

RESEARCH BULLETIN 2025

VOLUME 2



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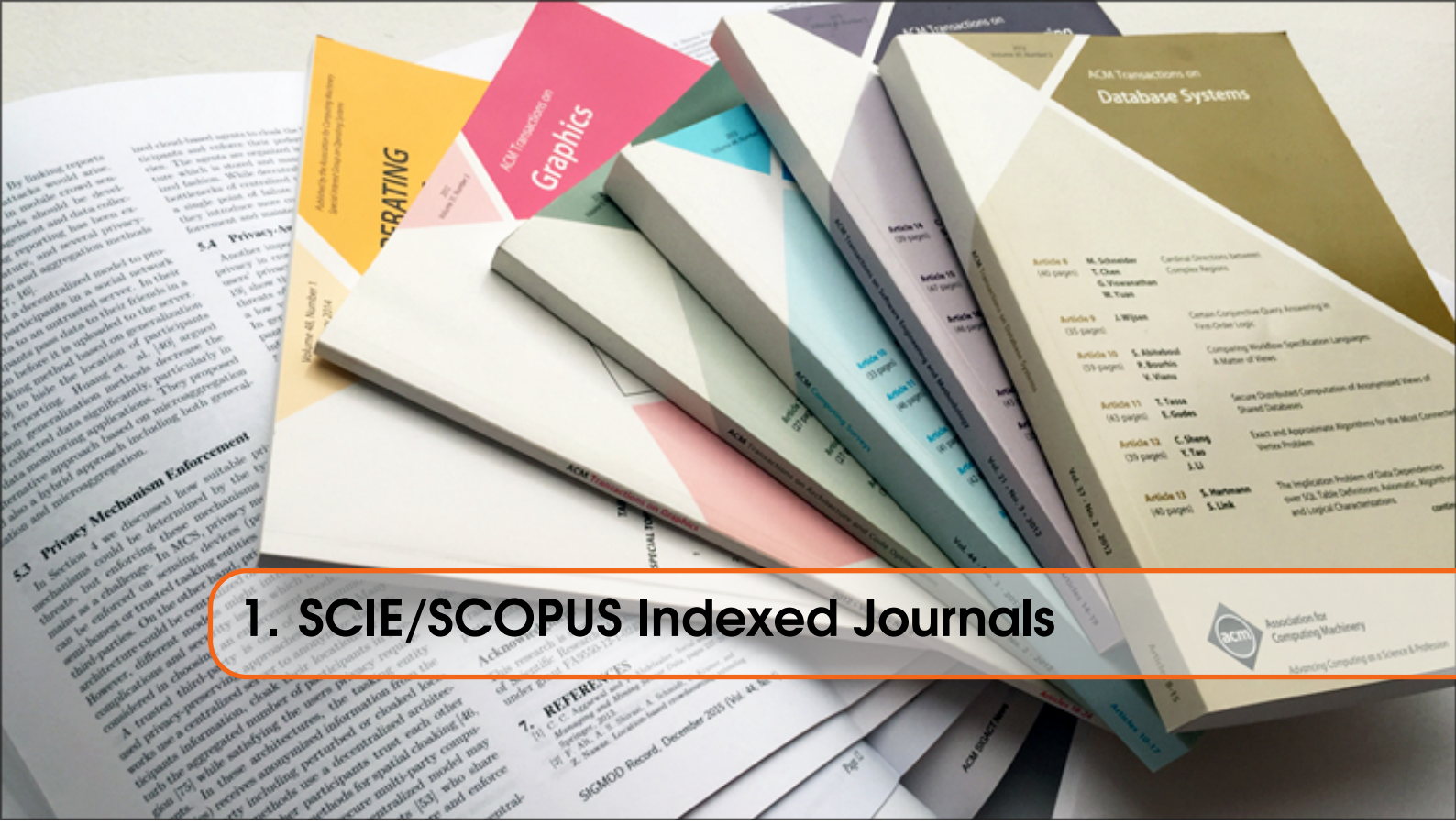
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1. SCIE/SCOPUS Indexed Journals

SCIE/ SCOPUS indexed journal papers published by the faculty in 2025

1. **Joseph, Riya**, Jeevan Mathew Tharayil, **Prabhasankar VP**, Kishore MS, and Viswanath Parol. "Assessing the Impact of Brahmapuram Landfill, Kochi, Kerala, India, on Groundwater Quality: A Physicochemical, Correlation, and Statistical Analysis Using WQI." ACS ES&T Water 5, no. 9 (2025): 5377-5386.

Abstract: Groundwater contamination from industrial effluents, agricultural runoff, and landfill leachate threatens water quality and public health. Aligning with United Nations Sustainable Development Goal 6 (UN SDG 6) on clean water and sanitation, this study evaluates groundwater quality in and around the Brahmapuram landfill (Kochi, Kerala, India) with respect to Indian and World Health Organization (WHO) standards. Comprehensive physicochemical analysis, water quality index (WQI) assessment, correlation matrix, and statistical evaluations were conducted to analyze key water quality parameters. WQI analysis indicated that 40% of the samples exhibited poor to very poor quality, rendering them unsuitable for direct consumption without treatment. Spatial distribution maps for pH, temperature, color, total alkalinity, total hardness (TH), chloride, sulfate, dissolved oxygen, biochemical oxygen demand (BOD), and turbidity were developed using QGIS, contamination hotspots were identified. A strong correlation between TH and sulfate ($r = 0.83$) suggested common contamination sources. Significant variations in chloride and hardness levels were also observed. The findings highlight the urgent need for leachate control, sustainable water management, and stricter landfill regulations, particularly following incidents such as the Brahmapuram landfill fire outbreak. Beyond its regional significance, this study provides a replicable framework for assessing landfill-induced groundwater pollution and supports evidence-based governance.

2. **Kollannur, Manju I.**, and Oudaya Coumar S. "TFIE: three-four inexact adder based 4: 2 and 5: 2 compressor for high performance approximate booth multiplier." International Journal of Electronics 113, no. 1 (2026): 65-88.

Multiplication plays a major role in fundamental arithmetic operations in all real-time deployments. The fundamental arithmetic circuits in many digital image processing (DIP) applications are multipliers and adders. A developing technology called approximate computing involves designing power-efficient circuits with less complexity, although at the expense of some accuracy loss. These circuits are appropriate for applications when precise measurements are not necessary. To overcome these challenges a novel approximate TFIE adder, approximate 5:2 compressor, approximate 4:2 compressor, Approximate TFIE Booth Multiplier1 (ATBM1), Approximate TFIE Booth Multiplier2 (ATBM2), Approximate TFIE Booth Multiplier3 (ATBM3) uses logic such as AND, OR, NOT, modified FA, half adder. The proposed Approximate booth multiplication utilises TFIE FA, TFIE 4:2, and TFIE 5:2 and forms three versions of TFIE multipliers (ATBM1, ATBM2, ATBM3) for high-performance and low-power computing. Additionally, the proposed TFIE multiplier for image processing applications provides higher-resolution output images with lower power consumption. A limited amount of accuracy loss can be tolerated in image sharpening and related applications where approximation computing improves performance and energy economy. The total power required for the proposed ATBM1, ATBM2, ATBM3, approximated 4:2 compressor, and 5:2 compressor method is 0.150 mW, 0.105mW, 0.103 mW, 0.103 mW, and 0.104 mW respectively. Finally, the proposed technique provides superior performance based on area, power, and delay compared with the prior method.

3. **Kollannur, Manju Inasu,** and Oudaya Coumar Souprayan. "Designing high power efficient finite impulse response filters with three-four inexact adder-integrated Booth multiplier." *Journal of Robotics and Automation*.

Finite impulse response (FIR) filters are widely utilized in several applications in digital signal processing, including data transmission, photography, digital audio, and biomedicine. It is necessary to use high sample rates for FIR filters, while moderate sample rates are needed for low-power circuits. To solve these problems, a Booth multiplier based on three-four inexact adder-based multiplication (TFIE-BM) was proposed. The goal of the proposed TFIE-based FIR Booth multiplier is to lower area usage, latency, and power consumption. The proposed method utilizes the spotted hyena optimizer (SHO) to find the optimal filter coefficient (FC) by minimizing the pass power consumption and Transition bandwidth. Moreover, a high-performance three-four inexact adder (TIFE adder) has been introduced, which uses fewer XOR gates for sum and carry generation, indicating that the logic has been simplified to reduce hardware complexity. By increasing speed and decreasing the FIR filter's critical path delay, a modified Booth multiplier that uses a 5:2 compressor is introduced. The overall delay of the proposed approach is 23.4%, 18.7%, 12.3%, and 5.7% lower than that of the Radix-4 Booth multiplier, CSA Booth multiplier, hybrid multiplier, and traditional Booth multiplier, respectively.

4. **Valiaveetil, Della Reasa,** and Kanimozhi T. "Elephant herding optimized features-based fast RCNN for classifying leukemia stages." *Technology and Health Care* 33, no. 1 (2025): 167-183.

Abstract:Leukemia is a malignant disorder of the bone marrow and blood characterized by the excessive production of abnormal white blood cells caused by DNA damage

in immature cells. Accurate diagnosis of acute leukemia through microscopic blood smear analysis is a challenging and time-consuming task for radiologists, requiring advanced computational assistance. To address this issue, this study proposes a novel deep learning-based framework, LEU-EHO NET, for the efficient and accurate classification of leukemia from blood smear images. The proposed model classifies blood smear images into leukemia-free and leukemia-infected categories. The input images undergo preprocessing through normalization and cropping of black edges, followed by feature extraction using MobileNet. Elephant Herding Optimization (EHO) is then applied to select the most relevant features, and a Faster R-CNN classifier is trained with these optimized features to distinguish between normal and abnormal cells. The proposed LEU-EHO NET achieves an overall classification accuracy of 99.30%, outperforming several state-of-the-art models, with accuracy improvements of 0.69%, 16.21%, 1.10%, 1.71%, and 1.38% over Inception v3 XGBoost, VGGNet, DNN, SVM, and MobileNetV2, respectively. The LEU-EHO NET demonstrates superior performance in leukemia detection; however, further enhancements are needed for precise segmentation of overlapping cells. Future research may focus on integrating alternative deep learning architectures to further improve classification accuracy.

5. **Milner, Paul V.**, Philips Zachariah, Jijo Francis, Siji George, Adarsh V. Parekkattil, **Suni Jose, S. Athithya, Caren Babu** et al. "A Multifunctional, Embedded-based, Bluetooth-enabled, Programmable, Biphasic-waveform Stimulator with Real-time Neural Signal Acquisition." *Journal of Visualized Experiments (JoVE)* 223 (2025): e68837.

Abstract: The study introduces a lightweight, Bluetooth-enabled deep brain stimulation (DBS) device that is designed specifically for preclinical research in small, freely moving animals. To address the current limitations in waveform flexibility and wireless control, we developed a compact, multifunctional stimulator capable of delivering programmable, charge-balanced biphasic waveforms while simultaneously acquiring neural signals. The system integrates off-the-shelf components for current regulation, signal amplification, and analog-to-digital conversion, all managed by a low-power microcontroller. The assembly includes key steps such as circuit integration on a double-sided 30 x 30 mm PCB, waveform programming via nRF Connect, and validation through saline and load resistance testing. In vitro assessments demonstrated reliable current output across varying load impedances, effective saline operation without waveform degradation, and high-fidelity neural signal recording with a signal-to-noise ratio exceeding 35 dB. These results confirm the device's suitability for closed-loop neuromodulation experiments and lay the groundwork for future translational studies in DBS therapy.

6. **Paul, V. Milner**, Jijo Francis, Smriti Menon, Loitongbam Surajkumar Singh, Adarsh V. Parekkattil, and Shuma Adhikari. "Development of a novel wireless telemetric brain stimulator for behavioral studies in rodents." *Ain Shams Engineering Journal* 16, no. 3 (2025): 103290.

Abstract: Brain simulators are moving the field of neuroscience at a rapid pace due to their wide applicability in treating neurodegenerative disorders. Although continuing advances in the field have made significant breakthroughs, most brain simulators remain too expensive for general clinical applications. We developed a user friendly, cost effective, multi-channel wireless brain stimulator that delivers output with high precision. The multichannel output of this device makes it amenable to conducting behavioral

studies on different regions of the brain in rodents. The efficacy of our head-mountable device is substantiated by conducting intracranial and intracortical experiments in rats. We tested the output of the device by changing the frequency (100 Hz–400 Hz), amplitude, pulse width and current (10 μ A – 1 mA) of the stimulator by altering the ON time period of the pulses and resistor values. We have defined optimum frequency (140 Hz) for the intracranial experiment and lower and upper threshold currents for the intracortical experiment. The successful feasibility of this device has been demonstrated *in vivo* in rats and *in vitro* in saline solution. Real-time experiments like Intracranial Self Stimulation (ICSS) and Intracortical Microstimulation (ICMS) tests were successful during the animal experiment to evaluate this brain stimulator. Our device has widespread applicability in conducting behavior-based studies and deriving insights into various mechanistic pathways in rodent brain.

7. John, Saju P., Valanto Alappat, **Needhu Varghese**, and Serin V. Simpson. "Edge-Cloud Computing for IoT Data Analytics Using Optimized Progressive Graph Convolutional Networks." *IETE Journal of Research* (2025): 1-8.

Abstract: The rapid proliferation of connected devices, including sensors, wearable and other Internet of Things (IoT) devices, has led to an explosion of time series data, driving advancements in human activity recognition (HAR). Deep learning (DL) based techniques have shown great promise in predicting human actions from such data, particularly from wearable sensors and mobile devices. However, traditional cloud-based processing of IoT data introduces latency and network congestion, while edge computing, although offering reduced latency, faces computational constraints for machine learning tasks. In this manuscript, Edge-cloud computing for IoT data analytics using optimized Progressive graph convolutional networks (ECC-IoT-PGCN-HSOA) is proposed. The objective of the proposed ECC-IoT-PGCN-HSOA approach is to enhance accuracy, reduce training time, and address the challenges associated with IoT data processing, such as latency and computational constraints. Initially, the input data are collected from the MHEALTH dataset. The input data is first pre-processed at the edge layer using Confidence Partitioning Sampling Filtering (CPSF) for data cleaning and normalization. This pre-processed data is then sent to the cloud, where it is fed into Progressive Graph Convolutional Networks (PGCN) to identify the type of activity in the HAR. The PGCN parameters are optimized with the Humboldt Squid Optimization Algorithm (HSOA) in the cloud layer, enhancing the accuracy of activity identification from sensor data. The proposed ECC-IoT-PGCN-HSOA approach is implemented in Python and the performance metrics like Accuracy, Precision, Recall, Matthews Correlation Coefficient (MCC), F1-score, and ROC are analysed. The proposed ECC-IoT-PGCN-HSOA approach achieves exceptional performance metrics, with an accuracy of 99.28%, a precision of 99.41%, and a RoC of 0.997. Furthermore, it significantly reduces the training time to 23.41 s, outperforming existing methods. These results demonstrate that the proposed ECC-IoT-PGCN-HSOA method is highly efficient, scalable, and capable of addressing the challenges associated with edge-cloud IoT data processing, ensuring accurate and timely human activity recognition.

8. Aiswarya, V., Sudev Das, **Alosh James**, Sandip Kumar Saha, and Bidyut Baran Saha. "An experimental investigation on the solar thermal energy storage potential of form stabilized paraffin microcapsules." *Journal of Environmental Chemical Engineering* 13, no. 3 (2025): 116825.

Abstract: Incorporating paraffin-based phase change materials (PCMs) into solar thermal systems allows for the persistence of excess solar heat during daylight peaks and its subsequent release during periods of low solar radiation, ensuring a steady energy supply. Meanwhile, leakage during phase transitions that can compromise the integrity of the storage system, and inherently low thermal conductivity leading to inefficient heat transmission, are the main concerns. Combining paraffin microencapsulation with form stabilization into a polymer matrix enhances the overall heat transmission capacities and prevents leakage, benefiting from both approaches' particular advantages. Concurrently, the PCM integration has also gained significant attention in extending the operational range and promoting the thermal efficiency of diverse solar-thermal systems. Therefore, the present work attempts to develop a novel form stabilized composite by blending the in-situ polymerized paraffin/melamine-formaldehyde (MF) microcapsules with polyvinyl alcohol polymer (PVA) via solvent evaporation. The results of scanning electron microscope (SEM), atomic force microscopy (AFM), and transmission electron microscopy (TEM) revealed the successful incorporation of microcapsules into the PVA matrix. The form stabilized composites show high form stability and mechanical strength, with improved post-peak behaviour. The thermally stable composites demonstrated excellent phase change behaviour and melting enthalpy 90.6 J/g. The composite with higher microcapsules is attributed to a maximum thermal conductivity of 0.401 W/mK (91% enhancement over paraffin). Thermal reliability studies have proven its superior solar harvesting property and demonstrated its potential in diverse solar management applications.

9. Kumar, PV Ajay, **Alosh James**, and M. Srinivas. "Performance investigation of a novel multi-tray solar cabinet dryer with multi-point air supply." *Thermal Science and Engineering Progress* 61 (2025): 103515.

Abstract: Agricultural produce requires drying for preservation. Employing renewable energy sources, particularly solar energy, can significantly enhance the sustainability of this process. This study seeks to improve the efficiency of a multi-tray solar cabinet dryer by achieving homogeneous drying through a multi-point air supply (MPAS). A thorough numerical analysis was performed to examine the thermal aspects of the proposed system using two configurations, namely, a multi-point air supply from two corners and four corners, and to contrast them with those of a conventional dryer. In addition, the numerically optimized system was experimentally tested under controlled indoor conditions to dry bitter melon (*Momordica charantia*) slices. Compared to the conventional system, the standard deviation of the temperature profiles across all trays of the proposed MPAS system was reduced by 52.2% and 35.5% for the two-corner and four-corner configurations, respectively, indicating greater uniformity in the heat distribution. Among the two configurations, the MPAS from the two corners exhibited superior heat transfer performance. Furthermore, an experimental study conducted to investigate the drying performance of the proposed MPAS from two corners demonstrated a 23.3% increase in energy efficiency over the conventional system owing to homogeneous drying across multiple trays. The average energy utilization was enhanced by 26.3%, with the Energy Utilization Ratio (EUR) for the proposed systems reaching 58.5% and 54.2%, respectively.

10. **Nithin, V. K.** "An investigational approach to determining the optimal tilt and azimuth angles for heat pipe solar collectors." *Sādhanā* 50, no. 4 (2025): 229.

Abstract:The ideal heat pipe solar absorber tilt and azimuth angles to maximize solar energy absorption and thereby improve the whole efficiency of the system. This research presents a research framework that integrates theoretical modelling and optimization methods to establish angular configurations for the heat pipe solar collectors from climatic variations. The analysis of solar insolation, seasonal variations, and geographical locality, among others, is done to enhance efficiency. In this research, the Binary Light Spectrum Optimizer (BLSO) algorithm has been utilized and showed the best performance in contrast to other traditional techniques such as differential evolution, genetic algorithms, and particle swarm optimization, with an improvement in efficiency by 5–8% over previous methods. The results revealed that BLSO promotes quick convergence and increased efficiency, with dynamic adjustments to seasonal and geographical variations. This research provides an intelligent framework for optimizing solar absorber configurations, leading to the enhancement of sustainable, high-performance solar energy systems, thus reducing dependence on non-renewable sources.

11. Lilhore, Umesh Kumar, Scaria Alex, **Vince Paul**, Rahoof Puthan Purayil, Sultan Mesfer A. Aldossary, Sarita Simaiya, Ehab seif Ghith, Heba G. Mohamed, and Monish Khan. "QHRMOF: A Quantum-Inspired hybrid Multi-Objective framework for Energy-Efficient task scheduling and load balancing in cloud computing." *Journal of Cloud Computing* 14, no. 1 (2025): 54.

Abstract:The swift expansion of cloud computing services has resulted in a notable increase in energy consumption, presenting challenges for sustainability and effective resource management in cloud data centres. This paper introduces a novel Quantum-Inspired Hybrid Reinforcement Learning and Multi-Objective Optimization Framework (QHRMOF) designed to optimize task scheduling, dynamic load balancing, and server consolidation while minimizing power consumption and enhancing system performance. QHRMOF integrates three fundamental techniques: Quantum-Inspired Evolutionary Algorithm (QIEA) employs quantum principles like superposition and entanglement to improve solution space exploration and mitigate local optima; Hybrid Deep Reinforcement Learning (HDRL) integrates convolutional neural networks (CNNs) and Long Short-Term Memory (LSTM) to forecast workloads and dynamically categorize virtual machines (VMs) into overloaded and underloaded states for efficient task migration and load balancing; and Multi-Objective Optimisation (MOO) reconciles multiple conflicting objectives, including minimizing energy consumption and makespan while maximizing resource utilization and system scalability. QHRMOF minimizes unnecessary migrations and overhead through informed decision-making and adaptive resource management, all while maintaining optimal system performance. Simulations performed on the CloudSim platform utilizing real-world datasets, including those from NASA, HPC2N, and Google workloads, indicate that the proposed framework surpasses leading methodologies such as Multi-objective Genetic Algorithm (MOGA), Particle Swarm Optimization (PSO), Deep Reinforcement Learning for Load Balancing (DRL-LB), and Ant Colony Optimization (ACO). The findings indicate that QHRMOF attains a maximum reduction of 18.76% in makespan, a 22.84% decrease in energy consumption, a 19.52% enhancement in resource utilization, a 25.39% improvement in load balancing efficiency, and a 12.67% reduction in failure rates. These findings

confirm the efficacy of QHRMOF in enhancing resource management, augmenting system reliability, and fostering energy-efficient cloud computing operations.

12. **Sreemol, R.,** MB Santosh Kumar, and A. Sreekumar. "Fusion Net-3: Denoising-based secure biometric authentication using fingerprints." *International Journal of Systematic Innovation* 9, no. 4 (2025): 84-105.

Abstract: Fingerprint-based authentication is a critical biometric approach for ensuring security and accuracy. Traditional methods often face challenges such as noise and suboptimal feature extraction. To address the challenges, Fusion Net-3, an extensive model, is proposed to improve the speed, precision, and security level of fingerprint-based authentication systems. Fusion Net-3 operates through two separate stages: enrollment and authentication. During the enrollment phase, advanced pre-processing of fingerprint images was performed, incorporating an enhanced bilateral filter optimized with the seagull optimization algorithm. After pre-processing, features were obtained using a two-phase method: Zernike moments for shape-based features and local binary patterns for texture-based features. This helped ensure that fingerprint features were considered comprehensive for representation. For feature selection optimization, the falcon-inspired jackal optimization algorithm was proposed, a hybrid method combining the strengths of the golden jackal optimization and falcon optimization algorithm. Then, the selected features were combined using a combination of the geometric mean and the Fisher score to facilitate classification for a balanced and novel representation. During authentication, fingerprints were processed using similar techniques for consistency. Each fingerprint was labeled as genuine or fraudulent with the aid of the Fusion Net-3 model, which leverages the combined strengths of convolutional neural networks, ResNet-50, and U-Net. The model achieved an accuracy of 98.956% and a mean squared error of 0.0234 when implemented on a Python platform. Overall, the Fusion Net-3 model demonstrated superior performance compared to existing methods, effectively enhancing authentication accuracy and security.

13. Madanan, Mukesh, Nurul Akhmal Mohd Zulkefli, and **Nitha C. Velayudhan.** "RM-SEAGR Net: Interventional Control of Retinal Microsurgery Using SEAS Network Segmentation and Modified GRU Model." *Optoelectronics, Instrumentation and Data Processing* 60, no. 5 (2024): 674-689.

Abstract: Retinal microsurgery is extremely difficult and requires highly skilled surgery with very little margin for error in manipulation. Unexpected manipulations could cause the tool and sclera to come into high force contact, which would harm the sclera. When a surgeon performs surgery, the usage of robotic aids may enhance and increase their manipulating power. However current robotic systems still struggle to identify and avoid the potential intraoperative risk posed by a surgeon's errors. So, in the proposed work, a novel modified deep learning-based interventional control of robot aided retinal surgery is developed. Structured analysis of the retina (STARE) images gathered from the microscope is used as the dataset. These collected raw data may consist of poor visual quality, hence it was enhanced using resize, convolution filtration and regularization reconstruction algorithm. After preprocessing, the enhanced retinal images were segmented using the supervised edge attention guidance segmentation (SEAS) algorithm, which segments the eye nerves and unhealthy portions preciously. The segmented images are extracted using features using the depth wise dilated convo-

lutions and feature reuse-residual block (DDC-FRB) model. These features were given to the modified gated recurrent model (GRU) model for the prediction of healthy and nonhealthy eyes. In GRU, the sigmoid function is modified as well and the performance of the prediction process is improved by selecting the optimal parameter of GRU using the walrus optimization algorithm (WaOA). Thus, the proposed modified deep learning classifier and SEAS segmentation model effectively detect the unhealthy portion with more accuracy. This deep learning based model can be used in real-time applications such as health care management to detect heart, kidney, lung and eye disease by training the model with different datasets. In other applications, the trained model can also be implemented in the robotic surgical tool for operating the patient's organ based on the detection of disease location.

14. Nitha C Velayudhan, Arun Pradeep, Mukesh Madanan, "Adaptive Ship Rescue Optimization Enabled Deep Learning for Sybil Attack Detection with Secure Transmission in Urban VANET," SSRG International Journal of Electronics and Communication Engineering, vol. 12, no. 8, pp. 11-21, 2025. Crossref, <https://doi.org/10.14445/23488549/IJECE-V12I8P102> (SCOPUS)

Abstract: Future road transportation is primarily reliant on connected vehicles. Moreover, Intelligent Transportation Systems (ITS) support road users through the utilization of Vehicular Ad Hoc Networks (VANETs). Rogue nodes, termed *Sybil nodes*, transmit bogus signals to interrupt the system, thereby impacting its security. However, the detection of Sybil attacks is complicated due to the dynamic nature of nodes and stability issues. To address this problem, an Adaptive Ship Rescue Optimization-based Deep Kronecker Network (ASRO-DKN) based Sybil attack detection method is proposed. Initially, VANET simulation is carried out, followed by the implementation of Fractional Glowworm Swarm Optimization for Traffic-Aware Routing (FGWSO-TAR). The Sybil attack is detected at the Base Station (BS), where the input data packet undergoes feature extraction, and the attack is identified using a Deep Kronecker Network (DKN). The hyperparameters of the DKN are tuned using ASRO. Precision, Recall, and F-measure metrics are utilized to validate the proposed ASRO-DKN-based Sybil attack detection method in VANETs. The experimental results achieve optimum values of 90.84%, 90.48%, and 90.13%, respectively.

15. Anaswara, K. P., **Susen Jose**, Meera Varghese, Aleena Ann Mathew, and Manoj Balachandran. "Recent trends in the transformative impact of biomass-derived carbon dots in biomedical science." *Journal of Environmental Chemical Engineering* (2025): 119657.

Abstract: Carbon dots (CDs) have gained significant attention from researchers due to their unique properties, which make them a promising option among nanomaterials for biomedical use. From recent trends, it is confirmed that CDs are the best candidates available among nanomaterials for the treatment of various diseases, including Ulcer, Diabetes, Gout, Wound healing and other syndromes. Semiconductor dots, which dominated in the early days, have been replaced by biomass-derived CDs (BCDs) due to their low toxicity, biocompatibility, and ease of synthesis. Although extensive research has been carried out on the applications of CDs in the biomedical field, the use of biomass as a precursor for CDs in therapeutic and clinical applications remains least explored and has not been systematically reviewed. This review primarily focuses on synthesis strategies, factors influencing the biomedical use of CDs, and recent research

in therapeutic and clinical applications. In addition, the earlier trend of employing BCDs in bioimaging, biosensing, and molecular detection is also discussed. By examining the latest research developments, we provide a comprehensive overview of the progress and future prospects of BCDs in healthcare. This exploration highlights not only the potential of these sustainable nanomaterials but also their promise in enabling new breakthroughs in disease treatment.

16. **Jose, Susen**, Anaswara K. P, Aleena Ann Mathew, Meera Varghese, and Manoj Balachandran. "Biomass Carbon Dots: Illuminating New Era in Antimicrobial Defense and Cancer Combat." *BioNanoScience* 15, no. 1 (2025): 170.

Abstract: The twenty-first century has witnessed remarkable advancements across diverse facets of human life, including significant progress in the medical field, economic growth, scientific breakthroughs, and technological advancements. Despite these strides that improved living standards, the persistent threat posed by pathogenic infections caused by bacteria, fungi, viruses, etc., remains a critical concern. The enduring emergence of new variations of these infections continues to impact lives profoundly. Cancer is another looming spectre that continues to challenge human health security. Consequently, extensive research endeavours aim to develop swift, efficient, and innocuous methods for curing and preventing these infections. This paper explores a burgeoning field in physics, focusing on recent advancements in nanomaterials, particularly in developing carbon dots (CDs). Characterized by their size, which is less than 10 nm, CDs have proven exceptionally beneficial in diagnosing and treating life-threatening health issues while preserving the viability of healthy cells. Their versatility is evident in various biomedical applications, serving as bioimaging probes, intracellular drug delivery agents, and agents for bactericidal and fungicidal, as well as in cancer treatment and diagnosis. The key attributes contributing to their efficacy include ease of functionalization, biocompatibility, fluorescence, low cytotoxicity, and catalytic properties. As an innovative nanomaterial, CDs showcase tremendous potential in advancing medical diagnostics and therapeutics, offering a glimpse into a future where these tiny entities play a pivotal role in ensuring human well-being. This review focuses on the antibacterial, antifungal, antiviral, and anticancerous activities of the CDs derived from various precursors derived by biomass.

Patents

2. Patents Published/Granted

Patents Published/Granted in 2025

Patent Number	202541026752
Date of Publication	11/04/2025
Title	EEG-EOG CONTROLLED WHEELCHAIR USING THE BIO AMP EXG PILL FOR MOBILITY ASSISTANCE
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Ms. Emilin Thomas Kangappadan 2. Suvin A S 3. Sreelakshmi M S 4. Savedh Divakaran 5. Thomas Legin 6. Dr. Eugene Peter

Abstract: This work presents the development of an EEG and EOG signal-controlled wheelchair based on the Bio Amp EXG Pill. The system is designed to help paralysis sufferers, using a natural and useful method of movement control based on brain activity and eye movement signals. EEG activity signals from the brain are used to control motor, whereas EOG eye movement signals control forward and backward movement. The signals are recorded by placing electrodes on either side of the eye, with the reference electrode behind the ear. Signals are filtered and amplified with the Bio Amp EXG Pill data collected, processed by an Arduino Uno for affordability. For driving the motor of the wheelchair, an external supply of 12V is provided for on-and-off operations. In addition, an IBT-2 motor driver is utilized to ensure effective speed control and direction of the motor to provide smooth and accurate motion. The overall system is designed to be accessible, affordable, and usable, and is a viable possibility for individuals with mobility impairments.

Patent Number	202541023893
Date of Publication	28/03/2025
Title	Automation of Traffic Signal Using AI
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Dr. Jino John 2. Dr. Krishnapriya M.G. 3. Ajeesh S 4. Nasiya S.A. 5. Sandra Shaji 6. K. Amrutha Sunil 7. Amal V. Nair 8. Praise Varghese Paul

Abstract: The present invention relates to an AI-powered adaptive traffic signal system designed to optimize traffic flow by dynamically adjusting signal timings based on real-time traffic density. Traditional traffic signal systems rely on fixed-time cycles, which fail to accommodate fluctuating traffic conditions, leading to congestion, increased fuel consumption, and longer travel times. This invention addresses these challenges by integrating manual data collection, computer vision, and machine learning to create an intelligent traffic management solution. The system operates by first collecting manual vehicle count data to determine the optimum cycle time for traffic signals. A key observation from this data is the significant difference in traffic density between morning and evening peak hours, highlighting the need for an adaptive solution. To automate traffic monitoring, video feeds are processed using the YOLO (You Only Look Once) object detection algorithm, which accurately detects and counts vehicles. The collected data is then utilized to train an AI model capable of predicting traffic patterns and dynamically adjusting signal durations. Once deployed, the system continuously monitors real-time traffic conditions, learns from historical data, and optimizes traffic signal operations accordingly.

Patent Number	202541057891
Date of Publication	27/06/2025
Title	Sustainable Re-entrant Auxetic Grids for Lateral Confinement in Columns
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Angitha Sasidharan 2. Riya Joseph 3. Arjun Krishna K.J. 4. Athul Krishna K. V. 5. Hostin Herald 6. Joseph Thomas

Abstract: External confinement in RCC columns is necessary for retrofitting existing structures, seismic upgrading, repairing damaged columns and increasing load capacity, ultimately extending the lifespan and resilience of existing structures. By providing external confinement, columns can experience enhanced strength and ductility, improved seismic resistance, and

increased durability. Auxetic materials have become increasingly relevant in engineering as they expand in transverse direction in tension and shrink laterally in compression, exhibiting Negative Poisson's Ratio (NPR). This approach evaluates the confinement effect of auxetic grid on concrete columns, focusing on their structural performance enhancements. Conventional geogrid, commonly used for soil reinforcement in applications like road construction, slope stabilization, and retaining walls, features a regular square or rectangular grid pattern, typically made from polymers, metals, or composite materials. When subjected to tensile forces, this type of mesh generally stretches along the force direction but contracts perpendicularly, following the typical Poisson's ratio behaviour. The proposed auxetic geogrid behaves differently when stretched compared to conventional materials. Instead of contracting perpendicularly when stretched, it expands in both directions. In this study, re-entrant honeycomb geometry is adopted for the grid to enable the auxetic effect. The auxetic geogrid can be produced using advanced extrusion and weaving techniques, ensuring uniform auxetic behaviour and mechanical performance across large-scale production. The development of sustainable auxetic geogrids involves the integration of eco-friendly materials and energy efficient manufacturing techniques while maintaining superior mechanical properties. This innovative geogrid will improve the load-bearing capacity of confined columns by reducing lateral expansion under compressive loads, thereby enhancing seismic resistance by improving energy absorption and crack control in earthquake-prone areas.

Patent Number	202541074635
Date of Publication	22-08-2025
Title	Real Time Environmental Data Driven AI Model for Landslide Risk Prediction System
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Hingston Xavier 2. Minnu Moothedhan 3. Suni Jose 4. Antony T Jose 5. Avin Benny 6. Augustine S Alappat 7. Aizal Begene Melite 8. Angel Maria K B 9. Amina Nasrin P S

Abstract: The Real-Time Environmental Data Driven AI Model for Landslide Risk Prediction System (LRPS) addresses critical limitations in conventional landslide prediction systems, which largely depend on static models and historical records. These older methods often result in delayed or inaccurate alerts, posing serious threats to human life and infrastructure. LRPS introduces a dynamic, real-time, machine-learning-based approach to landslide risk forecasting, integrating multi-source data streams such as satellite imagery, meteorological data, soil and terrain features, and historical event logs. At the core of LRPS is an ensemble machine learning engine leveraging Random Forest, SVM, and XGBoost models, stacked with a Logistic Regression meta-learner to optimize prediction accuracy. The system processes and analyzes data through a structured pipeline consisting of collection modules, data preprocessing (including feature scaling, class balancing with SMOTE, and polynomial feature engineering), model training, and a real-time alert generation engine. With an emphasis on cost-effective

implementation, LRPS eliminates the need for expensive ground-based sensors by relying on widely available data sources. This AI-powered system generates highly reliable early warnings, transmitted via dashboards and automated communication tools such as WhatsApp, to help communities and disaster management agencies make timely decisions. Scalable and adaptable, LRPS offers a major leap forward in proactive disaster preparedness, response, and risk mitigation

Patent Number	6459976
Date of Publication	31-07-2025
Title	AI-based Personalized Student Mentoring Computer Device Using Large Language Models and Risk-Based Action Routing
Patent Issuing Authority	UK
Name of the person/s associated with the patent during the service period in the respective institution	1. Ms. Jasmine Jolly 2. Ms. Athithya S 3. Dr. Sreetha ES 4. Ms. Hima Jose 5. Mr. Geo George 6. Mr. Christeenno Telfin 7. Mr. Kailas V S

Abstract: The device operates as a data processing and communication platform, capable of analyzing student interactions in real time and dynamically adjusting mentoring strategies. Risk-based action routing ensures that critical cases receive timely escalation, while routine queries are handled efficiently through automated responses. This approach not only improves the scalability of mentoring services but also ensures a more responsive and personalized educational experience.

Patent Number	202541083295
Date of Publication	01/10/2025
Title	IOT Enabled Landslide Detection and Alert System Using Node Red
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Dr. Krishnapriya S 2. Lima Rose 3. Devika Dinesh 4. Arya Anandan 5. Benpaul Benny 6. Dr. Rajesh M

Abstract: Landslides are a serious hazard in hilly and mountainous areas and usually cause extensive loss of life and destruction of property. Recent research reports that sensors have the capability to monitor evangelical parameters like vibration, moisture content, and land deformation with good accuracy, thus yielding vital information regarding possible landslide incidents. The current technologies used for landslide monitoring tend to be very expensive and less reliable, thus less viable for widespread deployment on distant and harsh environments. This

project intends to overcome these challenges by creating an integrated sensor-based landslide monitoring system that capitalizes on real-time data acquisition, processing, and analysis. The system comprises several sensor nodes situated strategically in landslide locations to acquire vital environmental parameters. These sensors relay real-time information to a microcontroller, which processes the data and then sends it to a cloud platform for sophisticated data analysis, visualization, and storage. By leveraging the use of cloud computing, the system facilitates remote access and real time monitoring, enabling disaster management units and authorities to monitor evolving conditions and adopt preventive action promptly. The core use of this system is in the generation, detection, and constant monitoring of early warnings, greatly enhancing disaster preparedness and response measures. This cost-efficient and expandable solution has the potential to transform landslide monitoring through the delivery of precise, real-time information, which eventually assists in reduce the dangers posed by landslides and improve the security of populations

Patent Number	454756-001
Date of Publication	29/07/2025
Title	Medical Trolley Integrated with Waste Disposal System (Set)
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Jesna Jose 2. Malavika Sureshababu 3. Mariya Santhosh 4. Riya Mary Prince 5. Lekshmi Nair M 6. Vinoj P G

Abstract:Healthcare facilities generate a significant volume of biomedical waste during routine clinical procedures, and improper segregation or delayed disposal can lead to cross-contamination, occupational hazards, and environmental risks. Conventional medical trolleys primarily focus on mobility and storage of instruments but lack integrated mechanisms for systematic waste management. This project proposes the design and development of a Medical Trolley Integrated with a Waste Disposal System (SET) aimed at improving operational efficiency, hygiene, and safety within hospital and clinical environments. The proposed system combines a multifunctional medical trolley with a built-in waste segregation and disposal unit. The trolley is designed with ergonomically arranged compartments for medical instruments, consumables, and medications, along with color-coded waste bins conforming to biomedical waste management guidelines. Touch-free disposal mechanisms, such as foot-operated or sensor-based lids, are incorporated to minimize direct contact and reduce the risk of infection transmission. The system may also include removable waste containers for easy handling, sterilizable surfaces, and optional smart features such as fill-level indicators or RFID-based waste tracking. Engineering principles related to mechanical design, material selection, ergonomics, and hygiene control are applied to ensure durability, ease of movement, and compliance with healthcare standards. The integrated approach reduces the time and effort required by healthcare personnel to manage waste separately, thereby streamlining clinical workflows and enhancing patient care efficiency. The Medical Trolley Integrated with Waste Disposal System (SET) offers a practical and scalable solution for hospitals, clinics, and emergency care units. By promoting proper waste segregation at the point of generation and improving mobility and accessibility of medical tools, the system contributes to safer

healthcare practices, reduced infection risks, and improved compliance with biomedical waste management regulations.

Patent Number	202541056157
Date of Publication	20/06/2025
Title	GEOMAG SENTINEL UAV: AUTONOMOUS UAV FOR REAL-TIME MAGNETIC ANOMALY DETECTION
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Ajeesh S. 2. Samuel Job P. 3. Vasudev Ravunni Kutty 4. Meghasyam Pulikkathara Modesh 5. Aman T. Naseer

Abstract: The GeoMag Sentinel UAV is a state of the art, autonomous aerial system engineered for the real time detection, classification, and mapping of subsurface magnetic anomalies. Leveraging the strengths of modern embedded sensing, communication, and AI technologies, this invention addresses the critical limitations of traditional magnetic anomaly detection systems, such as slow post processing, poor coverage, and lack of adaptability to dynamic terrains. At its core, the system integrates a three axis high sensitivity magnetometer (HMC5883L) for continuous magnetic field monitoring, a GPS module for precise geo tagging, and a LoRaWAN based wireless communication module for reliable, low power, long distance real time data transmission. These are embedded into a UAV platform that autonomously navigates the survey area, making intelligent decisions in flight based on live sensor feedback. A distinguishing feature of this system is the Baseline Geomagnetic Field Mapping Technique, which allows the UAV to create a reference map of the Earth's magnetic field in an undisturbed region before active anomaly detection begins. This enables the system to effectively discriminate between normal magnetic field variations and those caused by buried metallic or magnetic objects. The data collected during flight is transmitted in real time to a cloud based processing platform, where AI driven algorithms analyze magnetic variations and generate intuitive heatmaps indicating potential anomalies. These visualizations are immediately accessible by ground station operators or remote users, enabling rapid decision making and reducing the time between detection and response. In addition to anomaly detection, the UAV is capable of dynamic path correction. In addition to anomaly detection, the UAV is capable of dynamic path correction—altering its flight trajectory in real-time based on the density and severity of detected anomalies. This ensures higher resolution mapping in areas of interest without human intervention. Applications of the GeoMag Sentinel UAV are diverse and impactful, including but not limited to military landmine detection, unexploded ordnance (UXO) localization, geological mineral exploration, archaeological site surveys, and environmental monitoring for buried infrastructure or hazardous materials. The system's modular and scalable architecture enables deployment across various field

conditions, terrains, and mission profiles. across various field conditions, terrains, and mission profiles.

Patent Number	202441088008
Date of Publication	22/11/2024
Title	Pneumonia detection using CNN in Federated Learning environment
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Ms. Suni Jose 2. Dr. Gopika S 3. Dr. Ajay James 4. Dr. Needhu Varghese 5. Ms. Minnu Mooothedan 6. Ms. Keerthana I P 7. Mr. Antony T Jose 8. Ms. Iris Jose

Abstract: As the symptoms of certain fatal diseases are not readily visible on CT as well as X-ray images, computerized identification of serious respiratory conditions like pneumonia, caused by inflammation of the air sacs of the lung alveoli, poses a substantial problem in medical imaging. Moreover, it is a crucial job because pneumonia affects millions of people each year. The main purpose of this work is to develop an innovative machine learning technique in federated learning environment using a deep learning neural network to solve the aforementioned problem. A convolutional neural network is used for detection of the disease. The proposed technique was trained and tested using a collection of 5856 images with tags from one of Kaggle's medical imaging challenges. Anterior-posterior chest X-ray pictures were obtained. Federated Learning is a collaborative learning unlike the traditional machine learning where the entire learning happens in a centralized server. Many organizations like hospitals are reluctant to share their patient's data due to privacy concerns. Federated Learning comes as a solution to this problem. In FL method, models are trained locally on the client side. Data is not transferred outside the organization. Thus FL helps the model to attain finer accuracy by training model on vast amount of data without sharing. Thus this method of training ensures data privacy and security. In this work, pneumonia detection using CNN in a federated learning environment has been developed. This model uses Federated averaging as the aggregation mechanism. Flower framework is used for the implementation of federated learning environment. An accuracy of 97 percent is obtained for 10 communication rounds which is at par with the accuracy obtained with centralized learning implementation

Patent Number	202541045480
Date of Publication	12/05/2025
Title	PV-TEG hybrid collector integrated smart tiles for better sustainability and energy harvesting
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Dr. Alos James 2. Prabhasankar V P 3. Theresa Joshy 4. Akshara K S 5. Anna Rose 6. Ison Johnson

Abstract: With the growing demand for renewable energy, solar energy capture and integrated technologies are gaining attention from a sustainability perspective. The present invention relates to a novel energy-harvesting interlocking tile system that integrates photovoltaic (PV) cells and thermoelectric generators (TEGs) to simultaneously capture solar and thermal energy for power generation. This approach addresses the rising need for clean energy while reducing reliance on conventional power sources. Designed for deployment in pavements and outdoor surfaces, the smart tile consists of a top-mounted PV panel to convert sunlight into electricity, while residual heat is harnessed by the underlying TEG modules, enhancing overall energy conversion efficiency. Extracting surplus heat from the pavement tiles helps mitigate thermal expansion and contraction under varying weather conditions, extending their service life. The tile is further engineered with heatretaining materials such as hydro gel to maintain a temperature gradient critical for TEG operation. This dual-energy harvesting system is embedded within a durable concrete interlocking tile reinforced with silica fume for improved strength and sustainability. As a dual-purpose solution, it offers the potential to transform standard construction materials into decentralised energy sources. The generated electricity can be stored or used for powering street lighting, sensors, or charging small-scale devices. This invention aligns with the United Nations' Sustainable Development Goals, particularly in promoting affordable and clean energy, and fostering sustainable urban communities. The project aims to produce a market-ready prototype that not only contributes to energy efficiency but also enhances the durability of pavement materials, paving the way for future applications in smart city infrastructure, including wireless electric vehicle charging.

Patent Number	202541026749
Date of Publication	11/04/2025
Title	Solar Powered Autonomous Waste Collection Robot for Sustainable Beach Clean-Up
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Dr. Needhu Varghese 2. Vishnukanth R D 3. Chris Paul Simon 4. P. Sidharth K R 5. Godwin Pauly

Abstract: The solar-powered waste collecting robot on beach is a sustainable and autonomous solution designed for efficient waste collection in coastal areas. By harnessing solar energy through strategically positioned solar panels, the robot operates independently, reducing reliance on conventional power sources and minimizing environmental impact. Integrated battery storage systems ensure uninterrupted functionality even during periods of low sunlight. The robot features a Raspberry Pi-based control system, enabling both autonomous navigation and IoT-based remote control via a mobile interface, ensuring efficient operation in various environments. As IoT is enabled, the robot can be controlled remotely from anywhere, providing flexibility and real-time monitoring for optimized performance. To enhance safety and reliability, the robot is equipped with an object avoidance system, preventing collisions with obstacles and ensuring smooth operation even in crowded or debris-filled areas. A mechanized arm mechanism efficiently collects and deposits waste, reducing the need for human involvement in potentially hazardous waste cleanup. Specialized terrain-adaptive tires provide stable movement on sandy surfaces, overcoming mobility challenges often faced in beach environments. Additionally, a smart notification system alerts operators when the waste storage compartment is full, ensuring timely disposal and preventing overflow. The combination of renewable energy, automation, and intelligent control makes the robot a cost-effective, eco-friendly, and scalable solution for maintaining cleaner coastal regions, reinforcing the role of technology in sustainable waste management.

Patent Number	202541051169
Date of Publication	13/06/2025
Title	Real-Time Monitoring and Classification of Airborne Synthetic Drugs Using AI
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Libihari K B 2. Nithin K S 3. Josevin Sojan 4. K. Divyesh Menon 5. Lakshmi A. 6. Lenin Sunil 7. Lloyd T J 8. Navneeth C Manoj

Abstract:Traditional drying or moisture removal methods for food materials as well as other wet substances mainly involve processes such as sun drying and conventional dryers. Apart from these, we consider drying food materials and spices by a method which involves two circulation fans in which one is used for the removal of moisture whereas the other is for the circulation of heat. We identified a need for such dryers in the rural areas of the state, especially in our district where moisture removal is mainly dependent on sun drying which imbibes inconsistent drying throughout the process which is also time-consuming. Along with this the loss of aroma, colour and texture also degrades the commercial value of mace in international as well as domestic markets. Kerala being the largest producer of nutmeg in India truly needs such a compact and economically sustainable nutmeg drier. A platform such as IoT also enables data acquisition along with the result analysis that inhibits the inconsistent drying of spices such as mace by proper monitoring of the process through temperature and humidity sensors that prevent over-drying and under drying. The addition of the solar panel also makes the process sustainable and economically feasible which uses the solar energy for the power required to run the circulation fans.

Patent Number	202541017146
Date of Publication	07/03/2025
Title	A Copper Plating Bath Without Ammonium Nitrate for the Deposition of Copper on Aluminium Substrate
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Dr. Arun Augustin 2. Dr. Meril Shelly

Abstract:Thin film deposition of copper on aluminum is essential in the design of touch free surfaces, medical utilities, household items, electronic circuits and decorative applications. Conventionally, this is done using electrolytic deposition process either by using cyanide and non-cyanide baths. Cyanide baths are environmentally hazardous and hence its use is not encouraged. Accepted non-cyanide bath contains ammonium nitrate as one of the ingredient. But the commercial usage of ammonium nitrate is banned in many of the developing countries (like India) and some of the developed countries like USA. Efforts are there to develop non-cyanide, environmental friendly electrolytic baths for copper deposition. Here, we present a non-cyanide electroplating bath (without ammonium nitrate) which was used to deposit copper thin films on aluminum, successfully.

Patent Number	202541015493
Date of Publication	07/03/2025
Title	AI for digital immortality using reinforcement and multimodal learning
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1. Dr. Caren Babu 2. Ms. Sreelekha T 3. Sidharth KS 4. Ajay Krishna VS 5. Aloshius Francis 6. Fahad MD

Abstract:The invention titled "AI for Digital Immortality Using Reinforcement and Multimodal Learning" presents an advanced artificial intelligence framework designed to preserve, simulate, and evolve human interactions and decision-making processes. The system leverages reinforcement learning to continuously optimize responses based on user feedback and integrates multimodal learning to process diverse data streams, including text, audio, and visual inputs. This comprehensive approach ensures context-aware and highly personalized interactions. The invention comprises a scalable frontend and backend web-based architecture, facilitating real-time communication through secure and intuitive interfaces. A robust data preservation module stores user-specific preferences and behavioral patterns, enabling the AI system to develop a dynamic, evolving digital persona that can interact autonomously. The system supports cloud storage solutions for scalable data management and ensures secure user interactions through modern authentication mechanisms. Applications include digital legacy management, AI-powered customer service systems, personalized virtual assistants, and intelligent content delivery platforms. This invention offers a transformative approach to creating enduring digital identities, addressing the demand for intelligent and personalized interaction systems through advanced machine learning techniques

Patent Number	6477949
Date of Publication	21/10/2025
Title	Data Processing Equipment to Enable 5G-Integrated Smart Home Device
Patent Issuing Authority	UK
Name of the person/s associated with the patent during the service period in the respective institution	1. Dr. Vijaya Maheswari Muthukrishnan 2. Dr. Vinoj Parambaloth George 3. Isha Das 4. Chaitra Praveen 5. Neha Singh 6. Ishan Das 7. Anirudh Nelamangala Manjunath 8. Adrish Das

Abstract: The proposed innovation presents a next-generation data processing equipment designed to enable seamless integration of smart home devices within a 5G communication ecosystem. With the rapid growth of the Internet of Things (IoT), conventional home automa-

tion systems face challenges such as latency, limited bandwidth, and inefficient real-time data handling. This system leverages the high-speed, low-latency, and massive connectivity capabilities of 5G networks to enhance the performance, scalability, and intelligence of smart home environments. The developed equipment functions as a centralized edge-processing unit that collects, processes, and manages data from multiple smart devices, including sensors, appliances, security systems, and energy management modules. By incorporating edge computing techniques, the system minimizes reliance on cloud infrastructure, thereby reducing response time and improving data privacy and reliability. Advanced data processing algorithms and AI-based analytics are integrated to enable real-time decision-making, predictive maintenance, and adaptive automation tailored to user preferences. The architecture supports secure communication protocols, ensuring robust protection against cyber threats while maintaining high data integrity. Additionally, the system is designed for interoperability, allowing compatibility with diverse IoT standards and legacy devices. The implementation of this innovation facilitates efficient energy utilization, enhanced user convenience, and intelligent control over home environments. Overall, this 5G-integrated data processing equipment represents a scalable and future-ready solution for smart homes, enabling faster communication, smarter automation, and improved quality of service, thereby contributing to the evolution of intelligent living systems.

Patent Number	202541103717 A
Date of Publication	28/11/2025
Title	AI-DRIVEN PLASTIC SORTING AND PELLETIZING KIOSK
Patent Issuing Authority	Indian
Name of the person/s associated with the patent during the service period in the respective institution	1)Dr .Jobin M V 2)Dr Nixon Kuruvila 3)Dr Nitha C Velayudhan 4)DR SIGIMON N B

Abstract: The main design of the present invention discloses an AI-driven plastic sorting and pelletizing kiosk, comprising a power supply system, input feed section, detection and sorting module, pelletizing module, output unit, and a user interface and connectivity unit. The invention automatically identifies, sorts, cleans, shreds, and converts post-consumer plastic waste into reusable pellets. The power supply ensures continuous operation. Users deposit plastic waste into the input feed section, where oversized or unsuitable items are removed, and accepted plastics are transported for processing. The detection and sorting module uses AI vision cameras and near-infrared sensors to classify plastics and direct them through automated gates into appropriate channels. The mechanical processing unit washes, dries, and shreds plastics, preparing them for the pelletizing module, where they are melted, extruded, cut, and cooled into uniform pellets. The output unit delivers the recycled product, while the user interface allows monitoring, tracking and operational updates, providing an automated and sustainable solution for plastic recycling.

Patent Number	6463103
Date of Publication	04/09/2025
Title	Predictive Analytics device utilising gesture control
Patent Issuing Authority	UK
Name of the person/s associated with the patent during the service period in the respective institution	1. Dr. Vince Paul 2. Dr. S. Brilly Sangeetha 3. Dr. John Chembukkavau 4. Kavya Clare Palackal Shaji 5. Dr. Asha Sulabha 6. Ms. Santhi Parekatte 7. Ms. Neethu Prabhakaran 8. Ms. Athira Bose

Patent Number	6415861
Date of Publication	27/01/2025
Title	Network Monitoring Computer
Patent Issuing Authority	UK
Name of the person/s associated with the patent during the service period in the respective institution	1. Dr. Vince Paul 2. Dr. Vadhana Kumari Selvaraj 3. Dr. Winson Rajaian 4. Ms. Hrudya Kavalloor Prabhakaran 5. Dr. Anbu Megelin Star Anbiah 6. Dr. Brilly Sangeetha



3. Conference Publications

Conference Publications

1. Manohar, Binu, **S. Krishnapriya**, Dewmol Johny, Emy Sara George, and Josna Mary Jose. "Implementation of IoMT-Assisted Smart Healthcare Monitoring for Clinical Infectious Diseases." In 2024 IEEE Region 10 Symposium (TENSYP), pp. 1-5. IEEE, 2024.

Abstract: Contactless interactions are more common in recent years due to advances in technology and consumer demand for the convenience of touch-free transactions. In this work, a nursing assist for hospitals is proposed which can reduce the risk of infection by decreasing the interactions with the patients. Nurses have to take rounds at least twice a day for the health check-up and doctors spend a part of their consultation time for the daily check-up of each in-patient. Therefore, the proposed device assists the nurses by monitoring the patient's health such as measuring temperature, heart rate and oxygen saturation level periodically using sensors. The medical report of the patient can be stored in the cloud and accessed from the nursing station. From the database, the doctors can analyze the patient's health easily and can change the way of treatment if needed. The proposed device here can avoid the systematic and tedious rounds by nurses and doctors and also improves the patient satisfaction. This machine could be a key system to help and drive down the costs of care and human labour.

2. **S. Krishnapriya**, "Simulation Studies of Nonspiral Planar Microcoils of Square Geometry," 2024 International Conference on Advances in Modern Age Technologies for Health and Engineering Science (AMATHE), Shivamogga, India, 2024, pp. 1-4, doi: 10.1109/AM-ATHE61652.2024.10582234.

Abstract: Planar microcoils are integrated components in micro sensors and actuators with the recent advancements in MEMS technology. Spiral planar microcoils are reported mostly in literature. Non-spiral planar coils provide an easier option to using

lesser number of metal levels. They can be used effectively for generation and detection of magnetic fields. In this paper, a non-spiral planar square microcoil is proposed and its finite element model is developed. Simulation results are presented highlighting the unique features of the coil.

3. **Krishnapriya.S**, Rama Komaragiri, "Micromanufacturing and characterization of Coplanar microcoils of Various geometries" [in press]

Abstract: This paper presents the microfabrication and characterization results of emerging coplanar microcoils of circular and square geometries and compares their electrical characteristics. Conventional coils are of spiral non-coplanar geometry. The advantages of the coplanar microcoils are highlighted here since the coplanar microcoils require a single metal level for their manufacturing with reduced series resistance. Circular and square geometries are studied as they are the standard geometries for microactuator applications. Series resistance, inductance, and capacitance of both the geometries are evaluated to decide the most feasible geometry for sensing applications.

4. **Paul, V. Milner**, Shuma Adhikari, Loitongbam Surajkumar Singh, **Tony C. Thomas**, and **Caren Babu**. "A Low Noise Signal Conditioning Circuit for Neural Signal Acquisition." In 2025 11th International Conference on Smart Computing and Communications (ICSCC), pp. 1-6. IEEE, 2025.

Abstract:

Neural signals such as action potentials and neural spikes require precise amplification and noise suppression for accurate acquisition. In this work, a low-noise signal conditioning circuit is designed to enable the detection of neural spikes from the human body. The amplitude of these signals lies in the microvolt range, which demands an efficient signal conditioning system to amplify and process them. In this design, a preamplifier with sufficient gain is developed to amplify the signal while minimizing noise. This stage is followed by a bandpass filter capable of filtering signals in the frequency range of 300 Hz to 11 kHz. The proposed signal conditioning circuitry achieves a passband gain of XX dB. Additionally, the design is validated for stability in terms of gain margin and phase margin. The circuit achieves a signal-to-noise ratio (SNR) of XX dB and drops to 40.97 dB at 11 kHz when input noise is applied. Its low-voltage operation and wide specification range make it suitable for diverse biomedical applications, ensuring reliable neural recording for brain studies.

5. Annliya Raju, Nivedhitha V Anil, Archana T A ,Seethalakshmi,**Krishnapriya.S**, **Tony C Thomas**, "FEA and Experimental Studies of MOS Microgas Sensor with integrated in-plane microheater." 2025 11th IEEE International Conference on Smart Computing and Communications (ICSCC), Cochin, India

Abstract: Metal Oxide Semiconductor based Microgas Sensors are widely employed for detecting even a trace amount of gas, with widespread applications in detection of poisonous gases for environmental monitoring and biomedical fields. Sensing layers in microgas sensors can be suitably optimized to detect target gases. Metal Oxide Semiconductors (MOS) is a sensitive structure for gas sensing due to its superior performances. A microheating layer with an interdigitated electrode (IDE) is useful to excite and activate the sensing layer. In this work, the scope of Finite Elemental

Analysis (FEA) is explored to analyse the electrical and thermal performance of the electrode and heater layers, while experimental validation ensures its accuracy. The sensitivity of the methane gas sensor was found to be optimal at 300 Degree C, with a maximum sensitivity of 65%. The sensor exhibits high sensitivity, saturation and recovery, making it an efficient tool for sensing applications. The simulation of in-plane microheater with interdigitated electrodes is performed using the software COMSOL Multiphysics.

6. **Vinoj, P. G.**, and Varun G. Menon. "AI assisted BCI system for rehabilitation." In 2025 4th International Conference on Advances in Computing, Communication, Embedded and Secure Systems (ACCESS), pp. 741-745. IEEE, 2025.

Abstract: BCI (Brain Computer Interface) is a leading technology designed to assist individuals with disabilities. However, current BCI-based devices encounter challenges in promoting recovery due to inadequate training, insufficient supervision, and the mental fatigue that arises from prolonged use. Users often feel frustrated because executing mental commands requires intense concentration, which can lead to inaccuracies and a lack of control over the assistive technologies. To tackle these issues, a BCI framework has been unified with machine learning model to mitigate mental tiredness and improve user satisfaction. This model uses an integration of LSTM (Long Short-Term Memory) and CSP (Common Spatial Pattern) based approach to interpret a patient's movement intentions based on signal characteristics learned during training. It classifies various Electroencephalogram (EEG) patterns to translate them into desired upper limb movements, effectively activating muscles to aid rehabilitation of stiff body parts. Testing on both healthy and paralyzed subjects yielded a classification accuracy of 98.2% in determining limb motion intentions. These findings position the LSTM-based deep learning model as a powerful tool for BCI-controlled rehabilitation.

7. Adithya Jayan, **Vinoj P G**, Sreeja Rajesh, Chinn Mohanan, Edwin C S, Ardra Maria, Issac Paul K Fabin, Sukritha Krishna, Kalidasan E S, " A smart, IoT- enabled embedded system powered by renewable energy for the safe and efficient disposal of medical wastes", National Symposium & Research Colloquium (NSRC), organised by NIT Calicut from 4-5 October 2025

Abstract: The increased number of hospitals, patients, atmospheric pollution and occurrence of pandemics like Covid 19 have contributed to the Personal Protective Equipment's (PPE) consumption rate. There is a huge shoot up in the use of masks, gloves and other PPE by sanitation workers, garbage man, front- line health care and laboratory workers. The terrestrial and marine ecosystems as well as the human health will be affected by these infectious materials if it is not handled scientifically and disposed properly. The safe disposal of used masks, gloves, and PPE kits is one of the major concerns, as it can enhance the possibilities of spreading infection. Thus, we're setting ahead a smart embedded system which guarantees the right dismissal of masks, gloves and PPE kits in an ecologically sustainable way wherein the fitness and productiveness of the existing generation is maintained. The proposed IoT enabled system not only protects humanity from the infection, but also ensures environmental pollution control to a greater extent. This renewable energy driven IoT enabled system also provides a platform for sterilization and disposal of infectious waste.

8. Joy, Abhay Varghese, **Emilin Thomas Kangappadan**, Amras Prasad, K. S. Nandakishore, and Thansiya Ismail. "On-Board Electric Vehicle Charger Using Phase Shifted Single Phase DC-DC Converter and Totem Pole Power Factor Correction Converter." In 2024 International Conference on Advancement in Renewable Energy and Intelligent Systems (AREIS), pp. 1-5. IEEE, 2024.

Abstract: This paper presents an on-board charger for electric vehicle applications which consists of two sections. The first section consists of a boost power factor correction converter using totem pole configuration and the second section consists of a phase-shifted single phase converter. The bridgeless totem pole converter functions in continuous conduction mode within the on-board charger. The paper focuses on the control strategy employed in the first stage of the charger which helps to sustain the power factor. This in turn limits the harmonic distortion through the active shaping of the line current. The prototype developed charges a 12 V, 7 Ah lead acid battery. To lower the overall rating of the system, a 24 V AC is supplied to the entire charging system. An auto-cut-off system has been implemented to monitor the charging levels and switching of the system.

9. Chungath, Ivin Inasu, **Needhu Varghese**, Dheeraj Kumar, and Daniel TS. "Solar Powered Raspberry Pi Based Snack Vending Machine Using QR Code." In 2024 International Conference on Advancement in Renewable Energy and Intelligent Systems (AREIS), pp. 1-6. IEEE, 2024.

Abstract: The solar powered snack vending machine represents a sustainable innovation in the realm of vending technology. By harnessing solar energy through strategically placed solar panels, the machine operates autonomously, reducing reliance on traditional power sources and minimizing its carbon footprint. Integrated energy storage systems ensure uninterrupted functionality even during periods of low sunlight. This paper outlines the design and implementation of a solar powered snack vending machine, aiming to combine sustainability with modern convenience. It can provide essential foods in remote outdoor locations. It is powered by a 75W solar panel and a 12V battery with 2 days of autonomy and operates without traditional power sources. It is automated by a Raspberry Pi microcontroller which offers product selection and digital payment through a dedicated website, supporting platforms like Unified Payments Interface and PayPal. The machine features precise dispensing with 12V DC motors and Infrared Sensors, and is designed for unmanned operation. This solar powered snack vending machine not only offers a sustainable alternative to conventional vending machines but also serves as a practical application of renewable energy in everyday scenarios.

Milner Paul, Caren Babu, Tony C Thomas 11th International Conference on Smart Computing and Communications (ICSCC 2025) Muthoot Institute of Technology and Science "A low noise signal conditioning circuit for neural signal acquisition" in 11th International Conference on Smart Computing and Communications (ICSCC 2025) organized by Muthoot Institute of Technology and Science held on 3rd to 5th July, 2025

10. **Sreemol, R., P. R. Neethu, and C. Velayudhan Nitha.** "Secure Fingerprint Reconstruction-based Authentication System using WDBS-VSS and Geometric Mean Ronald Fisher Score Algorithm." In 2025 Advanced Computing and Communication Technologies for High Performance Applications (ACCTHPA), pp. 1-8. IEEE, 2025.

Abstract: This study introduces a comprehensive approach that synergizes cryptographic encryption, Wiener Direct Binary Search-centered Visual Secret Share (WDBS-VSS) and deep learning to fortify the security and precision of fingerprint authentication systems. During enrollment, authentic fingerprint images are collected from individuals, forming the core of the database. Collected images undergo pre-processing, which includes noise reduction, contrast enhancement and resizing. To address privacy concerns, genuine fingerprint images are encrypted using the Advanced Encryption Standard (AES), converting them into an unreadable format without proper decryption keys. Furthermore, the encrypted fingerprint images undergo the WDBS-VSS process. In the authentication phase, a query fingerprint-intended for authentication is pre-processed similarly to the enrollment phase. The pre-processed image then undergoes feature extraction using an improved Deep Belief Network (iDBN) coupled with the Self Improved Wild Geese Migration Algorithm (SI-WGMO). Following feature extraction, the Geometric Mean Ronald Fisher Scores (GMRFS) algorithm is employed which quantifies the discriminatory power of the extracted features. Lastly, classification is executed using an optimized threshold. The hybrid model, enhanced by both feature extraction and GMRFS, determines whether the query finger-print is genuine or fake based on the optimized threshold. This system enhances security and efficiency in fingerprint recognition for modern biometric applications. It provides robust protection against spoofing and tampering attacks and improves fingerprint matching accuracy by using geometric mean statistics. The system achieves up to 15 % higher accuracy and a security level of over 98

11. National Conference on Applied Interdisciplinary Civil Engineering (AICE-2025) Adi Shankara Institute of Engineering and Technology **Vinitha E. V.**, Ansha M. M., Adith A. S., Brahmadathan C. P., Vinayak K. Mohandas, “Greywater Characterization and Treatment For Reuse”, National Conference on Applied Interdisciplinary Civil Engineering (AICE-2025) organized by Adi Shankara Institute of Engineering and Technology held on 7th and 8th March, 2025

Abstract: Grey water, the wastewater generated from domestic activities such as bathing, washing, and cooking, often constitutes a significant portion of inhouse wastewater. This wastewater stream, while less polluted than black water, holds substantial potential for reuse in non-potable applications like irrigation and toilet flushing. The sampling of greywater will be conducted from different households varying the income level-low, middle and high in both rural and urban areas since the lifestyles vary significantly based on income which causes variation in greywater characteristics. This sample is analyzed to deliver a detailed characterization of greywater by examining its physical, chemical, and biological properties. By assessing how these contaminants persist in greywater and their potential effects on both the environment and public health, the study seeks to highlight the long- term implications of improper greywater management and by understanding how contaminants accumulate in soil and water, the study highlights the potential disruption to ecosystems. This analysis provides valuable insights into how treatment solutions can be customised and scaled to suit different economic contexts, making grey water reuse more accessible and effective across diverse communities. The results underscore the critical need for implementing robust grey water reuse strategies to enhance environmental sustainability and resource management. The study’s findings advocate for improved waste management practices and regulatory frameworks to

mitigate the negative impacts of grey water disposal, promoting a more sustainable approach to water resource management.

12. **Jolly, Jasmine**, and V. Ananthanarayanan. "Machine Learning for Malware Detection: A Comprehensive Review of Visual, Textual and Network Traffic Features." In 2024 International Conference on Computing and Intelligent Reality Technologies (ICCIRT), pp. 353-359. IEEE, 2024.

Abstract:IoT devices, constrained by limited resources and weak security measures, are highly vulnerable to malware attacks. This review examines malware detection methods using textual, visual, and network traffic features, with experiments focused on network traffic data. Feature extraction techniques such as correlation analysis, extreme Gradient Boosting(XGBoost), and the Firefly algorithm were applied to machine learning models, including logistic regression, random forest, Adaptive Boosting(AdaBoost), and perceptron. Results highlight the potential of these approaches for resource-constrained environments.

13. Velayudhan, Nitha C.,Sreemol R, Neethu P R and Mukesh Madanan. "Sybil Attack Detection in Urban VANET Using Exponentially Spider-Tailed Viper Optimization Based Shuffle Attention Network." 2025 2nd International Conference on Artificial Intelligence, Metaverse, and Cybersecurity (ICAMAC). IEEE, 2025.

Abstract:In urban Vehicular ad-hoc network (VANET), the high movement of vehicles across street roads face challenges and has significant impacts on the performance of network. Also, sybil attack mostly affects transportation safety services and may produce traffic congestion. Therefore, Exponentially Spider-Tailed Viper Optimization based Shuffle Attention Network is introduced in this research, for detection of sybil attack in urban VANET. Initially, VANET is simulated and next, routing is done by Fractional Glowworm Swarm Optimization (FGWSO). Afterwards, sybil attack detection is accomplished at base station (BS) by performing following steps. Firstly, data packets are acquired from KDD Cup 1999 dataset and then, KDD feature extraction is accomplished. After that, features are selected based on Wave Hedges metric for further process. Lastly, sybil attack is detected utilizing Shuffle Attention Network (SA-Net). Furthermore, SA-Net is tuned by Exponentially Spider-Tailed Viper Optimization (ESTVO). However, ESTVO is derived by an integration of Exponentially Weighted Moving Average (EWMA) and Spider-Tailed Horned Viper Optimization (STHVO). Additionally, ESTVOSA Net has achieved F-measure of 93.290%, precision of 93.514% and recall of 93.067%.



4. Ph.D Awardees in 2025

Name of Faculty	Dr. Sreetha E S
Department	CSE
Date of PhD Awarding	08-04-2025
Title of Thesis	Optimizing Food Image Recognition and Nutrient Estimation Using Deep Learning Techniques
University Name	Karunya Institute of Technology and Sciences

Abstract: Dietary management systems have become crucial tools for promoting healthy eating habits and addressing lifestyle-related health conditions. However, the accurate identification of food items, estimation of portion sizes, and nutrient evaluation remain challenging tasks due to the diversity of food presentation, and visual similarities among different food items. Traditional approaches to dietary tracking, which often rely on manual input or standard portion sizes, are subjective, time-consuming, and prone to errors. These limitations necessitate the development of advanced algorithms that leverage cutting-edge technologies in computer vision and deep learning to achieve precise food recognition, volume estimation, and nutrient analysis. The primary goal of this research is to design a comprehensive dietary management system capable of accurately identifying food items from images, estimating their portion sizes, and calculating their nutritional content. This includes developing a robust image recognition model optimized for high accuracy, creating methods for precise food volume estimation, and integrating comprehensive nutritional databases to generate personalized diet charts. Furthermore, the system aims to provide real-time feedback and dynamic calorie tracking, making it a practical tool for personalized nutrition management. To achieve these objectives, a Convolutional Neural Network (CNN) architecture called NutriFoodNet is developed for food image recognition. The model undergoes rigorous evaluation using

the benchmark Food-101 dataset and achieved a baseline accuracy of 97.3%. NutriFoodNet is implemented using Enhanced NutriFoodNet by a powerful optimization technique that fine-tunes data augmentation parameters—such as rotation, shear, zoom, and shift—and hyperparameters, including learning rate, batch size, dropout rate, and dense units. This optimization process leads to an improved accuracy of 98.5%, demonstrating significant robustness in recognizing a diverse range of food items under varying conditions.

The system also incorporates a CNN-based approach for food volume estimation, FoodVolNet, enabling accurate assessment of portion sizes by integrating visual data with density information. To enhance the nutritional analysis, the USDA FoodData Central API was utilized to extract macronutrient and micronutrient information for identified food items. The nutrient data is organized into structured formats, enabling seamless integration into a personalized diet chart system. This system dynamically adjusts caloric requirements based on user-specific factors such as age, gender and activity level, offering real-time tracking and feedback. The developed system achieves significant advancements in the field of dietary management.

The enhanced NutriFoodNet model demonstrates superior accuracy, outperforming traditional CNN architectures, and proved capable of handling real-world complexities. The use of EPSO optimization not only improved model performance but also reduced the time and effort required for manual parameter tuning.

The integration of the USDA FoodData Central API enabled comprehensive nutrient analysis, providing detailed information about carbohydrates, proteins, fats, vitamins, and minerals. The personalized diet chart system offered users a dynamic and interactive platform for monitoring their dietary intake, with features such as real-time feedback on remaining calorie allowances and nutrient consumption. This holistic approach ensures that users can make informed dietary choices aligned with their health goals. This study introduces an innovative dietary management system that leverages advanced technologies to address key challenges in food recognition, volume estimation, and nutrient analysis.

Name of Faculty	Dr. Sreemol R
Department	CSE
Date of PhD Awarding	27/05/2025
Title of Thesis	Secure Frameworks for Addressing the Challenges in Biometric Authentication Systems
University Name	CUSAT

Abstract: Precast structures gained the attention of many builders and researchers on the behavior and performance under various extreme loading cases, which are designed to resist gravity loads only. Poor connection detailing, low ductility, and energy dissipation limit their use in moderate seismic zones, and not recommended in high seismic regions. The dry precast connections will collapse during earthquake loading without utilizing the entire capacity of the structure that is not satisfactory. The present study proposes an emulative dry precast connection by incorporating post-tensioning and external stitching practices. The study was carried out on a particular beam of 3 m long extracted from a 5-storey building modelled on a commercial software ETABS. Precast beams are

made by dividing the entire length of the beam into 3 parts via one middle portion and two end portions. The connection between various portions was achieved by external stitching and post-tensioning. Considering symmetry, a half beam of 250 mm wide and 300 mm deep was taken for testing. The whole study is divided into two phases. In Phase 1, the performance of two types of precast dry connections with external pins and prestressing strands was experimentally verified. One monolithically cast beam was tested under monotonic and other under quasi-static reverse cyclic loading. For precast beams, connection was provided at two locations at 1/4th length from either end of the beam. The connection was achieved through a pair of 16 mm diameter HYSD bars in the form of J-pins or U-pins externally and a concentric monostrand internally. In Type 1 connections, J-pins were used, whereas U-pins were used in Type 2 connections. A comparison of the performance of precast beams with external pins and prestressing, with monolithic beam was carried out. Post-tensioning in precast beam-beam connections increases load-bearing capacity, reduces deflections, improves structural continuity, allows for long spans, ideal for bridges, high-rise buildings, and other large-scale structures. In Phase 2, three full-scale segmental precast beams were tested under four-point loading. Segmental beams are constructed in segments and assembled on-site to create long spans without any extensive supporting structures or complex on-site casting. One monolithic beam and two segmental beams with Type 2 dry connection and post-tensioned with 40% of ultimate prestress were studied. The specimens were tested under four-point loading with varying a/d ratios. The test results were analyzed in terms of failure mode, crack patterns, load-displacement behaviour, opening of the dry joint, ductility, damping, etc. The performance of the pre-cast beam with Type 2 connection resembled the monolithic beam to an extent in various aspects.

Name of Faculty	Dr. Vivek K. Viswanath
Department	Civil
Date of PhD Awarding	11/07/25
Title of Thesis	Performance of RC Precast Beam–Beam Connections under Cyclic Loading
University Name	Indian Institute of Technology Madras

Abstract: Biometrics is the measurement and study of an individual's distinctive physical or behavioral traits such as voice, movement, iris pattern, fingerprint, face, gait, palm print, finger vein, signature and so on. Biometric systems plays an important role in ensuring security across various domains. However, existing systems face challenges such as limited accuracy and vulnerability to spoof attacks such as inserting fake biometrics into the sensor, utilizing a Trojan virus to target the feature extractor, changing the representation of the biometrics, tampering with the matcher and attacking previously saved biometric template. Other significant obstacles include privacy issues, difficulties in fusing data from several biometric sources and requirement for secure biometric data transmission and storage. Furthermore, there is still a research gap in the development of precise and effective algorithms for multi-biometric systems. The fact that fraudsters may be able to breach the biometric authentication system and obtain the original biometrics to produce various biometric spoofs is one of the

main disadvantages of the current biometric system. Biometric traits cannot be reset, in contrast to conventional passwords, therefore they may pose serious risks. Secure frameworks need to be created in order to prevent this. So, the goal of this research is to present secure biometric authentication algorithms with high performance and accuracy. The main objective of this research is to create some new security frameworks for locating the original biometric system flaws and developing a workable fix. Multi-biometric authentication systems based on finger vein, fingerprint, iris, palm print and ear is constructed and the efficiency of the systems are evaluated using various matrices coupled with Fast Gradient Sign Method (FGSM) analysis for adversarial assessment. This research suggests a new, updated secure biometric systems based on different machine learning and deep learning techniques which helped to produce better results when compared with the existing systems. Various modified optimization algorithms are used for extracting the optimal biometric features. Also, a successful method of reconstructing latent fingerprints was suggested to aid in forensic analysis. Finally, in order to transfer the research contributions to society, a Secure Smart farming System (SSS) using biometrics, which is a novel methodology for securing the smart farming devices was proposed. This invention certainly assists the agronomists in doing secure communication among the various smart farming devices with the help of fingerprint biometrics of the workers in a particular farm. Furthermore, this study presents the possible further research directions so as to help the researchers in this field to design more effective and reliable biometric authentication systems.



5. Collaborative Research Projects

Collaborative Research Projects

- 1 Dr. Nitha C. Velayudhan (CSE): Project entitled “Cardiovascular Risk Prediction” in collaboration with AIMS, guided by Dr. Ajith T. A.
- 2 Dr. Sreemol R. (CSE): Project entitled “Cardiovascular Risk Prediction” in collaboration with AIMS, guided by Dr. Ajith T. A.
- 3 Ms. Neethu P. R. (CSE): Project entitled “Cardiovascular Risk Prediction” in collaboration with AIMS, guided by Dr. Ajith T. A.
- 4 Ms. Athithya S. (CSE): Project entitled “Cardiovascular Risk Prediction” in collaboration with AIMS, guided by Dr. Ajith T. A.
- 5 Dr. Divya R. (CSE): Project titled “AMR (Anti-Microbial Resistance) Surveillance System” in collaboration with AIMS, guided by Dr. Iswarya Babu P.
- 6 Ms. Monisha Thomas (CSE): Project titled “AMR (Anti-Microbial Resistance) Surveillance System” in collaboration with AIMS, guided by Dr. Iswarya Babu P.
- 7 Mr. Eldhose P. Sim (CSE): Project titled “AMR (Anti-Microbial Resistance) Surveillance System” in collaboration with AIMS, guided by Dr. Iswarya Babu P.
- 8 Dr. Sooraj T. R. (CSE): Project titled “Bone Tumor Detection from X-rays” in collaboration with AIMS, guided by Dr. Dijoe Davis.
- 9 Dr. Viswanath K. Kaimal (ME): Project titled “Bone Tumor Detection from X-rays” in collaboration with AIMS, guided by Dr. Dijoe Davis.
- 10 Ms. Jincy Denny (CSE): Project titled “Artificial Intelligence for Low-Dose CT-Based 3D Understanding of Lung Nodules (AI-LUNG)”.
- 11 Mr. Vaisakh C. Krishnan (CSE): Project titled “Artificial Intelligence for Low-Dose CT-Based 3D Understanding of Lung Nodules (AI-LUNG)”.
- 12 Ms. Merryl Mary Forbin (CSE): Project titled “Artificial Intelligence for Low-Dose CT-Based 3D Understanding of Lung Nodules (AI-LUNG)”.
- 13 Dr. Vinoj P. G. (ECE): Project titled “AI-Powered Hospital Waste Segregator” in collaboration with AIMS.
- 14 Dr. Caren Babu (ECE): Project titled “AI-Powered Hospital Waste Segregator” in

collaboration with AIMS.

- 15 Ms. Bincy T. J. (BS&H): Shelf Life Extension of Paneer using permitted preservatives and GDL, guided by Dr. Beena R. L.
- 16 Dr. Caren Babu (ECE): Autism detection using deep learning methods with multimodal data.
- 17 Ms. Suni Jose (CSE): Autism detection using deep learning methods with multimodal data.
- 18 Fr. Milner Paul (EEE): Autism detection using deep learning methods with multimodal data.
- 19 Dr. Divya R. (CSE): Autism detection using deep learning methods with multimodal data.
- 20 Ms. Anitta Antony (ECE): “MedSOS: A Smart Wearable Surgeon’s POV Glasses for Emergency Medical Assistance” in collaboration with AIMS.
- 21 Ms. Swathy P. M. (ECE): “MedSOS: A Smart Wearable Surgeon’s POV Glasses for Emergency Medical Assistance” in collaboration with AIMS.
- 22 Dr. Eugene Peter (EEE): Alzheimer’s Disease Early Detection (AIMS collaboration).
- 23 Ms. Swathy P. M. (ECE): Alzheimer’s Disease Early Detection (AIMS collaboration).
- 24 Ms. Anitta Antony (ECE): Alzheimer’s Disease Early Detection (AIMS collaboration).
- 25 Dr. Krishnapriya S. (ECE): MEMS-Based Micro Gas Sensor and Ionic Sensor Development.
- 26 Mr. Tony C. Thomas (ECE): MEMS-Based Micro Gas Sensor and Ionic Sensor Development.



6. FRSG Research Projects

- 1 **Investigating the Pore Structure of Self-Cured Self-Compacting Concrete with Partial Cement Replacement by Metakaolin**
Investigators: Dr. Jino John, Dr. Krishnapriya M G
- 2 **Autonomous Robotic Water Sampler with AI-Driven Satellite Monitoring System for Inland Water Bodies**
Investigators: Dr. Sherjah P Yusuf Ali, Mr. Prabhasankar V P
- 3 **Automated Traffic Signal Using AI**
Investigators: Dr. Jino John, Dr. Krishnapriya M G
- 4 **Characterization and Removal of Emerging Contaminants from Greywater**
Investigator: Ms. Vinitha Sharon
- 5 **Effect of HDPE Substrate Roughness on the Morphology of Electrodeposited Copper Coating for the Application of EMI Shielding and Antimicrobial Touch Surface**
Investigators: Dr. Arun Augustin, Mr. Tony C Thomas
- 6 **Nutmeg Decorticating Machine**
Investigators: Dr. Viswanath K Kaimal, Ms. Aswathy P Sajeew
- 7 **Machinability Studies on Aluminium 7075 Alloy**
Investigators: Dr. Sijo M T, Mr. Nithin V K, Dr. Alosh James
- 8 **Automated Reconfiguration of Solar Photovoltaic Arrays and Batteries During Partial Shaded Conditions**
Investigators: Dr. Vishnu P Madhanmohan, Dr. Needhu Varghese
- 9 **Battery Life Extension for Lithium-Ion Battery Using Battery Management System**
Investigators: Ms. Emilin Thomas K, Dr. Needhu Varghese
- 10 **Compensation Topology for High Efficiency Inductive Transfer Wireless System**
Investigators: Mr. Nithin K S, Ms. Preethi T I
- 11 **Battery Cooling & Development of Liquid Cooled Battery Storage Systems**
Investigators: Dr. Ravisankar A N, Mr. Febin Raju

12 Power Quality Issues in Domestic Appliances*Investigators:* Mr. Febin Raju, Mr. Jinu K T**13 Microsensor Fabrication, Characterisation and Development for Detection of Cardiovascular Disorders Using Exhaled Breath Biomarkers***Investigators:* Dr. Krishnapriya S, Mr. Tony C Thomas**14 Design and Implementation of a System for Neoplastic Proliferation in White Blood Cells***Investigators:* Ms. Della Reasa Veliaveetil, Ms. Catherine J Nereveetil, Dr. Caren Babu**15 Power Quality Issues in Biomedical Devices***Investigators:* Ms. Sreelekha T, Ms. Manju I Kollannur**16 Pneumonia Detection Using CNN in Federated Learning Environment***Investigators:* Ms. Suni Jose, Ms. Minnu Moothedan, Dr. Divya R



7. International Collaborative Research Talks

Collaborative Research Talks

Research talk by Prof. (Dr.) Narayanan M. Komerath

A research talk was conducted on 15 December 2025 at the Conference Hall with the objective of inspiring students towards research, innovation, and technical excellence. The session was delivered by Prof. (Dr.) Narayanan M. Komerath, a distinguished academician, writer, and researcher, who is a Fellow of the NASA Institute of Advanced Concepts (2001), a Boeing Welliver Fellow, and a Sam Nunn Senior Fellow.

During the session, the speaker shared his academic journey and ongoing research activities, highlighting a 4-meter span aerial vehicle project designed for environmental monitoring applications. He emphasized the importance of engaging in innovative and practical projects, actively participating in conferences, and publishing research work as essential steps in building strong technical skills and enhancing career opportunities.

The talk also included an interactive session where students were encouraged to take up hands-on engineering projects and focus on research-driven learning. The speaker motivated students to develop solutions addressing societal challenges, particularly those related to climate change. As a direct outcome of the session, students have initiated a project to build, test, and verify a 4-meter span Flying Leaflet weather measurement craft aimed towards



Figure 7.1: Students working towards the flying leaflet project

flight testing.

The research talk was highly informative and motivational, fostering a spirit of innovation, scientific inquiry, and practical learning among the participants.

International Academic Exchange and Collaboration Programme

An International Academic Exchange and Collaboration Programme was organized at Christ College of Engineering with the aim of fostering global academic partnerships and enhancing research collaboration.

The programme featured the participation of two distinguished faculty members from South East Technological University, Carlow, Ireland, namely Dr. Diarmuid O’Brian, Head of the Department of Electronics Engineering and Communications, and Dr. Arun Sankar M S, Assistant Lecturer in the same department. The session provided an excellent platform for meaningful interaction between the visiting faculty and the institution’s faculty members.

Discussions were held on mutual academic and research interests, with a focus on identifying common areas of expertise and opportunities for joint initiatives. The interaction emphasized the importance of international collaboration in advancing research quality, promoting knowledge exchange, and enhancing academic excellence. Potential collaborative activities such as joint research projects, faculty exchange programmes, and student mobility initiatives were explored during the session. The engagement with Dr. Diarmuid O’Brian, in particular, offered valuable insights into global academic practices and emerging research trends in electronics and communication engineering. The programme successfully strengthened institutional ties and laid the foundation for future collaborations, thereby contributing to the global outlook and research capabilities of the institution.



Figure 7.2: Interaction with Dr. Diarmuid O’Brian

International research collaboration session

An international research collaboration session was conducted at Christ College of Engineering with the objective of strengthening global academic partnerships and enhancing

research output. The session was led by Prof. (Dr.) Asokan Vasudevan, Director of International Relations and Collaborations at INTI International University, Malaysia. During the interaction, the resource person provided valuable insights into the university's policies and framework for fostering international collaborations. The discussion primarily focused on exploring opportunities for collaborative research publications in reputed journals, with particular emphasis on encouraging faculty members from the Management discipline to actively engage in high-quality research. The session highlighted the importance of global networking, interdisciplinary collaboration, and strategic partnerships in improving research visibility and academic excellence. Overall, the interaction was highly informative and served as a significant step towards establishing meaningful international research collaborations for the institution.



Figure 7.3: Interaction with Prof. (Dr.) Asokan Vasudevan



RESEARCH

8. Research and Development Cell of CCE

Research and Development Cell Members

Convener

Dr. Elizabeth Elias

Finance and Infrastructure

Fr. Milner Paul V

Fr. Jojo Arikkadan

Dr. Jino John

Dr. Alosh James

Collaboration and Community

Dr. Sudha Balagopalan

Dr. Caren Babu

Dr. Nitha C Velayudhan

Dr. Needhu Varghese

Research Program and Policy Development

Dr. Vishnu P Madhanmohan

Dr. Sherjah P Yusuf Ali

Dr. Krishnapriya S

Dr. Sreemol R

Product Development, Monitoring & Commercialization

Dr. Divya R

Dr. Eugene Peter

Dr. Diana Mathew

IPR, Legal and Ethical Matters

Dr. Vince Paul

Dr. Arun Augustin

Dr. Vivek K Viswanath



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