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AN AUTONOMOUS INSTITUTION

Department of Electronics and Communication Engineering

Technical Magazine

ACADEMIC YEAR 2025-2026 [EVEN SEMESTER]

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1. Message from the Head of Department

Established in 2009, the Department of Electronics and Communication Engineering (ECE) at Akshaya College of Engineering and Technology boasts an intake of 60 students and is affiliated with Anna University. By providing high-quality education and maintaining excellent academic standards, the department received NBA accreditation in 2024. The department has been recognized as a research centre for conducting Ph.D. programmes under Anna University. With a commitment to providing professional training in emerging areas, the department aims to mould young professionals and enhance their skills and knowledge in line with current developments. Equipped with high-tech facilities, the department offers a conducive environment for students to excel in their academic pursuits and engage in research activities. Its affiliation with Anna University further enriches the academic experience, ensuring that students receive comprehensive education and training in Electronics and Communication Engineering.and training in Electronics and Communication Engineering.

Dr.K.Sumathi
Professor & HoD

2. Vision and Mission of the department

Vision

Emerge as an eminent Centre of learning in Electronics and Communication Engineering to produce engineers, capable of meeting the global challenges through design, development and research, for the welfare of the society and humanity.

Mission

DM 1: Adopt a systematic and technology enabled teaching-learning process with an ability to contribute for research.

DM 2: Develop electronics and communication engineers with managerial skills and life-long learning practices, for sustainable economic growth, beneficial to the society.

DM 3: Establish Centre of excellence in VLSI technologies and Embedded systems and provide a creative environment with industry linked initiatives for encouraging innovation.

3. Program Educational Objectives – PEOs

PEO 1: The graduates will have successful careers in industries or pursue higher studies and research or emerge as entrepreneurs.

PEO 2: The graduates will be able to apply fundamental and advanced knowledge, skills and techniques in devising innovative products for the benefits of society.

PEO 3: The graduates will be able to critically analyze existing literature in an area of specialization and research-oriented methodologies to solve the problems identified.

4. Program Specific Outcomes – PSOs

PSO 1: Professional skills: Students shall have skills and knowledge to work on analog and digital systems, ad hoc and sensor networks, VLSI, embedded and communication systems

PSO 2: Competency: Students shall qualify at the State, National and International level competitive examination for employment, higher studies and research.

5. Program Outcomes –POs

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Message from the Editorial Team

We are excited to present to you the second issue of the ECE Department's Technical Magazine for the academic year 2025-2026(Even Semester). This edition is a reflection of the talent, dedication, and hard work of our students, showcasing their remarkable achievements in both co-curricular and extra-curricular activities.

The primary goal of this magazine is to highlight the innovative projects, research, and technical skills exhibited by our students. We believe that the exchange of knowledge and experiences plays a key role in shaping the future of technology and engineering.

We would like to extend our sincere gratitude to the Management and our esteemed Principal for their unwavering support and encouragement, which have been instrumental in the success of this initiative. We hope this magazine continues to inspire and inform, fostering a spirit of collaboration and innovation within the ECE department.

Chief Editor:	Dr. K. Sumathi, Professor & HoD/ ECE
Faculty Advisors:	Mrs.R. Vanitha, AP (Sl.G)/ECE,
	Mrs.A.RamjanBegam, AP/ECE,
	Mrs.R.Suriya,AP(Sr. G)/ECE
Student Editor:	P. Silambarasan, III ECE
Design Team:	Mrs.R.Suriya,AP(Sr. G)/ECE

6. Table of Contents:

1. FPGA-Based Fall Detection and Prediction for Elderly People

Falls and cardiac anomalies represent critical health risks for elderly individuals and remote patients, often requiring immediate medical intervention. Existing healthcare monitoring systems are either confined to clinical environments or rely solely on software-based processing, resulting in latency and reduced reliability for real-time emergency detection. This paper presents an FPGA-based healthcare monitoring system that integrates continuous heart rate surveillance with hardware-accelerated fall detection in a unified embedded platform. The system employs an optical pulse sensor interfaced with an ESP32 microcontroller for photoplethysmography-based heart rate acquisition and beats-per-minute computation. Simultaneously, an ADXL345 accelerometer captures single-axis (X-axis) acceleration data, which is transmitted via UART to an Altera Cyclone II FPGA. A hardware-implemented Finite State Machine (FSM) described in Verilog performs real-time fall detection by evaluating dual conditions, acceleration threshold exceedance and a minimum persistence duration of 200 ms, thereby minimizing false positives. Upon fall confirmation, the ESP32 transmits an emergency alert via Bluetooth to connected monitoring devices. The system further classifies patient status into three categories: normal, accidental fall, and medical fall, based on combined physiological and motion parameters. Experimental results validate accurate bradycardia detection, reliable fall event classification, and consistent UART-Bluetooth communication with negligible latency. The proposed hardware–software co-design offers a cost-effective, low-power, and scalable solution for real-time elderly care and remote health monitoring applications.

-Dharani Dharan SB
Kathiravan KS
Dharmaraja B
Akash R
IV ECE

2. AI driven LORA based Satellite Integrated Disaster prediction system

Natural disasters such as floods, cyclones, and landslides demand intelligent early warning systems capable of integrating large-scale environmental intelligence with localized real-time sensing. This paper proposes a multi-parameter disaster prediction framework that combines AI-based satellite image analysis with embedded environmental and structural sensor fusion using LoRa-based long-range communication. Unlike conventional threshold-based systems, the proposed model employs probabilistic weighted fusion of rainfall intensity, ultrasonic water-level rise, accelerometer variance, slope tilt displacement, atmospheric humidity, and satellite-derived cloud density classification. Alerts are generated only when correlated parameters exceed calibrated probability thresholds, significantly reducing false positives. The system integrates resilient communication using LoRa and GSM modules to ensure operation in remote or infrastructure-compromised regions. Experimental validation demonstrates improved detection reliability and lower alert latency compared to single-sensor monitoring systems. The architecture provides a scalable and energy-efficient solution for proactive multi-disaster early warning deployment.

-Sam Daishuan J
Dhinesh S
Abilesh P
Bala S
IV ECE

3. AI-Based Industrial Predictive Maintenance System

Industrial equipment failures pose significant challenges to manufacturing industries by causing unexpected downtime, reduced productivity, and increased operational and maintenance expenses. Traditional preventive maintenance strategies typically rely on predetermined service intervals, regardless of the equipment's real-time operating condition. Such methods often lead to unnecessary maintenance activities or, conversely, fail to prevent unexpected breakdowns, making them inefficient and costly.

To overcome these limitations, this work introduces an advanced AI-driven predictive maintenance system that integrates Industrial IoT sensors with edge AI capabilities for continuous monitoring and intelligent assessment of machine health. The system employs multiple sensors—such as vibration, temperature, current, and acoustic sensors—to capture critical operating parameters from industrial machines in real time. These data streams are processed using edge computing techniques, enabling local analysis at the device level, which reduces dependency on cloud computation and

significantly minimizes communication costs, latency, and network congestion.A key feature of the proposed framework is the use of unsupervised machine learning algorithms, which learn the normal behavioural patterns of equipment without requiring historical labelled fault data—often scarce in industrial environments. Models such as Autoencoders or Isolation Forest detect anomalies by identifying deviations from learned normal patterns, allowing early identification of potential faults and deterioration trends.

-**G.Harivathsan**
S.Lokeshwar
S.Kathirvel
M.Manoj
IV ECE

4. AI-Enhanced Smart Writing Assistance Pen and Pad for Children with Learning Difficulties

Handwriting is an important skill for talking and doing well in school. But kids who have Specific Learning Difficulties (SLD) often have trouble with handwriting. This is because they might have weak hand movement skills, find it hard to focus, have trouble matching what they see with what they do, and apply pressure unevenly when writing. Traditional ways of teaching handwriting depend on guessing what's wrong and waiting a while to correct mistakes. This makes it hard to watch how they write all the time and give them help right away. This paper introduces a smart writing system that uses AI. It has a smart pen with sensors and a writing pad that senses pressure. This helps kids with SLD practise their handwriting better. The smart pen uses a small computer and a motion sensor to track how fast and how far the pen moves and how it's held. There's also a vibration part in the pen that gives gentle feedback when it notices the child is not writing properly, like moving the pen around too much or getting distracted.

The writing pad has sensors that detect how hard the pen is pressed and if it's being hit too hard. All the information from the pen and pad is sent to a computer where it's analysed, broken into parts, shown as graphs, and sorted into different types of writing behaviours. This helps teachers and therapists see how the child is writing clearly and watch their improvement over time. The system is cheap, easy to carry, and works well for special education and at home.

It uses data to help kids with SLD write more neatly and feel surer of themselves. Specific Learning Difficulties (SLD), Smart Pen, ESP32, MPU6050, IMU, Force Sensor, Handwriting Assistance, Real-Time Feedback, IoT, Machine Learning. Achieving

arithmetic overheads of less than 1% in convolutional neural network (CNN) applications. Furthermore, matrix codes that combine Hamming and parity codes are employed to enable error correction and protect against multiple-bit upsets.

-P. VENKATA LAKSHMI PRASANNA
KRISHNA VENI R
NANABALA DILLI
SHATAKSHI M.D.
IV ECE

5. FPGA Based Voice Controlled Smart Wheelchair

Mobility assistance for physically challenged and elderly individuals remains a critical challenge, especially for those who are unable to operate conventional wheelchairs manually. Existing solutions often rely on joystick control or caregiver assistance, which may not be suitable for users with severe disabilities. To overcome these limitations, this project proposes the design and implementation of a voice-controlled smart wheelchair using FPGA technology.

The system utilizes a voice recognition module to capture and process user commands such as forward, backward, left, right, and stop. These commands are interfaced with a Field Programmable Gate Array (FPGA), which acts as the central processing unit for real-time control and decision making. The FPGA ensures high-speed processing, parallel execution, and improved reliability compared to traditional microcontroller-based systems.

Motor driver circuits are used to control the movement of DC motors based on the decoded voice commands. Additionally, ultrasonic sensors are integrated to detect obstacles in the path, ensuring user safety by automatically stopping or redirecting the wheelchair when an obstruction is detected. The system can also be extended with features like emergency alerts and GPS tracking for enhanced functionality.

The proposed system demonstrates fast response time, accurate command recognition, and efficient obstacle avoidance. The use of FPGA makes the system highly flexible, scalable, and reliable. This solution provides a cost-effective and user-friendly mobility aid, significantly improving independence and quality of life for physically challenged individuals.

-K.Shamukha Lakshmi
M.Manogna
Menaga.p
Swetha.T
IV ECE

6. IoT Based Smart Safety and Worker Alert System for Cracker Factories using ESP32 and AI/ML

The manufacturing units of fire crackers and other dangerous industries are at great risk of accidents due to the presence of combustible materials, toxic gases, abnormal temperature conditions, and electrical hazards. Traditional safety systems are not effective in handling these risks, which are detected through manual observation and response. This increases the probability of causing great damage, fires, and injuries. To reduce the risks in the firecracker manufacturing industry, the project proposes the implementation of an intelligent safety system using the Internet of Things (IoT) technology.

The system includes the integration of temperature (DHT22 sensor), humidity, gas (MQ-135 sensor), flame, voltage, and current (ACS712 sensor). This system is capable of detecting environmental and electrical conditions in real time using the ESP32 microcontroller. This data is transmitted to the cloud using the ThingSpeak service. Real-time alerts are sent to the user through the Blynk mobile application.

The decision algorithm is designed using the decision tree concept. This algorithm classifies the conditions of the firecracker industry into four levels: normal, warning, danger, and fire. Based on the classification, the system performs the required safety actions. This includes disconnecting the power supply, operating the ventilation system, operating the sprinkler system, and operating the alarm system using the relay module.

The experiment results show that the system is capable of detecting dangerous conditions and responding to them within less than 2 seconds. This is effective in providing the required response time. This solution is effective, reliable, and economical, making it suitable for the firecracker manufacturing industry.

- Madhu Mitha R
Sandhiya devi V
Gowsika S
Meena M
IV ECE

7. Semi-Circular Crown-Shaped UWB Antenna

In this work, a compact ultra-wideband (UWB) antenna for satellite communication applications is proposed and designed through a systematic four-stage evolution

process, where each stage produces a unique performance output. The antenna has compact dimensions of 30 mm × 30 mm × 1.6 mm and is fabricated using an FR-4 dielectric substrate with a relative dielectric constant of 4.4 and a thickness of 1.6 mm. The proposed structure is developed by progressively modifying the geometry, resulting in a semi-circular crown-shaped antenna that enhances overall performance.

UWB antennas are widely used for short-range wireless communication systems due to their high data rate, low power consumption, and high precision. The designed antenna operates in the C-band and X-band frequency ranges, making it suitable for satellite communication and related applications. The antenna is modelled and simulated using High Frequency Structure Simulator (HFSS), which utilizes the Finite Element Method (FEM) for accurate electromagnetic analysis.

The performance of the antenna is evaluated using key parameters such as return loss (S11), gain, and voltage standing wave ratio (VSWR). The results indicate that the antenna achieves a wide impedance bandwidth with return loss values below -10 dB, ensuring good impedance matching. The gain of the antenna is observed to be stable across the operating range, with improved radiation efficiency. The VSWR values are maintained within acceptable limits, indicating efficient power transfer between the feed line and the antenna.

Furthermore, the radiation pattern analysis demonstrates nearly omnidirectional characteristics, which are desirable for reliable communication in multiple directions. The current distribution analysis shows that the inclusion of pentagon and triangular elements enhances current flow and creates multiple resonances, leading to improved bandwidth and radiation performance.

Overall, the proposed semi-circular crown-shaped UWB antenna offers compact size, wide bandwidth, stable gain, and efficient radiation characteristics. These features make it a suitable candidate for satellite communication systems, radar applications, and modern wireless communication technologies

-Mohammed Haris. I
Santhosh Kumar.P
Rajesh Kumar.P
Mithun.M
IV ECE

8. Compact MIMO Antenna Design for Advanced 5G/6G and IoT Communication Systems

This paper presents a compact Multiple-Input Multiple-Output (MIMO) antenna designed for advanced 5G/6G and Internet of Things (IoT) communication systems. The proposed work begins with the systematic evolution of a single circular microstrip antenna operating at 28 GHz using an FR4 substrate with an overall compact dimension of 10 mm × 10 mm × 1.645 mm, and is later extended to a compact

MIMO configuration to enhance channel capacity, isolation, and diversity performance. The single antenna undergoes multiple geometric modifications, including slot insertion and shape optimization, to improve impedance matching and gain characteristics. Based on the optimized single element, a compact MIMO antenna is realized with improved isolation and reduced mutual coupling. The antenna performance is evaluated in terms of S-parameters, gain, radiation patterns, envelope correlation coefficient (ECC), and diversity gain (DG). The obtained results demonstrate that the proposed MIMO antenna is a suitable candidate for future 5G/6G and IoT applications due to its compact size, good isolation, and stable radiation characteristics.

- RAHULPRASATH P
ANGAMUTHU V
SUHASH S
SANJAI V
IV ECE

9. AUTONOMOUS INDOOR DELIVERY ROBOT USING AGENTIC AI FOR INTELLIGENT NAVIGATION

The rapid advancement of automation technologies has led to increased demand for efficient and intelligent indoor delivery systems in environments such as hospitals, offices and warehouses. This project presents the design and development of an autonomous indoor delivery robot powered by agentic artificial intelligence for intelligent navigation and decision-making. Unlike traditional robots that rely on pre-defined paths, the proposed system utilizes agent-based AI to perceive its surroundings, make real-time decisions and adapt dynamically to changing indoor environments. The robot integrates sensors for obstacle detection, path planning and localization, enabling safe and efficient navigation. The agentic framework allows the robot to independently plan routes, avoid obstacles and optimize delivery tasks without human intervention.

Additionally, the system enhances operational efficiency by reducing manual labor, minimizing delivery time and improving reliability in complex indoor spaces. The proposed solution demonstrates a scalable and cost-effective approach to smart automation, contributing to advancements in robotics, artificial intelligence and smart infrastructure.Matrix multiplication is a fundamental computational kernel used in various domains such as scientific simulations, signal processing, computer vision and machine learning. Applications in safety-critical systems, including autonomous vehicles and aerospace, require both high performance and high reliability. However, hardware

accelerators, particularly SRAM-based FPGAs are vulnerable to radiation-induced single-event upsets (SEUs), which may lead to incorrect computations. Traditional fault-tolerance techniques often introduce significant overhead in terms of area, power and performance.

-DHARUNIKA M
KAVISHREE S
KALAIVANI C
REEMA S
IV ECE

10. HIGHLY RELIABLE MATRIX MULTIPLICATION FOR SYSTOLIC ARRAY ARCHITECTURE

Matrix multiplication is a fundamental computational kernel used in various domains such as scientific simulations, signal processing, computer vision, and machine learning. Applications in safety-critical systems, including autonomous vehicles and aerospace, require both high performance and high reliability. However, hardware accelerators, particularly SRAM-based FPGAs, are vulnerable to radiation-induced single-event upsets (SEUs), which may lead to incorrect computations. Traditional fault-tolerance techniques often introduce significant overhead in terms of area, power, and performance.

This paper presents a reliable matrix multiplication approach based on systolic array architectures. A multi-level fault propagation model is proposed to analyze the impact of persistent configuration faults in FPGAs. In addition, a lightweight algorithm-based fault tolerance (ABFT) technique, termed Light ABFT, is introduced for efficient error detection, achieving arithmetic overheads of less than 1% in convolutional neural network (CNN) applications. Furthermore, matrix codes that combine Hamming and parity codes are employed to enable error correction and protect against multiple-bit upsets.

Experimental results obtained through extensive fault injection demonstrate that the proposed approach significantly improves system reliability while maintaining minimal resource overhead.

- JAYASHREE ML
SRIHARINI K
ARCHANA T
SAKTHI K
IV ECE

11. SMART HELMET BY USING OFFLINE AI

Road accidents involving two wheelers account for a significant percentage of traffic fatalities, primarily due to the absence of helmet usage, delayed emergency response, and rider fatigue. This paper presents the design and development of a Smart Helmet integrated with Offline Artificial Intelligence (AI) to enhance rider safety without dependency on continuous internet connectivity. The proposed system employs onboard sensors such as an accelerometer and impact sensors to monitor helmet usage, rider head movement, and accident conditions in real time. An embedded AI model running locally on a low power edge device analyses sensor data to detect crash events, drowsiness, and abnormal riding behaviour. In the event of an accident, the system triggers an alert mechanism and initiates emergency response actions through a paired mobile device or GSM module. Offline AI ensures low latency, improved reliability, data privacy, and uninterrupted operation in remote or network limited environments. Experimental results demonstrate that the proposed smart helmet effectively detects accident scenarios and rider conditions with high accuracy while maintaining low power consumption. The system offers a cost effective and scalable solution for improving two-wheeler safety and reducing accident response time.

- HARI BALAJI R
MADHAN S
SANJEEV B
SANJAY R
IV ECE

12. IOT-DRIVEN RESTROOM OCCUPANCY AND HYGIENE MONITORING SYSTEM

Maintaining proper hygiene and efficient usage of public restrooms is a major challenge due to the lack of real-time monitoring systems. Most existing approaches depend on manual inspection, which is time-consuming and often inefficient. This project presents an IoT-enabled smart restroom occupancy monitoring and hygiene analytics system that helps address these issues. The system uses ultrasonic sensors to detect restroom occupancy and gas sensors to evaluate cleanliness levels. An ESP32 microcontroller collects sensor data and sends it to the ThingSpeak cloud platform for real-time monitoring. A web-based dashboard displays the availability and hygiene status of multiple restrooms using intuitive visual indicators and a realistic floor-plan layout. When poor hygiene conditions are detected in an unoccupied restroom, an automated cleaning mechanism is activated, and alert notifications are sent to maintenance personnel. The proposed system improves restroom management by reducing manual

effort, enhancing user convenience, and ensuring timely cleaning. It is cost-effective, scalable, and suitable for use in public buildings such as malls, hospitals, and educational institutions.

- GOKULNATH.K
SURENDER.P
SRIDHAR.N
SEKAR.S
IV ECE

13. AI BASED SMART AGRICULTURE FOR EFFICIENT CULTIVATION IN HILLY REGION

Farming in hilly regions is often difficult because of uneven land, quick water runoff, unpredictable rainfall, and poor soil moisture retention. These conditions can lead to inefficient irrigation and lower crop productivity. This work presents an intelligent and adaptive irrigation approach that uses real-time environmental information to make better watering decisions. The system continuously observes factors such as soil moisture, rainfall patterns, and surrounding weather conditions, and uses this information to decide when irrigation is actually needed.
Unlike traditional methods that depend on fixed schedules or simple thresholds, this approach understands changes in environmental conditions over time and adjusts irrigation accordingly. It also supports centralized data management, allowing long-term monitoring and easier expansion to larger farming areas. Test observations show that this method helps reduce unnecessary water usage while maintaining proper soil moisture for healthy crop growth. In addition, backup and manual control options are included to ensure the system continues to function even in challenging situations. Overall, this approach offers a more practical and sustainable solution for irrigation in hilly agricultural environments.

- KATHIRESHKUMAR K
SHYAM GANESH K
SRIDHARAN G
LOHIT S
IV ECE

14. AI INTEGRATED IOT SYSTEM FOR WIND TURBINE HEALTH MONITORING AND CONTROL

The increasing deployment of wind energy systems demands reliable and autonomous monitoring mechanisms to minimize downtime and maintenance costs. Wind turbines operate under fluctuating environmental and mechanical stress conditions, making early

fault detection essential for sustainable energy generation. This work presents an AI-integrated IoT architecture for real-time health assessment and adaptive control of wind turbine systems. Multiple sensing units capture electrical and mechanical parameters including temperature, vibration intensity, rotational speed, and load current. An ESP32-based edge node performs local acquisition and transmits data to a cloud analytics platform. A Random Forest classification model processes historical and live data streams to identify operational states categorized as healthy, critical, or faulty. Based on prediction results, an automated relay-based protection mechanism is activated to prevent equipment damage. Experimental validation using a DC motor prototype demonstrates accurate fault identification and responsive control, confirming the feasibility of integrating edge IoT and machine learning for predictive wind energy management.

- SIVAMANI LOKESH S
THULASIDHARAN M
SANJEEV KUMAR M
SANJAY V
IV ECE

15. INTELLIGENT AI-POWERED LI-FI + RF INTEGRATED IOT SYSTEM FOR HIGH-SECURITY, FUTURE-READY NETWORKS

Vehicle-to-Everything (V2X) communication enables vehicles to exchange information with other vehicles (V2V), infrastructure (V2I), pedestrians (V2P), and networks (V2N) to enhance road safety, traffic efficiency, and autonomous driving. This project presents a real-time V2X communication system implemented using embedded controllers such as ESP32-S3, STM32H7, or NVIDIA Jetson Xavier NX, capable of supporting low-latency data exchange for safety-critical applications.

The system integrates DSRC (Dedicated Short Range Communication) or C-V2X protocols with real-time processing units to handle message prioritization, vehicle status updates, and collision avoidance alerts. Sensor fusion from onboard LiDAR, RADAR, and GPS modules enables accurate detection of surrounding vehicles, pedestrians, and infrastructure.The embedded software uses RTOS-based multitasking to schedule high-priority safety messages while maintaining deterministic latency for real-time decision-making.

Messages are transmitted securely over vehicular ad hoc networks (VANETs) with low packet loss and minimal jitter. Experimental simulations demonstrate reliable inter-vehicle communication, rapid hazard warnings, and traffic congestion reduction in urban and highway scenarios. The system supports integration with intelligent traffic

lights, smart road infrastructure, and autonomous vehicle control modules. This project demonstrates how embedded real-time V2X communication systems can enhance safety, efficiency, and scalability in next-generation intelligent transportation networks.

- MALIPATEL DHANUSH KUMAR REDDY
KAKARALA ROHITH KUMAR
VADDE VISHNU VARDHAN
VETCHA SIDDARDHA
IV ECE

16. AI-BASED EMBEDDED FACE-BASED ACCESS CONTROL SYSTEM

An AI-Based Embedded Face Recognition Access Control System is a modern security solution that uses artificial intelligence and embedded systems to provide secure and contactless authentication. Traditional access control methods such as passwords, PINs, or ID cards are vulnerable to theft, duplication, and unauthorized access. To overcome these limitations, this system employs face recognition technology, which identifies individuals based on their unique facial features.

The system is built using an embedded platform such as a microcontroller or single-board computer integrated with a camera module. It captures real-time images of individuals and processes them using machine learning algorithms for face detection and recognition. The system compares the captured face with a pre-stored database to verify identity. Upon successful authentication, access is granted, while unauthorized attempts are denied and can be logged for security purposes.
This solution offers high accuracy, fast processing, and enhanced security, making it suitable for applications in offices, educational institutions, and restricted areas. Additionally, it reduces the need for physical contact and human intervention, improving convenience and hygiene. The integration of AI with embedded systems makes the system cost-effective, scalable, and efficient for real-world deployment.

- V.Esakkimuthu
D.Arutjothi
V.Amala
III ECE

17. AI-BASED EMBEDDED SIGN LANGUAGE RECOGNITION SYSTEM

Communication is a fundamental aspect of human interaction; however, individuals with speech and hearing impairments often face significant challenges in expressing themselves effectively. To address this issue, an AI-Based Embedded Sign Language Recognition System is proposed, which aims to translate hand gestures into understandable text and speech in real time. The system leverages advancements in machine learning and computer vision to accurately recognize sign language gestures and convert them into meaningful outputs, thereby improving accessibility and inclusivity.

The proposed system utilizes an ESP32-CAM module for capturing real-time images of hand gestures in an embedded environment. These images are processed using computer vision techniques implemented through OpenCV, which performs image preprocessing, feature extraction, and gesture classification. A trained machine learning model is used to identify and interpret various hand signs with improved accuracy. The recognized gestures are then converted into text format and further transformed into speech output using a text-to-speech module, enabling effective communication with non-sign language users.

In addition to gesture recognition, the system incorporates IoT capabilities to enhance its functionality. The processed data and recognized outputs can be transmitted to mobile devices or cloud platforms, allowing remote monitoring and communication. This feature is particularly useful in scenarios where real-time alerts or communication support is required over a network. The integration of embedded hardware ensures that the system remains compact, portable, and energy-efficient, making it suitable for practical deployment.

The system is designed with a focus on cost-effectiveness, reliability, and ease of use. By combining embedded systems, artificial intelligence, and IoT technologies, the proposed solution offers a scalable and efficient approach to assist individuals with communication disabilities.

-HARSHAVARTHINI S
ABDULHAFEEZ M.H
ANANDKUMAR S
KOWSALYA P
III ECE

18. EMBEDDED ARTIFICIAL INTELLIGENCE SYSTEM FOR AUTONOMOUS DELIVERY ROBOT

An embedded artificial intelligence system for an autonomous delivery robot is designed to enable efficient and safe movement in indoor environments. The system is built using the NodeMCU ESP8266 as the core controller, integrated with the HC-SR04 Ultrasonic

Sensor for obstacle detection and the L298N Motor Driver Module for motor control. The robot operates by continuously sensing the surrounding environment, processing the sensor data, and making real-time decisions to navigate without collisions.

The embedded system executes programmed logic to control the movement of DC motors, allowing the robot to move forward, stop, or change direction based on detected obstacles. Basic intelligent behavior is achieved through sensor-based decision-making, forming a foundation for embedded artificial intelligence applications. Additionally, the use of wireless communication capabilities in the controller enables potential integration with IoT-based monitoring and control systems.

This project demonstrates the implementation of embedded systems combined with intelligent control techniques for autonomous navigation. The developed robot can be applied in environments such as hospitals, offices, and warehouses for contactless delivery and material handling. The system is scalable and can be further enhanced by integrating advanced AI techniques such as machine learning and computer vision for improved navigation and decision-making.

- NAGA YASHWANTH M
KAVITHA C
VISHWA B
III ECE

19. EMBEDDED AND AI ENABLED SMART TROLLEY

Embedded and AI-Enabled Smart Trolley is an advanced technological solution aimed at transforming conventional shopping systems into automated and intelligent retail experiences. This project integrates embedded systems with basic artificial intelligence concepts to design a smart trolley that simplifies product identification, billing, and user interaction within a shopping environment.

The core of the system is built around the ESP32 microcontroller, which provides efficient processing capability and supports real-time operations. When a product is scanned, the system reads the tag and retrieves the corresponding product information from a structured dataset developed using Visual Studio Code. The retrieved information is instantly processed and displayed on an LCD screen, allowing users to view the total cost and product details in real time. A buzzer is also integrated into the system to provide audible feedback during successful scans or error conditions, thereby improving user interaction and system responsiveness. The combination of these components ensures a seamless and efficient shopping experience.

The software aspect of the project involves creating and managing the product dataset using Visual Studio Code, which allows structured data storage and easy modification. The embedded programming is implemented using Arduino-based coding, enabling smooth communication between the hardware components and the dataset. This integration ensures accurate data processing and reliable system performance.

Furthermore, the system reduces dependency on manual billing processes, thereby minimizing human errors, reducing waiting time at checkout counters, and improving overall efficiency in retail stores. It also provides a scalable platform that can be extended with additional features such as wireless billing, mobile application integration, and cloud-based data storage. In conclusion, the Embedded and AI-Enabled Smart Trolley demonstrates an effective application of embedded systems and intelligent data handling in modern retail automation. The project highlights how emerging technologies can be utilized to create smart, user-friendly, and efficient solutions for real-world problems, contributing to the development of next-generation smart shopping systems.

- UDHAYA PRAKASH M
NANTHINI P
ENIYA V
III ECE

20. A SELF-ADAPTIVE EDGE-AI FRAMEWORK FOR ENERGY-EFFICIENT SMART AGRICULTURE SYSTEMS.

Agriculture is increasingly adopting advanced technologies to improve productivity, reduce resource consumption, and ensure sustainability. This project proposes a Self-Adaptive Edge-AI Framework for Energy-Efficient Smart Agriculture Systems, which integrates edge computing and artificial intelligence to enable real-time decision-making directly at the field level.

The system utilizes edge devices such as sensors and microcontrollers to monitor environmental parameters including soil moisture, temperature, humidity, and crop health. By processing data locally using AI algorithms, the framework minimizes reliance on cloud communication, thereby reducing latency and energy consumption. The self-adaptive mechanism allows the system to dynamically adjust irrigation, fertilization, and other farming operations based on real-time conditions.

Additionally, the framework optimizes power usage by activating components only when necessary, making it suitable for resource-constrained rural environments. The proposed solution enhances crop yield, conserves water and energy, and supports sustainable farming practices. Overall, this system demonstrates an efficient, intelligent, and scalable approach to modern agriculture using Edge-AI technologies.

- MOHAMMED AASIK S
PRAVIN KUMAR P.G
NIRANJAN R
ABINAYA S
III ECE

21. AI -POWER THEFT DETECTION SYSTEM

Power theft is a major issue in electricity distribution systems, leading to huge financial losses and reduced efficiency. Traditional methods of detecting power theft are manual, time-consuming, and often inaccurate. This project proposes an Artificial Intelligence (AI)-based power theft detection system that uses data analysis and machine learning techniques to identify abnormal electricity consumption patterns.

The system collects data from smart meters such as voltage, current, and energy usage. Using machine learning algorithms, it analyzes this data to detect unusual behavior that may indicate power theft. The model is trained on historical consumption data to differentiate between normal and suspicious usage patterns.

When abnormal activity is detected, the system alerts the authorities for further investigation. This automated approach improves accuracy, reduces human effort, and enables real-time monitoring. The proposed system helps in minimizing power losses, increasing revenue for electricity providers, and ensuring fair usage of electricity.

- KAVISRIMATHI S
D.KARTHIKEYAN
MONALISHA S
V. LOKESH
III ECE

22. WIFI CAN TRACK THE HEART RATE WITHOUT ANY WEARABLE

This project presents a method to monitor heart rate using WiFi signals without the need for any wearable device. Traditional heart rate monitoring systems require physical contact through sensors such as smartwatches or chest straps, which may not always be comfortable for continuous use. In this system, WiFi signals are used to detect small chest movements caused by heartbeats. A WiFi transmitter sends signals continuously, and these signals reflect from the human body. The reflected signals are received by an ESP32 module, which captures small variations in the signal pattern. These variations are processed using signal processing techniques to extract heartbeat information and calculate the heart rate in beats per minute (BPM). This approach provides a contactless, convenient, and efficient method for health monitoring. It can be widely used in hospitals, home care, and elderly monitoring systems for continuous and comfortable observation of vital signs.

G.K. DEEPIKA SHREE
C. ASWIN BEBIDO
R. AISHWARYA
R. AMBIKA
S. CHIJON
II ECE

23. AI BASHED SMART ENERGY MONITORING AND OPTIMIZING SYSTEM

The AI-Based Smart Energy Monitoring and Optimization System is developed to minimize energy wastage in institutional and commercial environments. The system continuously monitors electricity consumption using sensors connected to an ESP32 microcontroller. It incorporates occupancy detection through PIR sensors to intelligently control electrical appliances such as lights and fans. By leveraging machine learning algorithms, the system analyzes usage patterns, predicts peak demand periods, and optimizes energy utilization automatically. A centralized web dashboard provides real-time monitoring and historical data analysis, enabling efficient decision-making. This solution enhances energy efficiency, reduces operational costs, and promotes sustainable energy management practices.

-S. DHARANEDHARAN
M.GAYATHRI
P. ENIYASRI
V.DHILIP
II ECE

24. AI BASED EMBEDDED FLOOD MONITORING AND ALERT SYSTEM

Floods are natural disaster that causes major damage to life and property this project proposes an AI-based embedded system for flood monitoring and early warning. The system uses sensors like ultrasonic sensors to measure water levels in real time. Temperature and humidity sensors are also used to monitor environmental conditions. A microcontroller such as ESP32 collects and processes the sensor data. Artificial intelligence analyzeanalyses the data to detect abnormal water level rise. When the water level corsses a safe limit, the system tiggers an alert. Alerts are given through buzzer,LED,or mobile notifications. This helps people take quick action and move to safet locations. The system is low -cost,relia and easy to install. it can be used in rivers,dams, and flood -prone areas. Overall, the system helps reduce damage and improves disaster management .es.

- MANIKANDAN K
MADHUMITHA K
GOWTHAM A
MAGESH P
II ECE

25. EMBEDDED ARTIFICIAL INTELLIGENCE SYSTEM FOR MACHINE HEALTH MONITORING

The rapid advancement of embedded systems and Artificial Intelligence has enabled the development of smart monitoring solutions in industrial applications. This project presents an Embedded Artificial Intelligence System for Machine Health Monitoring, designed to continuously track and analyze the condition of machines in real time. The system utilizes sensors to collect parameters such as temperature, vibration, and sound, which are then processed using AI algorithms to detect abnormalities and predict potential failures. By implementing intelligent data analysis, the system helps in reducing unexpected breakdowns and maintenance costs. It also improves the overall efficiency and lifespan of machinery. The proposed model is compact, cost-effective, and suitable for real-time deployment in various industries. Additionally, it ensures reliability by providing early warnings and alerts. This work highlights the importance of combining embedded systems with AI to achieve smart and automated machine monitoring solutions.

- MATHAN KUMAR M
GOWTHAM S
MITHUN N
KANISH D
II ECE

26. AI-ENABLED EMBEDDED AIR QUALITY MONITORING SYSTEM

Air pollution is one of the most serious environmental issues affecting human health, ecosystems, and overall quality of life. Continuous monitoring of air quality is essential to detect harmful gases and take preventive actions. This project presents a real-time Air Quality Monitoring System based on Internet of Things (IoT) technology using the ESP-12E Wi-Fi module.

The system primarily uses the MQ-135 gas sensor, which is capable of detecting a wide range of hazardous gases such as carbon dioxide (CO_2), ammonia (NH_3), nitrogen oxides (NOx), benzene, smoke, and other air pollutants. The sensor continuously measures the concentration of these gases in the surrounding environment and converts it into electrical signals. These signals are processed by the ESP-12E microcontroller, which acts as the core processing and communication unit of the system.

The processed data is then transmitted wirelessly to the cloud platform, ThinkSpeak, via Wi-Fi. A dedicated channel is created in ThinkSpeak to store, analyze, and visualize the air quality.

- KARPAGARAJ KAVIN.S
UTHAYA KUMAR.S

G. SATHYA SRI
T.R. VISHZAM
II ECE

27. EMBEDDED AI SYSTEM FOR FRE AND SMOKE DETECTION AI & EMBEDDED SYSTEMS

This project proposes an Embedded AI System for Fire and Smoke Detection designed to improve early fire detection and reduce damage to life and property. Traditional fire detection systems mainly rely on heat or smoke sensors, which may respond slowly or produce false alarms. The proposed system integrates embedded hardware with artificial intelligence and computer vision techniques to detect fire and smoke in Realtime. A compact embedded platform such as a microcontroller or single-board computer is connected to a camera module that continuously monitors the surroundings. The captured mages or video frames are analysed using a trained AI model capable of identifying visual patterns associated with flames and smoke. The model is trained using datasets containing fire, smoke, and normal environment to accurately classify each frame. When fire or smoke is detected, the system immediately triggers an alert such as a buzzer alarm and can also send notifications through communication technologies like Wi-Fi, GSM, or IoT platforms. This intelligent approach enables faster detection, higher accuracy, reduced false alarms, and real-time monitoring, making it suitable for applications in homes, industries, forests, and public places. The system demonstrates how combining embedded systems and artificial intelligence at the edge can enhance safety and provide an efficient solution for fire hazard detection.

-NAVEENPRASATH K
RATHINAPRIYA C
NAVEEN B
MEENA V
II ECE

28. AI-BASED RF SIGNAL CLASSIFICATION FOR COGNITIVE RADIO NETWORKS

A voice vision learning system aims to enhance the teaching and learning experience by integrating modern technologies such as the Internet of Things (IoT), automation, and interactive digital tools. This project focuses on developing an intelligent classroom environment that improves efficiency, monitoring, and student engagement.
The system utilizes IoT-based sensors and devices to automate classroom operations such as lighting, attendance, temperature control, and equipment management. Smart boards and connected devices enable interactive and collaborative learning, making the educational process more engaging and effective.

Additionally, real-time data collection and monitoring help teachers and administrators track student participation, classroom conditions, and overall performance. This leads to better decision-making and resource optimization.

- SIVADHARSHINI. V
MUTHURAJA. B
KARTHICK. P
VIYAS.S
II ECE

29. AI ENABLED EMBEDDED DISASTER MONITORING SYSTEM

Traditional disaster monitoring methods often suffer from high latency, high costs, and single-parameter detection. This paper presents a novel AI-powered Embedded Internet of Things (IoT) system for multi-hazard monitoring. The proposed system utilizes a network of intelligent nodes equipped with sensory hardware, interfaced with an ESP32 microcontroller that acts as an edge node. A Convolutional Neural Network (CNN) or Random Forest model is deployed directly on the embedded system to analyze live data streams (tilt, moisture, acoustic) and detect hazards like landslides or structural failures before they escalate. The system features autonomous, real-time alert dissemination via MQTT protocols to a cloud dashboard for geospatial visualization. Experimental validation demonstrates that edge-based AI drastically improves early warning speed and reduces false positives compared to threshold-based traditional systems, offering a reliable and scalable solution for smart city disaster resilience.

-DHANASEKAR S
SATHIYADEVI S
SUNIL DEVA T
SURYA SR
II ECE

30. EMBEDDED AI SYSTEM FOR REAL-TIME OBJECT DETECTION

Embedded Artificial Intelligence (AI) systems are transforming real-time applications by enabling devices to process data locally without relying on cloud computing. This project presents the design and implementation of an embedded AI system for real-time object detection using a compact and low-cost hardware platform such as the ESP32-CAM.
The system captures live video input through a camera and processes it using optimized machine learning models to detect and identify objects in real time. By performing computation on the device itself, the system reduces latency, improves response time, and ensures better privacy and efficiency.

This project demonstrates how embedded AI can be effectively used in applications like surveillance, smart monitoring, and automation. The proposed system is cost-effective, energy-efficient, and suitable for real-world deployment in resource-constrained environments.

- A.MURUGANANDHAN
T.PRIYADHARSHINI
G.RAMKUMAR
S.THISON
K.VIJAI
II ECE