry and academia. As part of their career advancement, they seek to obtain not only formal tertiary (university) qualifications in cybersecurity but also formal industry certification. However, there is a shortage of formal undergraduate and postgraduate qualifications in cybersecurity, particularly in developing countries. The solution provided in this paper proposes considerations for developing postgraduate cybersecurity qualifications that focus on both the academic and industry certification requirements. Graduates are required to transfer knowledge, for example, cybersecurity professionals should be aware of various cryptographic algorithms. On the other hand, skills are related to the ability to apply knowledge, and can be developed through practice. The skills required by cybersecurity professionals may include the ability to configure cryptographic settings on a firewall. Dispositions reflect ways of thinking, such as being innovative and culminating in the inherent abilities of cybersecurity professionals to apply their knowledge and skills to complete a task.

P_ID617

AI-Driven Green Beyond 5G Wireless Communication Framework for Carbon Footprint Reduction in Smart Sustainable Networks

Abhay Bindle (Maharishi Markandeshwar (Deemed to be) University)

abhaybindal@gmail.com

Beyond 5G (B5G) and emerging 6G wireless communication systems are expected to support ultra-high data rates, massive Internet of Things (IoT) connectivity, intelligent edge services, autonomous systems, and ultra-low latency applications. Conventional wireless optimization approaches are unable to dynamically adapt to changing traffic patterns, channel conditions, spectrum utilization, and energy availability, thereby limiting energy efficiency and sustainable operation. This paper presents an AI-driven green Beyond 5G wireless communication framework for intelligent carbon footprint reduction in smart sustainable networks. The proposed framework integrates multiple Artificial Intelligence (AI) techniques across communication layers, including Long Short-Term Memory (LSTM)-based channel prediction, Deep Q Network (DQN)- based routing optimization, Reinforcement Learning (RL)-based energy management, Genetic Algorithm (GA)-assisted traffic scheduling, Multi-Agent AI-based resource allocation, AI-assisted Massive MIMO beamforming, Convolutional Neural Network (CNN) and RL-based Reconfigurable Intelligent Surface (RIS) optimization, XGBoost-based carbon prediction, and Federated Learning-based edge energy control. The integrated AI architecture enables adaptive communication optimization for reducing energy consumption, minimizing carbon emission, improving spectral efficiency, and maintaining Quality of Service (QoS). Simulation results demonstrate that the proposed framework achieves superior performance in terms of energy saving, carbon reduction, throughput enhancement, latency minimization, and intelligent resource utilization compared to conventional wireless optimization approaches. The proposed framework provides a scalable, intelligent, and sustainable solution for future green B5G and 6G communication systems.

P_ID619

Design And Theoretical Analysis of a High Sensitivity 2D Photonic Crystal Biosensor for Malaria Diagnosis

Dipti Ranjan Sahu (Namibia University of Science and Technology), Macheso Paul Stone (University of Malwai), Divason Kashe (University of Malwai)

dsahu@nust.na, pmacheso@unima.ac.mw, dkashe@gmail.com

Malaria remains a major global health challenge, requiring sensitive and reliable diagnostic approaches for early detection and disease monitoring. In this study, a two-dimensional photonic crystal-based biosensor is designed and numerically investigated for stage-specific detection of Plasmodium falciparum. The optical performance of the biosensor was investigated using ANSYS Lumerical finite-difference time-domain (FDTD) technique by high-performance computing, which is employed to solve Maxwell's equations and accurately model electromagnetic wave propagation and light–matter interactions in high-index-contrast nanostructures. The sensor performance is evaluated for different infection stages of red blood cells, yielding wavelength sensitivities of 325.7 nm/RIU, 305.3 nm/RIU, and 568.95 nm/RIU for the ring, trophozoite, and schizont stages, respectively. The results demonstrate improved performance, particularly at the schizont stage, due to significant refractive index variations in infected erythrocytes. Although lower responses are observed at earlier stages, the sensitivities remain within the typical range of photonic crystal biosensors and can be further enhanced through structural optimization. The proposed design shows strong potential for reliable, stage-specific malaria detection and point-of-care diagnostic applications

P_ID620

Smart Shopping Trolley With Ocr Based Audio Assistance For The Visually Impaired

Harish Ms (Sathyabama Institute of Science And Technology, Chennai), Parameswaran Ramesh (Sathyabama Institute of Science and Technology, Chennai), Madhumitha J (Sathyabama Institute of Science And Technology, Chennai), Hindhuja S (Sathyabama Institute Of Science And Technology, Chennai), Jeab Nimsiya N (Sathyabama Institute of Science And Technology, Chennai), Preetha A (Sathyabama Institute of Science And Technology, Chennai)

cb105ec021@gmail.com, parameswaran.r.ece@sathyabama.ac.in, madhumithajayaram29@gmail.com, hindhuja.s.ece@sathyabama.ac.in, jebanimsiya.n.ece@sathyabama.ac.in, preethashok99@gmail.com

we present a practical and camera-based assistive framework focused on enhancing the independence of visually impaired individuals in identifying product labels and packages while shopping. Our solution integrates a Raspberry Pi camera system to capture static images of product packaging. These images are processed using the OpenCV library to enhance the clarity, followed by text extraction using the Tesseract Optical Character Recognition (OCR). The extracted text is then converted into audio feedback by using the Raspberry Pi through the eSpeak text-to-speech (TTS) engine and played using omxplayer, delivering real-time voice assistance to the user. This strategy eliminates the need for complex gesture detection or tracking algorithms, making it suitable for embedded systems with limited processing power. To further assist in shopping for visually impaired individuals, the product ID and pricing information can be retrieved by using the RFID-based identification incorporated in the system, making the process smoother and preventing errors. Moreover, the obstacles can be detected using ultrasonic sensors, with an audio warning given to the user, ensuring safe navigation. The sections are selected by using the physical buttons, triggering audio prompts and controlling the movement of the trolley. The results show reliable text recognition and product identification using OCR when tested in a controlled environment. This research advances the accessibility and independence of shopping for visually impaired users by effectively integrating hardware and software into a single, user-friendly trolley framework.

P_ID621

A Canonical Microservice-Oriented Payment Integration Architecture for Secure Digital Transaction Processing

Vivek Arora (Wawa)

vivek.arora0716@gmail.com

As digital transformation accelerates, digital wallets are becoming an integral part of contemporary financial systems, offering a secure, efficient, and seamless payment solution. However, the growing volume of digital transactions increases exposure to financial fraud, necessitating accurate real-time detection mechanisms. The PaySim transaction dataset is used in this paper to present an ensemble-based fraud detection methodology that includes data preparation, feature engineering, class balancing using SMOTE, and feature normalization. XGBoost, LightGBM, and Deep Neural Network (DNN) models are trained and integrated into an ensemble architecture, which is further supported by security, resilience, event-driven communication, and observability layers for secure transaction processing. The results suggest that the ensemble model outperforms other models as well as the benchmark models and techniques such as the Random Forest (RF), and Decision Tree (DT) with accuracy of 99.98%, precision of 99.82%, recall of 99.63%, F1-score of 99.73% and AUC (Area Under the Receiver Operating Characteristic Curve) of 99.99%. In addition, with Kafka-based event streaming and circuit breaker, the microservice also offers low latency predictions, high fault tolerance. Results show the possibility and effectiveness of the suggested framework for safe digital transaction processing under the tested experimental conditions.

P_ID622

Deep Reinforcement Learning–Based Adaptive API Rate Limiting for QoS-Aware Cloud-Native Systems

Vivek Arora (Wawa)

vivek.arora0716@gmail.com

The traffic patterns experienced by cloud-native systems and microservice architectures are extremely dynamic, and static rate-limiting, when used, can cause service degradation, latency, and Service Level Agreement (SLA) violations. This paper presents a Deep Reinforcement Learning (DRL)-based adaptive API rate-limiting framework for Quality of Service (QoS)-aware cloud-native systems. The framework uses the NASA HTTP Web Server Logs dataset and the Google Borg Cluster Traces dataset to generate a model of the API traffic behavior and cloud resource usage. Data preprocessing, feature engineering, traffic burst simulation and Min-Max normalization are used for creating representative workload characteristics such as request rate, error rate, latency, CPU stress, memory stress, QoS violations, and SLA violations. Three different DRL algorithms are implemented and tested: Deep Q-Network (DQN), Proximal Policy Optimization (PPO), and Advantage Actor-Critic (A2C), which are compared to a rule-based baseline model. Experimental results show that the DRL-based approaches have better API rate limiting and cloud resource management performance than the baseline. In the API and cloud environment, the tested models gave the following mean rewards, respectively, A2C (1762.17) and the cloud (7983.72), with the lowest SLA breach rates. This framework is well-suited for modern cloud-native environments, effectively adapting to changing traffic patterns, balancing between throughput and latency, and optimizing resource utilization while taking QoS aspects into account.

P_ID623

Smart Energy Management System Using Occupancy Based Load Control and Priority Power Distribution

Parameswaran Ramesh (Sathyabama Institute of Science and Technology), Vaanmarai S (Madras Institute of Technology), Ukesh Raj V (Madras Institute of Technology), Sangeetha R (Madras Institute of Technology), Sridhar O (Madras Institute of Technology), Puneeth L (Madras Institute of Technology), Bino J (St. Joseph's Institute of Technology), Bhuvaneswari P T V (Madras Institute of Technology)

parameswaran0789@gmail.com, vaanmaraisundar@gmail.com, ukeshrajv@gmail.com, sangeetharece2024@gmail.com, obulisridhar777@gmail.com, puneetharuna298@gmail.com, stephenbino@gmail.com, ptvbmit@annauniv.edu

In electrical appliances, energy wastage due to inefficient operations has emerged as one of the main challenges in the residential, commercial, and institutional sectors. To solve this problem, this paper introduces an IoT-based smart energy management system that enables occupancy-based automation to reduce unnecessary power consumption and intelligent load prioritization. The proposed system will utilize a wireless signal, specifically infrared and ultrasonic sensors, as well as a relay control unit, and integrate an ESP32-S3 microcontroller, along with energy monitoring modules (PZEM), and have a feature to provide energy monitoring using the cloud. The system is monitoring the conditions of occupancy and electrical parameters in a continuous way so that the decisions of whether to operate the load are automated. The appliance switches ON/OFF depending on the state of occupancy, reducing the loss of energy. A priority-power-management approach also is implemented: When overloaded, non-essential devices are selectively turned off to maintain uninterrupted operation of the critical load(s). The collected energy data is fed into a cloud platform, which enables distributed monitoring and analytics of energy usage. The experimental testing of the proposed system showed that energy consumption could be reduced by as much as 40% as compared to the traditional control strategies with the reliable operation of the high-priority equipment under different loading levels. The findings show that the system improves the energy utilization profile and makes the energy use more efficient, hence advancing towards sustainable use of energy. The proposed architecture can be applied to smart buildings, educational institutions, industrial plants, and commercial buildings due to its low cost, scalability, and deployment.

P_ID627

Fiscal Fraud Detection and Prevention through Artificial Intelligence: A Unified Perspective on Models, Challenges, and Emerging Innovations

Rajeev Gupta (MMEC, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala), Pooja - (MMEC, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala)

rajeev.gupta@mmumullana.org, poojabhoria22@gmail.com

From a development to operational point of view, fiscal fraud detection is very crucial, and very challenging to deal with various implications ascends in consumer financial transactions. Financial fraud is now seen as the greatest threat to the world economy. Nowadays, fiscal fraud is rapidly growing, which results in huge losses in the growth of the economy. Through the advancement of artificial intelligence and its supporting techniques, consumer-sensitive financial data privacy concerns, adaptability limitations, explainability issues, and standardization policies are still major concerns in the financial sector. The problem is that most of the current systems are “black box” systems, which reduces confidence and legal compliance. Moreover, these models are not good at effectively safeguarding sensitive consumer information. These models are not intended for continuous learning and therefore are difficult to adjust to the latest trends in fraud. In addition, there are no well-known datasets or assessment tools that can be used. The manuscript reflects the emerging research work and discusses and demonstrates the same with a unified view of models, challenges, and emerging innovations in the fintech world for fiscal fraud detection and prevention models. Experimental results show that hybrid models combining privacy-preserving techniques and explainability outperform other models. Leading the way is the DP-SGD + LIME + XGBoost model, which achieves the highest accuracy of 94.7%, showing the effectiveness of ensemble learning with privacy and interpretability.

P_ID632

Artificial Intelligence guided design and optimisation of advanced functional materials

Dipti Ranjan Sahu (Namibia University of Science and Technology)

dsahu@nust.na

Functional materials are essential for advanced high-tech domains and technological progress based on the nature of processing, properties, functions and applications. However, traditional method of advanced functional materials discovery is slow and costly. Rapid development of functional materials demands integration of data-driven methods, accurate simulation, and scalable computing. Integration of artificial intelligence (AI) can accelerate discovery, optimize design and predict properties of the functional materials easily. This manuscript reviews the impact of AI emphasizing on the discovery, development, design and optimization of functional materials, Various key areas of AI such as machine learning, deep learning, reinforcement learning, active learning, data strategies, and representative success across energy, biomedicine, catalysis, and photovoltaic applications, are highlighted. This paper also identifies the technical and practical challenges and proposes strategies and best practices for achieving reproducible, interpretable, and equitable research outcomes on functional materials. AI methods have transformed materials discovery through structure generation, property prediction, optimisation, high-throughput screening, and computational design while advancing development with improved characterization and autonomous experimentation

P_ID636

HYPROT: Explaining Black-Box Models using Hypergraph Theory Image Prototype Generation.

Adolfo Diaz-Sardinas (UNAM), Rafael Rodríguez-Puentes (UNAM), Manuel S. Lazo-Cortés (Tecnológico Nacional de México)

adiaz@unam.na, rpuente@unam.na, manuel.lc@tlalnepantla.tecnm.mx

Although deep convolutional neural networks achieve excellent results in image classification and object detection tasks, their opaque internal decision-making mechanisms limit their application in high-risk environments. Existing post-hoc explainability methods often rely on pixel-level gradients or perturbations of isolated features, which ignore higher-order spatial interactions. In this paper, we introduce HYPROT (Hypergraph Prototype Explanations), a novel framework that models the collective influence of image superpixels through hypergraphs. Using a random binary set of superpixels to create the activation hypergraph. The vertex degree of each superpixel is considered to quantify its importance in the classification task. A group of superpixels that is enough to identify which object is in the input image using the black-box model is then calculated using a heuristic algorithm. Experimental results using the InceptionV3 model on different images demonstrate that HYPROT successfully isolates compact, human-interpretable prototype explanations compared to other techniques.

P_ID639

Hybrid DenseNet Approach for AI-Synthesized Media Detection

Lalit Kumar (MMDU Mullana), Preeti Rana (MMDU), Samima Nasrin (AMU), Ankita Yadav (VGU), Devanupally Archana (Telangana University), Kadambari Jain (Manipal University Jaipur)

lalit.cse@gmail.com, ranapreeti106@gmail.com, samima.amu.39@gmail.com, ankuankita1245@gmail.com, archanarao1411@gmail.com, kadambari1992@gmail.com

Deepfake technology is rapidly growing and presents serious challenges in determining if multimedia content is authentic and verified. Currently, there are no reliable methods that reliably generalize across multiple types of datasets or successfully capture the subtlety of both spatial and temporal inconsistencies that exist in deepfake media, which are both critical to developing an effective method of detection. This paper proposes a new hybrid DenseNet-based framework for detecting deepfake multimedia content. It offers improved feature extraction performance through the use of DenseNet's dense connectivity structure that enhances feature re-use and provides superior gradient flow.In addition to the enhanced ability to detect deepfake content through the use of optimal feature extraction methods, the proposed architecture also incorporates additional convolutional layers as well as optimized classification components that allow for the detection of Low-resolution (fine-grain) artifacts together with High-resolution (high-level) semantic features. The experimental evaluation demonstrates that this unique hybrid architecture performed better (in terms of accuracy and overall generalization capabilities) than either the traditional deep learning approaches or their individual implementations alone. Furthermore, this framework achieves an appropriate balance between computational requirements and overall detection performance, therefore, it can be employed effectively in real-world settings. As such, this research could help in providing reliable deep fake detection systems as well as creating an extensible option to protect the authenticity of multimedia content within today's digital environments.

P_ID640

Explainable Artificial Intelligence for Video Deepfake Detection

Meenakshi Tripathi (MNIT, Jaipur), Vikas Kumar Jain (SVKM'S, NMIMS, Indore), Jyoti Gajrani (Engineering College Ajmer), Dharm Singh Jat (Namibia University of Science and Technology, Namibia), Shoopala Nambahu (Namibia University of Science and Technology, Namibia)

mtripathi.cse@mnit.ac.in, vikasjainrtu@gmail.com, jyotigajrani@ecajmer.ac.in, dsingh@nust.na, snambahu@nust.na

The current deepfake detection methods are black box classifiers. They only have 2 outputs and do not communicate about their predictions. In parallel, many popular deepfakes benchmarks are skewed towards a western demographic, as they typically include only Western subjects. This poses a serious problem when implementing these systems with a variety of populations. This work seeks to address the explainability gap and diversity gap. We present a new dataset with more than 500 deepfake video clips and target them specifically towards Indian demographics. The dataset was constructed with the face swap and lip sync method. It contains annotations on the spatial/manipulated areas as well as text explanations. We adopted a Retrieval Augmented Generation (RAG) pipeline and Vision Language Models (VLMs) to produce explanations that are comprehensible for humans. The proposed framework takes the prompt refinement strategies, adds more annotations using secondary VLMs, and adds an instruction aware instructblip backbone. The enhancements are designed to improve forensic reasoning and localization skills. Experimental results demonstrate that advanced prompting methods and enhanced annotations have a significant positive impact on semantic alignment and explainability scores. The final framework is more than just fake/real. It delivers forensic analysis of manipulated video elements which is detailed, localized and understandable.

P_ID642

HPC-Enabled Video-based Coastal Wave Parameter Estimation Using V-JEPA and Deep Spatiotemporal Learning

Abubakar Hamisu Kamagata (Namibia University of Science and Technology), Dharm Jat Singh (Namibia University of Science and Technology), Attlee Munyaradzi Gamundani (Namibia University of Science and Technology), Saravanakumar Paramasivam (Namdeb Diamond Corporation), Babangida Sani (Bayero University, Kano), Aliyu Zakariyya (Federal University Dutsin-Ma)

kamagata012@gmail.com, dsingh@nust.na, agamundani@nust.na, paramasivam.saravanakumar@debeersgroup.com, bsani.se@buk.edu.ng, azakariyya@fudutsinma.edu.ng

High deployment cost, poor spatial coverage and susceptibility to storm conditions are all challenges faced by traditional in-situ methods. This paper presents a video-based and high performance computing (HPC) enabled deep learning framework for joint sensor-free estimation of five coastal wave parameters, namely significant wave height (Hs), maximum wave height (Hmax), peak period (Tp), zero upcrossing period (Tz) and wave direction (θ) from monocular coastal video. The proposed architecture comprises of a V-JEPA (self-supervised) ViT-Small backbone for robust spatiotemporal feature extraction in visually challenging scenarios, a dual-stream SlowFast temporal encoder for broad bandwidth representation of wave motion in both hydrodynamic breaking and swell regimes, an optical flow stream based on Farneback optical flow algorithm for adding saliency information to the structure with emphasis on hydrodynamically active wavelength bands of waves, and a multi-task regression layer with dispersion constraints (Airy wave dispersion $\lambda p = 0.1$). The model was trained on an NVIDIA DGX A100 cluster and was early stopped at epoch 31 and achieved Pearson correlation coefficients of 0.451, 0.578, 0.643, 0.680 and 0.832 for Hs, Hmax, Tp, Tz and θ respectively, with generalization ability to geographically diverse held out test data sites. While operating in a data-limited regime (6 annotated training scenes), the framework demonstrates statistically significant temporal correlations (PCC 0.451–0.832), confirming proof-of-concept feasibility, R2 values (max 0.246) indicate that variance capture will improve with larger annotated datasets.

P_ID644

A Machine Learning-Based Predictive Failure Detection Model for IoT-Enabled Cold Chain Systems

Khalid Yusuf (SAWITT), Emmanuel Ejembi (Veritas University), Shawulu Hunira Nggada (Higher College of technology), Ambrose A. Azeta (Namibia University of Science and Technology Windhoek, Namibia), Tendai Mataranyika (Namibia University of Science and Technology Windhoek, Namibia)

klimanyusuf@yahoo.com, ejembiem@veritas.edu.ng, snggada@hct.ac.ae, aazeta@nust.na, tmataranyika@nust.na

Despite efforts by researchers and manufacturers, cold chain failure is a common problem in resource-poor settings like Nigeria, where vaccines get spoilt and produce is lost due to the late detection of equipment failure. This work proposes a predictive detection and temperature forecasting method that uses machine learning models based on synthetic data, consisting of Extreme Gradient Boosting-based (XGBoost) anomaly detection and Long Short-Term Memory-based (LSTM) temperature forecasting methods. To test the performance of the proposed method, a 7-day simulated cold chain dataset was created, consisting of 2,016 sensor records. The XGBoost algorithm showed 98.3% accuracy and an Area Under The Receiver Operating Characteristic Curve (AUC) of 96.8% in predicting failure, while the Long Short-Term Memory (LSTM) neural network generated a temperature forecast for one hour ahead of time, with a Mean Absolute Error (MAE) of 0.656°C, which corresponds to the desired Mean Absolute Error (MAE) of less than 1.0°C. A dashboard in real-time was deployed using Streamlit Cloud. This paper sheds light on the feasibility of the use of synthetic data-based machine learning models in cold chain monitoring systems. Keywords—cold chain, predictive maintenance, XGBoost, LSTM, IoT, anomaly detection, synthetic data, Nigeria.

P_ID646

Design and Implementation of a YOLOv8-Based System for Brain MRI Tumor Detection with Lightweight Attention and Feature-Refinement Enhancements

Ameh Anthony (Veritas University, Abuja), Emmanuel Ejembi (Veritas University, Abuja), Okwudili Anthony Ikechukwu (Honda of Canada Manufacturing (HCM)), Paulinus Okechukwu Ugwoke (University of Nigeria, Nsukka), Stanford Musarurwa (Namibia University of Science and Technology)

amehanthonyowoi@gmail.com, ejembiem@veritas.edu.ng, ikechukwu_anthony@yahoo.com, okeyugwoke@yahoo.com, stanford.musarurwa@gmail.com

Manually interpreting brain MRI scans is time consuming and the interpretation is subject to observer bias. Due to the time consuming nature of interpreting brain MRI scans manually, there is a need for computer-aided tools to aid in interpretation. This paper presents an enhanced YOLOv8-based system for automated brain tumor detection from MRI, leveraging lightweight attention modules and feature-refinement enhancements to optimize detection performance. The Convolutional Block Attention Module (CBAM) and a lightweight weighted single-scale feature-refinement block are integrated into a YOLOv8m baseline to strengthen feature representation and multi-scale detection. A publicly available annotated dataset of 2,443 MRI images across four classes (Glioma, Meningioma, Pituitary, and No Tumor) was used, with a strictly partitioned held-out test set of 246 images. A comparative ablation study evaluated the baseline against CBAM-enhanced, refinement-enhanced, and combined configurations using Precision, Recall, mAP@0.5, and mAP@0.5–0.95. The combined model achieved a precision of 0.9476 and mAP@0.5 of 0.9714, outperforming the baseline in detection sensitivity. A clinically acceptable reduction in mAP@0.5–0.95 (0.6382 vs. 0.6569 baseline) reveals a sensitivity–localization trade-off inherent to the combined enhancement. The model sustained real-time throughput of approximately 42 FPS (23.8 ms/image) on a Tesla T4 GPU. All experimental results are reported as explicit point estimates derived from a strictly deterministic training run (seed=0), demonstrating a clear baseline for the proposed enhancements. The system is positioned as a prototype for clinical decision support that is subject to forma clinical

validation as it is integrated into an end-to-end web platform which provides interactive 3D visualization and automatic PDF report generation.

P_ID647

A Real-Time Forensic Readiness Framework for Evidence Preservation in Kubernetes-Deployed Cassandra System

Prerit Bhandari (The University of Winnipeg), Oluwasola Mary Adedayo (The University of Winnipeg)

bhandari-p@webmail.uwinnipeg.ca, m.adedayo@uwinnipeg.ca

Kubernetes has become a dominant platform for deploying scalable applications due to its automated orchestration and self-healing capabilities. However, these same features pose significant challenges for digital forensics, as pods may restart automatically, resulting in the loss of volatile evidence. To address this problem and improve forensic readiness and evidence collection in containerized systems, this study presents a real-time forensic monitoring system for Kubernetes environments. Using Apache Cassandra as a containerized database, a DDoS-like query-flooding attack was generated to induce abnormal behavior, leading to memory exhaustion and pod restarts. Prometheus, Grafana, and Kubernetes events were used to monitor resource utilization, while a trigger-based mechanism was developed to initiate forensic evidence collection when predefined conditions, including high memory utilization and OOMKilled event, were detected. Our proposed framework successfully captured and preserved artifacts from multiple system layers, including Kubernetes and pod metadata, Cassandra logs, and configuration files prior to pod restart. The experimental results demonstrate the system progression from normal operation to resource exhaustion and show that integrating real-time monitoring with trigger-based evidence collection can preserve critical forensic context that may otherwise be lost. The findings highlight the importance of forensic readiness in cloud-native environments and demonstrate the feasibility of proactive evidence preservation in Kubernetes-deployed systems.

P_ID648

Redesigning a Research Collaboration Web Portal Using Human-Computer Interaction Principles

Nosipho Mavuso (Walter Sisulu University), Nobert Jere (University of Fort Hare), Judy Van Biljon (Unisa), Bruce Ferwerda (Jönköping University)

nmavuso@wsu.ac.za, njere@ufh.ac.za, vbiljja@unisa.ac.za, bruce.ferwerda@ju.se

Research collaboration is increasingly important in higher education, yet many digital collaboration platforms continue to exhibit usability challenges that hinder communication, engagement, and knowledge sharing. While previous studies have explored user needs and preferences for research collaboration systems, fewer have focused on the design and evaluation of human-centred solutions tailored to novice researchers. This paper presents the design and evaluation of a human-centred research collaboration portal to enhance usability and user experience. The study was guided by Human-Computer Interaction (HCI) principles and a User-Centred Design (UCD) approach. A qualitative methodology was employed through an HCI course project involving 194 students organised into groups of 10. Students conducted user-centred inquiry activities, including usability task analysis, persona development, scenario creation, and interface prototyping based on an existing ICT4D research collaboration website. The findings revealed several usability concerns, including complex navigation structures, weak information architecture, poor mobile responsiveness, limited researcher search functionality, ineffective communication mechanisms, inconsistent interface design, and inadequate support for novice users. Drawing on these findings, the study proposes a redesigned portal featuring improved navigation, researcher profiling, project collaboration support, document sharing, communication tools, and research opportunity discovery. The results demonstrate that applying HCI principles and UCD processes can significantly improve usability,

learnability, and user satisfaction within digital research collaboration environments. The study contributes practical design recommendations and empirical insights for the development of usable, user-centred collaboration platforms that support research engagement and knowledge sharing in higher education.

P_ID651

TabNet-Based Sleep Quality Assessment Through Adolescent Screen Usage Analytics

Kalaiselvi R (Chettinad Hospital and Research Institute), Monika S (Chettinad Hospital and Research Institute), Gomathi E (Chettinad Hospital and Research Institute), Gokulakrishnan S (Chettinad Hospital and Research Institute), Soundharya M (Chettinad Hospital and Research Institute), Mohan Raj M (Chettinad Hospital and Research Institute)

sivastat1980@gmail.com, saravanan.monika2918@gmail.com, gomathie2004@gmail.com, gokulkrishnan7193@gmail.com, soundharyam111@gmail.com, mohanrajmurugan944@gmail.com

The growing trend of digital device use among adolescents has prompted concerns about their effects on sleep quality and general wellbeing. This study aims to devise a predictive framework for assessing sleep quality based on adolescent screen usage using interpretable deep learning and feature selection algorithms. The proposed approach involves data preprocessing, behavior feature extraction, attention-based feature selection, decision-step learning, and sleep quality prediction by considering the intricate relation between screen usage and sleep. TabNet facilitates effective learning using heterogeneous behavioral and physiological features while maintaining model interpretability. The novelty in the work is derived from the incorporation of TabNet's attention-based feature selection technique and adolescent screen usage analytics to make sleep quality predictions. According to the results, low screen time corresponds with higher sleep quality and performance in the assessment test, and high screen time corresponds with poor sleep wellness and behavior control. The results of experimental evaluation using Kaggle Future of Families and Child Wellbeing Study (FFCWS) Sleep Dataset, which includes actigraphy-based sleep data, screen time, mood factors, physical activity, diet behavior, and wellness factors, were 91.24% Sleep Quality Score, 90.83% Sleep Efficiency, 90.12% Sleep Wellness Index, and 91.67% Assessment Accuracy.

P_ID652

Development of an AI-Assisted Web Application for Detecting and Classifying Brain Tumours in Scanned Images

Douglas Mashonganyika (University of Namibia), Nalina Suresh (University of Namibia)

hi@douglasmasho.com, nsuresh@unam.na

Brain tumours span over 120 recognised classifications. Manual interpretation of MRI scan images is slow, subjective, and error-prone. False positives and false negatives delay treatment and raise clinical costs. Most high-performing diagnostic models remain locked inside academic environments and are not accessible to clinical users. This paper presents Medalgo, a browser-based web application for AI-assisted brain tumour detection and classification. The system needs no local installation. Three convolutional neural network (CNN) models were trained: a YOLOv10 detection model, a four-class plain CNN classification model targeting Pituitary, Meningioma, Glioma, and Healthy brain categories, and a DenseNet121 binary grading model separating High Grade Glioma (HGG) from Low Grade Glioma (LGG). Each model was deployed as an independent FastAPI microservice. A React frontend connected to a Firebase Realtime Database delivered the user interface. The CNN classification model reached 93% test accuracy with a test loss of 17%. The DenseNet121 grading model reached 92.3% validation accuracy with precision, recall, and F1-scores of 0.94 across both classes. The YOLOv10 detection model achieved a mean Average Precision at IoU 0.5 (mAP@0.5) of 0.867. Web performance tests recorded a Largest Contentful Paint of 1.86 seconds, a Cumulative Layout Shift of 0.00, and an Interaction to Next Paint of 32ms. Pre-

and post-implementation questionnaires completed by medical professionals and researchers confirmed that Medalgo reduced perceived diagnostic error rates, improved workflow speed, and received strong interest in continued use.

P_ID653

Edge Computing-Enhanced Fulfillment Orchestration in Federated Multi-Brand Apparel Retail Ecosystems

Utpal Kumar Das (Independent Researcher)

utpal.d.blr@protonmail.com

Modern federated multi-brand apparel retail ecosystems require efficient coordination among distributed warehouses, retail stores, logistics providers, and digital commerce platforms to meet growing customer expectations for rapid and reliable order fulfillment. Traditional cloud-centric fulfillment systems often face challenges such as communication delays, limited real-time inventory visibility, and inefficient resource allocation, which can reduce operational responsiveness and fulfillment performance. This paper introduces an edge computing-enhanced fulfillment orchestration framework, which seamlessly combines distributed inventory synchronization, machine learning for demand prediction, intelligent order routing, and real-time analytics into a single framework. The framework makes it possible to make decisions in real time, with low latency, close to retail and fulfillment points, and to improve coordination between geographically distributed retail nodes through processing of operational information at the edge nodes. A Long Short-Term Memory (LSTM) forecasting model is used to forecast future demand based on historical sales data, inventory levels, and customer buying habits. The system monitors inventory levels, warehouse capacity, logistics performance, and demand trends in real time, making decisions on optimal fulfillment strategies. The proposed approach is evaluated experimentally on a realistic federated apparel retail dataset, which shows that the proposed approach is effective in supporting intelligent fulfillment operations. The proposed system has a 96.7% fulfillment classification accuracy, thus demonstrating its ability to handle different fulfillment scenarios accurately. The findings validate that edge orchestration can greatly enhance operational efficiency, scalability, and supply chain agility in today's multi-brand retail setting.

P_ID657

Graph Neural Network-Based Anomaly Detection and Traffic Classification for Intelligent Network Management

Venkata Rama Uday Kiran Bokam (Nokia), Sachin Vasanthkumar (Cisco Systems)

udaykiranbvr@ieee.org, sacvasan@cisco.com

Network anomaly detection and traffic categorization play crucial roles in modern cybersecurity solutions, as threats become increasingly sophisticated and intelligent. The efficacy of traditional machine learning techniques in identifying novel threats is typically limited by their inability to understand complex correlations among network traffic data. This paper uses the UNSW-NB15dataset to provide a Graph Neural Network (GNN)-based architecture for traffic categorization and network anomaly detection. For binary anomaly detection and multiclass traffic classification, four GNN architectures—Graphs AGE, Graph Attention Network (GAT), Hybrid Graph Convolution Network–GAT, and Hybrid Graphs AGE–GAT are created and assessed. Graphs AGE demonstrated the best anomaly detection performance with an accuracy of 93.28% and an AUC of 98.21%, according to experimental data. Comparative analysis against traditional ML models highlights the effectiveness of graph-based learning in capturing network traffic dependencies. Furthermore, an intelligent response layer is incorporated to support risk assessment and automated management actions. The proposed framework enhances intrusion detection accuracy, improves traffic analysis capabilities, and provides a promising solution for intelligent network security management in dynamic cyber environments.

P_ID658

Design and Simulation of a Carbon-Aware Workload Scheduler for Delay-Tolerant Cloud Tasks

Nihal Panwar (Department of Computer Science, CHRIST (Deemed to be University), Bangalore, Karnataka, INDIA - 560029), Ramesh Chandra Poonia (Department of Computer Science, CHRIST (Deemed to be University), Bangalore, Karnataka, INDIA - 560029), Vandana Mehndiratta (Department of Computer Science, CHRIST (Deemed to be University), Bangalore, Karnataka, INDIA - 560029)

panwar.nihal2004@gmail.com, rameshchandra.poonia@christuniversity.in, vandana.mehndiratta@christuniversity.in

Expansion of cloud computing has significantly increased global electricity consumption and although hardware efficiency continues to improve, software-level resource management remains carbon-blind, executing workloads regardless of the grid's real-time carbon intensity. To address this, this paper proposes a Carbon-Aware Workload Scheduler based on Percentile-Based Threshold Scheduling (PBTS) algorithm to temporally shift delay-tolerant tasks. Evaluated using empirical dataset metrics from the UK National Grid, the discrete-event simulation continually calculates a dynamic baseline threshold for optimal execution windows. The results demonstrate a 1.32% absolute reduction in cumulative carbon emissions and maintaining identical total energy consumption without violating any Service Level Agreement (SLA) latency constraints. This research validates that software-defined temporal shifting provides a viable mechanism for optimizing cloud datacenters.

P_ID659

Validation of a Hybrid Explainable Artificial Intelligence Framework for Mental Health Risk Assessment and Prediction

Richa Datta (Maharishi Markendeshwar Deemed to be University)

er.richacse@gmail.com

Mental health diseases are now becoming a serious global health issue that demands intelligent systems that can help in predicting and intervening at the right time. There are quite many recent studies that show great promise in applying machine learning techniques for prediction of mental health disease. However, there are still many existing approaches that lack the desired level of explain ability and inconsistency in their prediction power. Hence, this study proposes a novel approach called an Explainable Hybrid Ensemble Learning Framework for mental health disease prediction. The proposed framework uses seven machine learning classification algorithms, which include Random Forest, Ada Boost, Logistic Regression, Support Vector Machine, Gradient Boosting, Extra Trees, and Multi-Layer Perceptron by adopting soft-voting ensemble technique. In addition, Local Interpretable Model-Agnostic Explanations (LIME) are used to increase transparency and provide interpretable decision support. The framework is validated by Accuracy, Precision, Recall, F1-score, Area under the Curve (AUC), Matthews Correlation Coefficient (MCC), and Cohen's Kappa. The experimental results show that the proposed framework has great predictiveness with 84.32% accuracy, 85.12% precision, 88.74% recall, 86.89% F1-score, and the highest AUC value of 0.9200 among all tested models. From the comparison analysis, it can be observed that while Gradient Boosting demonstrates the highest accuracy level, the proposed framework is more effective concerning discrimination power and interpretability. Ensemble learning together with explainable AI provides a practical and transparent decision-making solution for evaluation of psychological health risk. From the results obtained, it can be stated that the proposed framework may assist medical practitioners in identifying risky patients in a transparent way

P_ID663

FedCausal-LLM-RS: A Federated Causal Reasoning Framework for Privacy-Aware E-Commerce Recommendation via Large Language Model Intent Encoding

Dr.Bhavana . (M.M Engineering College, Mullana, Ambala), Mukesh Sharma (Lovely Professional University Punjab), Kanika Pahwa (MM Engineering College, Maharishi Markandeshwar (Deemed to be University)), Neetika Gupta (MM Engineering College, Maharishi Markandeshwar (Deemed to be University)), Sonam Bajaj (MM Engineering College, Maharishi Markandeshwar (Deemed to be University)), Amit Bindal (MM Engineering College, Maharishi Markandeshwar (Deemed to be University))

er.bhavanachoudhary@gmail.com, sharmamukesh8113@gmail.com, kanikapahwa86@gmail.com, neetikagupta22@gmail.com, snsps2023sonam@gmail.com, amitbindal@mmumullana.org

In the age of e-commerce, there is a growing need for intelligent recommendation systems that can provide personalized and relevant suggestions. But the current recommendation approaches still have three major drawbacks: maintaining user privacy, reducing the bias arising from the observational data, and correctly representing the semantic information in a product description and customer-generated reviews. Furthermore, popular and exposure biases can lead to poor recommendation quality and conventional text embedding methods offer only partial content semantics of items. To overcome these challenges, the authors suggest a single recommendation framework combining federated learning, causal inference, and LLM-based semantic representation learning, called FedCausal-LLM-RS. The suggested framework uses the FedProx optimization algorithm combined with differential privacy to make it possible to create a collaborative network of model training without users having to share their raw data with the central server, but instead sending only privacy-preserving model updates. Rich semantic intent representations are created using a LoRA-fine-tuned LLaMA-3.1-8B model for product titles, descriptions and summarised user reviews, enhancing the quality of item representations. Three popular benchmark datasets (Amazon-Beauty, Amazon-Electronics, and Yelp-2024) are employed to assess the effectiveness of the proposed framework. Experimental results show that FedCausal-LLM-RS achieves a better performance than the previous privacy-preserving recommendation system on the standard metrics (HR@10, NDCG@10, Recall@10), and guarantees formal differential privacy ([\epsilon,\delta]) formally. The results achieved from these outcomes highlight the effectiveness and practicality of the proposed framework in creating accurate, privacy preserving, and bias-aware recommendation systems for contemporary e-commerce applications.

P_ID668

Bidirectional Evaluation of ML Ensembles for T1D Glucose Prediction

Neeraj Kumar (Chandigarh University), Meenu Gupta (Chandigarh University), Rakesh Kumar (Chandigarh University)

kaithneeraj@gmail.com, meenu.e9406@cumail.in, rakesh77kumar@gmail.com

Short-term blood glucose prediction is a challenging problem in the field of diabetes management. Glucose prediction is a critical aspect of Type 1 Diabetes (T1D) management, especially to prevent hypoglycemia and facilitate timely insulin intervention. Continuous Glucose Monitoring (CGM) systems produce data with high frequency which can be used in machine learning-based predictive analysis. Studies available thus far are limited to a single dataset evaluation, which limits its generalizability to the heterogeneity of patients seen in clinical practice. The model generalization performance is evaluated in different clinical settings in a bidirectional cross-dataset evaluation framework using the AZT1D and HUPA-UCM datasets. The proposed methodology considers five predictive models: linear regression, random forest, histogram-based gradient boosting, XGBoost, and long short-term memory (LSTM). The models were tested in within-dataset and cross-dataset test scenarios with two clinical datasets, each with a 30 and 60-minute glucose prediction horizon. Horizon predictions of 30 and 60 minutes. A fully automated feature harmonization pipeline is the

implementation of this standardization of heterogeneous data, with a datasetorigin classifier to support adaptive model selection. The outcome shows good achievement in the within-dataset settings were used to evaluate, and the cross-dataset evaluation was used within the dataset. It shows organized gaps in generalization. Up to Clinically safe zone, 86.5% of 86 predictions are within the zone. Average of Clarke Error Grid (W) of the Clarke Error Grid is acceptable and clinical reliable. This study sets up a systematic process that can be used to assess and enhance a set of throwaway element models for predicting glucose using CGM.

P_ID669

Integrated Deep Learning Architectures for Chronic Pulmonary Disease Prediction from CT Scans

Garima Jain (Sir Padampat Singhania University), Amit Kumar Goyal (Sir Padampat Singhania University), Rahul Kumar (Sir Padampat Singhania University)

garima.phd2023@spsu.ac.in, dean.fci@spsu.ac.in, rahul.kumar@spsu.ac.in

This research introduces a CNN-LightGBM hybrid deep learning model for automatic lung cancer identification from chest CT data. The system includes a 6-step picture improvement pipeline and a proprietary 4-layer CNN feature extractor with a LightGBM gradient-boosted classifier. Stratified sampling and LightGBM's weighting address the substantial class imbalance. Our training and assessment dataset used the IQ-OTH/NCCD lung cancer dataset, which contains 1,097 CT scan pictures from 120 benign, 561 malignant, and 416 normal classes. The hybrid model achieved remarkable performance, achieving an overall accuracy of 98.64% using the 80-20 stratified train-test split. The model achieved a weighted precision of 0.987, a recall of 0.986, an F1-score of 0.986, and an AUC of 0.998. The top 15 CNN features make 83.6% of classification judgments and are clinically interpretable. These results are much superior to current state-of-the-art methods, proving that the hybrid CNN-LightGBM architecture makes automated lung cancer screening with flawless cancer diagnosis possible.

P_ID670

TabNet-Based Automated Feature Learning for Scalable Data Transformation in AI-Driven Analytics Platforms

Ramesh Kumar Nanjundappan (Data & AI Engineer), K Prakasam (Muthayammal Engineering College, (Autonomous)), Sasirekha desabathula (Sasi Institute of Technology and Engineering), Dillibai R (Vel Tech High Tech Dr. Rangarajan Dr. Sakunthala Engineering College), R Meenakshi (Chennai Institute of Technology), S Sujatha (Saveetha School of Engineering)

ramesh.nanjundappan@gmail.com, prakasameee@gmail.com, sasirekha.d@sasi.ac.in, dillibai@velhightech.com, meenakshir@citchennai.net, sujathasmvr@gmail.com

The increasing amount of enterprise data in heterogeneous forms in cloud ecosystems poses some issues in relation to scalable feature extraction, transformation, and analytics processing. The goal is to create a feature learning framework based on the TabNet algorithm that can help in increasing the efficiency of data transformation and support intelligent analytics platforms through adaptive feature selection and representation learning. This methodology involves data preprocessing, feature normalization, attentive transformers, sequential feature selection, feature aggregation, and predictive analytics components in one learning model. This framework can identify relevant attributes and transform raw data into useful representations with minimal need for manual feature engineering. The experimental evaluation of the proposed system was done using the TPC-H Benchmark Dataset, which is a decision-support dataset featuring business-oriented queries, concurrent updates, database size settings, query processing workloads, multi-user execution workloads, throughput measurements, and price performance metrics. Results have shown that the query execution time

varied from 12.2-16.8 s, the throughput values were between 1324-1624 requests/s, the scalability was between 92.8-95.2%, the resource usage was between 69-74%, the reliability was 99.1%, the QoS was 92.8%, and the framework efficiency was 94.2%.

P_ID671

AIOps Foundation Model Architecture for Intelligent Incident Analysis in Cloud Computing Ecosystems

Anjajah Methuku (Senior Software Engineer), J Jagan Babu (R.M.D Engineering college), G Vijaya Lakshmi (Sasi Institute of Technology and Engineering), Sagar B S (REVA University), R Meenakshi (Chennai Institute of Technology), S Sujatha (Saveetha School of Engineering)

anjaiahspr@gmail.com, jj.ece@rmd.ac.in, vijayalakshmi@sasi.ac.in, sagar.bs14@gmail.com, meenakshir@citchennai.net, sujathasmvr@gmail.com

Intelligent incident analysis is required in cloud computing ecosystems to enhance reliability, minimize operational disruptions, and realize autonomous management. The development of an architecture of an AIOps Foundation Model for heterogeneous cloud operational data-based intelligent incident detection, contextual reasoning, root cause analysis, and automated remediation is our aim. Telemetry collection, semantic log processing, distributed tracing, semantic knowledge retrieval, foundation model reasoning, incident correlation, severity prediction, and self-healing orchestration have been combined into continuous learning architecture. Combining foundation model reasoning, semantic knowledge retrieval, and automated remediation into an AIOps architecture which understands the contextual incident and learns to make adaptive decisions without traditional rule-based monitoring is novel. The evaluation experiments will be conducted on 50,000 incidents of cloud outages using the Kaggle CloudOutagesAI (Synthetic Cloud Service Outage Data for AI & ML) dataset that contains more than 40 operational features such as duration, severity, SLA violations, engineer reaction time, mitigation steps, customer impact, and system load. This proposed architecture has demonstrated performance results such as 99.28% incident detection rate, 99.05% root cause identification rate, 154 ms reasoning latency, 4.31 s recovery latency, 1593 incidents per second throughput, 127 ms response latency, 82.37% CPU utilization, and 99.87%.

P_ID674

An Intelligent Hybrid Framework for Prostate Cancer Diagnosis Using Multi-Modal MRI and Context-Aware Deep Learning

Tanush Goel (Chandigarh University), Meenu Gupta (Chandigarh University, Punjab), Rakesh Kumar (Chandigarh University)

goeltanush051@gmail.com, gupta.meenu5@gmail.com, rakesh77kumar@gmail.com

Prostate cancer is a reason why many men die from cancer. It is very important to detect prostate cancer and start treatment right away for the best outcomes. Reviewing images from special tests like multi-parametric magnetic resonance imaging or mpMRI is time consuming and can be inaccurate because of human intervention. This research suggests a hybrid approach for automated prostate cancer detection is proposed here, which combines both lesion information and knowledge. The new method integrates Convolutional Neural Networks (CNN) for feature extraction, attention mechanism to emphasise clinically significant areas around the tumor and perilesional region and K-Nearest Neighbors (KNN) classifier for interpretability. In addition, multi-modal feature extraction is used to combine anatomical (T2-weighted) and functional (Ktrans) images for enhanced tissue differentiation. The Comparative evaluation indicates that proposed model accuracy of 95.86%, precision of 94.72%, recall of 95.10% and F1-score 94.91% is better than existing

methods. Based on what we found using attention mechanisms and hybrid learning can really help improve how accurately we diagnose prostate cancer. This approach also helps us understand the results better. It seems like a model for using computers to help doctors diagnose prostate cancer. The proposed approach using attention mechanisms and hybrid learning is suitable, for computer-aided diagnosis of prostate cancer.

P_ID675

Active Metadata Governance Capability and Enterprise AI-Readiness: The Mediating Roles of Data Trust and Semantic Interoperability in Cloud-Native Financial-Service Data Ecosystems

Prabhav Rathi (Independent Researcher), Sriram Ramakrishnan (Vingstech), Sai Sandeep Koneti (Independent Researcher)

Prathi@ieee.org, sriram.ramakrishnan@ieee.org, saisandeepkoneti@ieee.org

Financial-service firms increasingly rely on cloud-native data platforms and AI systems for regulatory reporting, fraud detection, credit scoring, risk analytics, customer intelligence, and decision support. However, enterprise AI-readiness remains limited when data governance is treated only as policy documentation rather than an operational capability embedded in data pipelines. Prior research discusses data governance, metadata management, data mesh, ethical data engineering, cloud-native AI workloads, and trustworthy AI, but offers limited empirical evidence on how active metadata governance converts governance intent into AI-readiness through organizational mechanisms. Drawing on Dynamic Capabilities Theory and Information Processing Theory, this study develops and tests a PLS-SEM model in which Active Metadata Governance Capability influences Enterprise AI-Readiness directly and indirectly through Data Trust and Semantic Interoperability, with Regulatory Data-Compliance Pressure as a moderator. Survey data were collected from 421 financial-service data professionals in banking, insurance, fintech, and digital lending/payment firms. The results show that Active Metadata Governance Capability significantly improves Data Trust, Semantic Interoperability, and Enterprise AI-Readiness. Data Trust and Semantic Interoperability partially mediate the governance-readiness relationship, while regulatory pressure strengthens the effects of metadata governance on both mediators. The model explains 67.2% of the variance in Enterprise AI-Readiness. The study demonstrates that AI-readiness is created not by governance documentation alone, but by active, traceable, semantically consistent, and regulation-compliant metadata practices embedded inside enterprise data pipelines.

P_ID676

A Metadata-Driven Framework for Scalable Data Quality Management and Automated Governance Enforcement in Cloud-Based Enterprise Data Systems.

Sai Sandeep Koneti (Independent Researcher), Vivek Kadam (BNP Paribas), Himant Goyal (Informatica)

saisandeepkoneti@ieee.org, vivek.kadam@ieee.org, himantgoyal@ieee.org

More and more credit-risk analytics, fraud detection, customer intelligence, regulatory reporting, and enterprise decision-making uses cloud-based financial data pipelines. Yet, metadata drift and schema inconsistency, incomplete lineage, duplicate entity propagation, delayed governance involvement and fragmented policy enforcement all degrade the reliability of these pipelines. Standard data quality systems which depend on rules check records after ingestion or transformation, causing governance to be reactive rather than preventive. This paper proposes a lineage-aware enforcement framework and conducts studies of quality control and regulatory compliance in cloud-based financial data pipelines. The schema validation, metadata drift detection, lineage verification, policy-as-code enforcement, role-based access control and continuous monitoring will be integrated into one enforcible governance framework. The metadata-

contract framework is one of the four Chapter 6 contrasting systems and the most variable one. Its design, uniquely to the context of our evaluation. The empirical evaluation shows that the accuracy of data quality validation has improved from 78.4% to 93.6%. The detection of governance policy violation has increased from 70.5% to 94.6%. Metadata drift detection has improved from 68.9% to 92.8%. Finally, the completeness of lineage has improved from 74.3% to 96.1%. The average time taken to detect an issue has reduced from 42.6 minutes to 11.8 minutes, while the mean resolution time has reduced from 6.4 hours to 2.1 hours. The findings of the paper confirm that metadata contracts can work as active governance controls, rather than as passive documentation artifacts. The research contributes to the theories of data governance, with cloud data engineering and automated compliance management practices, by demonstrating how metadata-driven enforcement enhances data reliability, auditability, and pipeline resilience in regulated financial data ecosystems.

P_ID678

Hardware-Enforced Signing Governance for Mobile Stablecoin Payments: Evaluating Biometric Re-Authentication and Secure-Enclave Time-Delay Authorization

Sriram Ramakrishnan (Vingstech), Bhaskar Rajbongshi (Independent Researcher)

sriram.ramakrishnan@ieee.org, bhaskar.rajbongshi@ieee.org

Hardware-backed secure enclaves protect mobile-wallet private keys from direct extraction but do not necessarily prevent unauthorized signing when an attacker controls an authenticated session, unlocked device, manipulated application interface, or coerced biometric interaction. This study evaluates a hardware-enforced signing-governance architecture that separates protection of cryptographic key material from authorization of cryptographic key use. The architecture combines transaction-risk assessment, adaptive biometric re-authentication, secure-enclave time-delay authorization, and a protected Transaction-Signing Trust State. The controlled evaluation comprised 5,248 stablecoin transaction-signing events, including 3,412 legitimate and 1,836 simulated adversarial events across 486 mobile devices and four stablecoin networks. Four configurations were compared: conventional secure-enclave custody, biometric re-authentication only, time-delay authorization only, and the integrated configuration. Bayesian structural equation modeling was used to estimate direct, mediated, interactive, and risk-contingent relationships among the security controls, trust state, and unauthorized transaction prevention. The integrated configuration reduced unauthorized signing from 18.7% to 7.2%, corresponding to a 61.5% relative reduction, while maintaining a 95.1% legitimate completion rate. Biometric re-authentication and protected delay were positively associated with the trust state, which was the strongest modeled predictor of unauthorized transaction prevention. Security gains were greatest for high-risk cross-border transactions, while mean signing latency increased by 9.5%. Within the controlled environment, the results support transaction-specific signing governance as a complementary layer to hardware-backed key custody.

P_ID679

Advances in Deep learning-Based Medicinal Plant Classification: A Systematic Review

Kebadu Mekuriaw Adamu (Namibia University of Science and Technology (NUST)), Stephen Gbenga Fashoto (Namibia University of Science and Technology (NUST)), Dharm Singh Jat (Namibia University of Science and Technology (NUST)), Clopas Kwenda (Namibia University of Science and Technology (NUST))

kebadumek@gmail.com, sfashoto@nust.na, dsingh@nust.na, ckwenda@nust.na

Medicinal plants are used as a treatment for various illnesses throughout the world. Deep learning models play a significant role for automated identification and classification of medicinal plants. The advancement of computer vision

in image processing improves the scalability of medicinal plant identification and classification models. However, medicinal plant identification and classification models are challenged due to the rare and limited nature of medicinal plants, different variations of the same species, and being affected by geographical variation. This survey focused on five major areas: (1) Analysis of the recent advances of deep learning models employed in medicinal plant identification and classification. (2) Application of Generative Adversarial Networks to generate synthetic images to improve dataset limitations and class imbalance. (3) The significance of explainable artificial intelligence models to improve model visualization and increase transparency. (4) The role of attention mechanisms for extracting discriminative features of medicinal plants to enhance the performance of medicinal plant classification models. (5) Systematical analysis of the recent challenges and future research areas in medicinal plant classification and identification. This survey identified that 34.3% of recent literature used conventional neural networks, 3.1% used generative adversarial networks for synthetic image generation, and 16% of the literature used explainable artificial intelligence for model visualization.

P_ID680

Automatic Speech Recognition for Afaan Oromoo: A Systematic Literature Review

Tadesse Kebede Guge (Namibia University of Science and Technology (NUST)), Stephen Fashoto (Namibia University of Science and Technology (NUST)), Sebastian Mukumbira (Namibia University of Science and Technology (NUST)), Haileluel Zeleke Woldemariam (Namibia University of Science and Technology (NUST))

taddeekb@gmail.com, sfashoto@nust.na, smukumbira@nust.na, hwoldemariam@nust.na

In recent years, the field of automatic speech recognition (ASR) has made remarkable progress. However, languages with low resources, such as Afaan Oromoo, remain underrepresented due to the lack of annotated speech resources and limited availability of language-specific technology. This paper presents the first systematic literature review on automatic speech recognition for Afaan Oromoo and provides a systematic synthesis of the research published between 2010 and 2026. Based on the methodology of the systematic review and following the PRISMA framework, studies were identified, screened, and analysed to study the Afaan Oromoo ASR evolution, available speech datasets, modelling approaches, evaluation methods, and research trends. The review identifies the main publicly available speech resources and analyses the transition from traditional hidden-markov models to hybrid architectures, deep neural networks, end-to-end models, and transformer-based pre-trained models, such as Whisper. Despite significant improvements in recognition performance, the review highlights remaining challenges, such as limited speech resources, insufficient dialect and speaker diversity, morphological complexity, poor generalisation across domains, and high computational requirements. Finally, the paper outlines future research directions, with emphasis on the creation of larger and more representative speech corpora, dialect-aware modelling, self-supervised and multilingual learning, robust evaluation criteria, and effective implementation strategies. This review provides a state-of-the-art overview of Afaan Oromoo ASR research and identifies key opportunities for developing speech technologies for this low-resource language.

P_ID681

An AI powered Large-Language Model Orchestrated Framework for Weather Resilient Crop Advisory

Om Jadhav (Namibia University of Science and Technology (NUST)), Dharm Singh Jat (Namibia University of Science and Technology (NUST)), Sabbi Vamshi Krishna (HPC Technologies Group), Edward Nepolo (Namibia University of Science and Technology), Fungai Bhunu Shava (Namibia University of Science and Technology), Loini Iiyambo (Namibia University of Science and Technology)

omjadhav@cdac.in, dsingh@nust.na, vamshis@cdac.in, enepolo@nust.na, fbshava@nust.na, liiyambo@nust.na

This paper presents the architecture and an empirical evaluation of an agentic, multi-agent crop advisory platform that combines large-language-model (LLM) reasoning, live meteorological APIs, and classical machinelearning models to deliver climate-adaptive crop recommendations for African countries. The system departs from prior zone-table-based advisory tools by removing all static climate, soil, and crop-price defaults, sourcing every value from a live API call or an LLM inference with a seven-tier provider fallback chain. We describe five subsystems in detail: (i) a location-resolution agent covering African countries (ii) a climate-signal-intelligence service that fuses NOAA Oceanic Niño Index (ONI) data with nine independent agricultural threat assessors (iii) a deterministic, six-factor weighted rulebased suitability engine (iv) a Random-Forest suitability-score regressor blended 60/40 with the rule engine and (v) legacy LSTM/XGBoost short-range weather forecasters. Because the deployment sandbox used for this study had no scikitlearn/PyTorch installation reachable within the available network budget, we re-implemented the Random Forest regressor from scratch in NumPy, mirroring the shipped model's hyperparameters, and trained it on 12,000 genuinely generated labelled samples produced by the project's own datageneration and rule-scoring code (46 crops × 40 sampled agroclimatic regions × 3 seasons × 5 soil textures × 2 irrigation regimes). The re-implemented model attains a test R^2 of 0.889 (RMSE = 6.88, MAE = 5.44, MAPE = 11.2%). We discuss the distillation nature of the training labels, compare our sandbox feature importance ranking against the metadata of the originally shipped model (Pearson r = 0.33), and outline limitations and future extensions including retrieval augmented farmer chat and satellite vegetation-index integration.