Excellence in Higher Education
AKSHAYA
COLLEGE OF ENGINEERING AND TECHNOLOGY
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AN AUTONOMOUS INSTITUTION

Department of Electronics and Communication Engineering

Technical Magazine

Issue 1 [DECEMBER 2025]

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.Offering a postgraduate programme (M.E. VLSI Design) with an intake of 9 students, the department has also 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.

Mrs. K. Nimisha, AP (Sr.G)
(HoD - i/c)

1. 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.

2. 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 Specific Outcomes – PSOs

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6. 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 first issue of the ECE Department's Technical Magazine for the academic year 2025-2026(Odd 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:	Mrs.K. Nimisha, AP (Sr.G)/ECE
Faculty Advisors:	Mrs.A. Ambika AP, (Sl.G)/ECE,
	Mrs.A.RamjanBegam, AP/ECE,
	Mr.S.Ravikumar, AP/ECE
Student Editors:	S.B.DharaniDharan, III ECE
Design Team:	Mrs.R.Suriya, AP/ECE

4. Table of Contents:

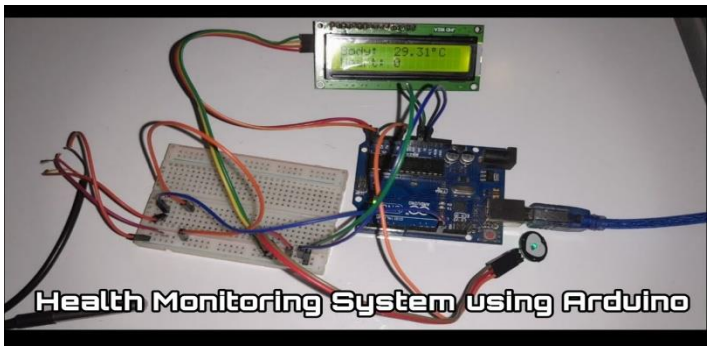
1. AI-ENABLED REAL-TIME SMART TRAFFIC CONTROL USING ESP32 AND FREE RTOS

Urban traffic congestion is a growing challenge in smart city infrastructure. This project presents an AI-enabled real-time traffic signal control system implemented using the ESP32 microcontroller and Free RTOS. Traffic density data is collected using vision sensors or IR-based vehicle detectors deployed at intersections. The embedded system processes sensor inputs in real time and dynamically adjusts signal timing to optimize traffic flow. Free RTOS enables task-level parallelism by separating sensing, decision-making, and communication processes, ensuring deterministic response. WI-Fi connectivity allows real-time data upload to a cloud dashboard for monitoring and analysis. Emergency vehicle prioritization is incorporated using pattern recognition and signal preemption techniques. The system minimizes idle waiting time, reduces fuel consumption, and improves road safety. This project demonstrates the effectiveness of combining AI algorithms with real-time embedded platforms for intelligent transportation systems in next-generation smart cities.

G. SRIDHARAN
K. SHYAM GANESH
K. KATHIRESH KUMAR
S. LOHIT
IV ECE

2. REAL-TIME IOT-BASED PATIENT HEALTH MONITORING USING ARDUINO

Healthcare systems increasingly rely on continuous monitoring for early diagnosis and emergency response. This project implements a real-time patient health monitoring system using an Arduino-based embedded platform integrated with biomedical sensors. Vital parameters such as heart rate, body temperature, oxygen saturation, and ECG signals are acquired continuously. The microcontroller processes sensor data in real time and compares it against predefined thresholds. In case of abnormal conditions, instant alerts are generated and transmitted wirelessly to caregivers or healthcare professionals. Data logging and visualization are supported through IoT connectivity, enabling remote monitoring. The system is designed for low power consumption, reliability, and affordability, making it suitable for home healthcare and rural medical services. This project highlights the role of Arduino-based real-time embedded systems in improving accessibility and responsiveness of modern healthcare solutions.



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R.VISHNUKUMAR
B.MADHAN KUMAR
M.AATHISH KUMAR
M.NITHISH
IV ECE

3. RTOS-BASED INDUSTRIAL EQUIPMENT FAULT DETECTION SYSTEM

Modern industrial environments demand continuous monitoring and rapid response to equipment anomalies to minimize downtime and maintenance costs. This project presents an RTOS-based industrial equipment fault detection system designed for real-time condition monitoring and predictive maintenance. The system employs an embedded controller integrated with multiple sensors to measure critical parameters such as vibration, temperature, acoustic noise, and electrical current drawn by industrial machinery. An RTOS is used to manage

concurrent tasks, including high-frequency data acquisition, signal preprocessing, feature extraction, fault classification, and communication, ensuring deterministic timing and low latency. Priority-based scheduling enables time-critical sensing tasks to preempt non-critical operations, improving reliability under varying load conditions. Fault detection algorithms analyze deviations from normal operating signatures to identify early signs of wear, misalignment, overheating, or electrical faults. Upon detecting abnormalities, the system generates instant alerts and transmits diagnostic data to a supervisory system or cloud platform for visualization and maintenance planning. Data logging supports trend analysis and long-term performance evaluation. The proposed architecture enhances operational safety, reduces unplanned downtime, and supports Industry 4.0 initiatives by enabling scalable, intelligent, and real-time equipment health monitoring across industrial plants.

HARIVATHSAN G
LOKESHWAR S
KATHIRVEL S
MANOJ M
IV ECE

4. REAL-TIME AIR QUALITY MONITORING SYSTEM USING ESP32

Environmental pollution monitoring requires continuous and real-time data analysis. This project implements a real-time air quality monitoring system using the ESP32 embedded platform. Air pollution poses a serious threat to public health and environmental sustainability, requiring continuous and accurate monitoring solutions. This project presents a real-time air quality monitoring system designed using an embedded system platform. The system integrates multiple environmental sensors to measure critical air quality parameters such as carbon monoxide (CO), carbon dioxide (CO_2), nitrogen dioxide (NO_2), particulate matter (PM2.5/PM10), temperature, and humidity. An embedded microcontroller performs real-time data acquisition, sensor calibration, and signal processing to compute the Air Quality Index (AQI). To ensure timely response, the system operates under real-time constraints, enabling immediate detection of hazardous pollution levels. Wireless communication modules transmit live air quality data to a cloud server or monitoring dashboard for visualization and analysis. Threshold-based alerts are generated instantly to notify authorities or users when air quality exceeds permissible limits. Data logging allows long-term trend analysis and supports pollution control planning. The system is designed for low power consumption,

scalability, and reliability, making it suitable for deployment in smart cities, industrial zones, traffic intersections, and indoor environments. This project demonstrates how embedded systems play a crucial role in real-time environmental monitoring and sustainable urban development.

GOKULNATH.K
SURENDAR P
SRIDHAR N SEKAR
S
IV ECE

5. EMBEDDED VISION-BASED DRIVER DROWSINESS DETECTION USING NVIDIA JETSON ORIN NANO

Driver fatigue is a leading factor in road accidents worldwide, creating an urgent need for intelligent, real-time in-vehicle safety systems. This project presents an embedded vision-based driver drowsiness detection system built on the NVIDIA Jetson Orin Nano platform is a recent high-performance edge AI processor optimized for computer vision and deep learning. The system continuously captures the driver's facial features using an IR-filtered camera mounted on the dashboard. Real-time video frames are processed using optimized CNN-based models (e.g., MobileNetV3/ResNet variants) accelerated by Jetson Orin Nano's Ampere GPU and Tensor Cores, enabling high-throughput inferencing at 30+ FPS with low power consumption.

Facial landmarks, eye aspect ratio (EAR), and blink frequency are computed in real time to determine signs of drowsiness such as prolonged eye closure, frequent yawning, and head nodding. The embedded software runs on Linux with NVIDIA JetPack SDK,

utilizing TensorRT for GPU-accelerated neural network inference. A multitasking architecture separates video capture, pre-processing, inference, and alert generation to maintain deterministic response times.

When fatigue thresholds are exceeded, the system immediately issues visual, auditory, and haptic alerts to the driver and can optionally send a notification to connected smartphone apps via Bluetooth/Wi-Fi. Data logging supports trend analysis and driver behavior profiling.The design emphasizes low latency, robustness under varying lighting conditions, and seamless integration with vehicle CAN-bus systems for future advanced driver-assistance system (ADAS) upgrades.

This project demonstrates how modern embedded AI processors like the NVIDIA Jetson Orin Nano enable sophisticated real-time vision applications, offering a scalable solution for improving road safety in 2025 and beyond.

-SWETHA.T
MENAGA.P
MANOGN.M
SHANMUKA LAKSHMI K
IV ECE

6. SMART IRRIGATION SYSTEM WITH REAL-TIME CONTROL USING ESP32-S3 AND IOT

Water scarcity and inefficient irrigation are major challenges in modern agriculture, driving the need for intelligent, real-time agricultural control systems. This project implements a Smart Irrigation System using the ESP32-S3 — a recent, high-performance IoT-ready embedded controller with built-in Wi-Fi, Bluetooth LE, and native support for FreeRTOS. The system continuously monitors soil moisture, temperature, humidity, and ambient light using precision sensors (e.g., capacitive soil moisture sensor, DHT or BME series environmental sensor). These readings are processed in real time on the ESP32-S3, which executes multitasking via FreeRTOS to ensure deterministic control responses even under network load.

The embedded controller uses adaptive irrigation logic: when soil moisture drops below preset thresholds, the system actuates solenoid valves or water pumps immediately to deliver precise water volumes. Real-time decision-making enables the system to handle sudden environmental changes such as unexpected rainfall or temperature swings. To support remote supervision, the controller connects seamlessly to IoT platforms (e.g., MQTT brokers, ThingSpeak, or custom dashboards) via secure Wi-Fi. Live sensor data, irrigation status, and historical trends are visualized through cloud dashboards and mobile applications, enabling farmers to monitor fields from anywhere.

The project emphasizes energy efficiency by incorporating low-power sleep modes

and solar power compatibility, making it suitable for off-grid agricultural sites. Additionally, threshold settings, irrigation schedules, and weather forecasts can be updated OTA (Over-The-Air) without physical access to the hardware. Fault detection (e.g., sensor anomalies or valve failures) triggers instant alerts for preventive maintenance.

By leveraging the ESP32-S3's processing capability and IoT connectivity, this real-time smart irrigation system enhances water conservation, boosts crop yield, and supports precision agriculture — a key technological priority for sustainable farming in 2025 and beyond.

-DHARANI DHARAN
SB KATHIRAVAN KS
DHARMARAJU B
AKASH R IV ECE

7. SMART PARKING SYSTEM WITH REAL-TIME UPDATES USING IOT EMBEDDED SYSTEMS

Rapid urbanization has significantly increased the demand for efficient parking management solutions in smart cities.This project presents a Smart Parking System with Real-Time Updates developed using modern IoT-enabled embedded systems. The system employs an embedded controller such as the ESP32 or ARM Cortex-M–based microcontroller, integrated with ultrasonic or magnetic sensors installed at individual parking slots to detect vehicle presence accurately. Sensor data is acquired and processed in real time to determine slot availability with minimal latency.

The embedded controller runs a lightweight real-time firmware that continuously updates parking status and transmits data wirelessly using Wi-Fi or LoRa communication protocols. Real-time updates are sent to a cloud-based IoT platform, where parking availability is visualized through mobile applications or digital display boards at parking entrances. The system supports instant notification of free and occupied slots, significantly reducing the time spent searching for parking spaces.

Advanced features such as slot reservation, entry–exit monitoring, and billing integration can be implemented using real-time data synchronization. The system also supports fault detection to identify sensor failures or communication issues and generate maintenance alerts. Designed for scalability, low power consumption, and reliability, the proposed smart parking system effectively reduces traffic congestion, fuel consumption, and carbon emissions. This project demonstrates the role of IoT-based embedded systems in enabling real-time urban infrastructure management for smart city applications.

KALAIVANI C

KAVISHREE
REEMA S
IV ECE

8. A REAL-TIME OBJECT DETECTION ACCELERATOR SOC FOR AUTONOMOUS VISION SYSTEMS

Real-time object detection is a critical requirement in autonomous vehicles, intelligent surveillance, and advanced driver-assistance systems (ADAS). This paper presents the design of a dedicated VLSI System-on-Chip (SoC) optimized for real-time object detection using convolutional neural networks (CNNs). The proposed SoC integrates a hardware accelerator tailored for YOLO-based deep learning models, enabling high-throughput inference with deterministic latency. The architecture employs parallel processing elements, pipelined data paths, and on-chip SRAM buffers to minimize memory access latency and reduce off-chip bandwidth. Weight compression and data reuse techniques are incorporated to improve energy efficiency. A hardware task scheduler coordinates image preprocessing, inference, and post-processing operations to meet strict real-time deadlines. Implemented using a 12 nm FinFET CMOS technology, the design achieves real-time processing of high-resolution video streams at over 60 frames per second while maintaining low power consumption suitable for automotive environments. Experimental results demonstrate significant performance and energy efficiency improvements compared to CPU- and GPU-based implementations. The proposed accelerator SoC provides a scalable and reliable hardware platform for real-time embedded vision applications.

- SANDHIYA DEVI. V
MADHUMITHA.R
GOWSIKA. S
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9. REAL-TIME ECG HEARTBEAT DETECTION ASIC FOR WEARABLE HEALTH MONITORS

This project presents the design of a custom VLSI ASIC for real-time heartbeat detection and ECG signal processing in wearable health monitoring devices. The chip integrates low-noise analog front-end amplifiers, ADC converters, and a digital processing engine to extract QRS complexes, heart rate variability, and arrhythmia indicators with

minimal latency. A highly optimized digital filter chain and threshold detector are implemented to reduce false positives while maintaining real-time performance. Power consumption is minimized through dynamic voltage scaling and clock gating. The ASIC interfaces with a microcontroller over SPI/I^2C to upload processed data to mobile apps via BLE. The design uses TSMC 22nm FD-SOI technology, achieving high throughput with low energy per sample. This solution enables continuous, on-chip ECG analysis for wearable healthcare platforms.

JAYASHREE.L
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ARCHANA T
SAKTHI K
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10. VLSI-BASED LOW-LATENCY FIR FILTER ARRAY FOR 5G BASE STATIONS

This VLSI design implements an array of hardware-optimized Finite Impulse Response (FIR) filters for real-time 5G base station signal processing. The architecture exploits parallel multiply-accumulate units, coefficient quantization, and distributed arithmetic to achieve high throughput with minimal logic area. Real-time processing is supported through pipelined data paths and multi-bank memory access. The filter array handles channel equalization, digital pre-distortion, and interference rejection tasks required for next-generation wireless communication. Implemented in a 16nm process, the design demonstrates deterministic latency, high energy efficiency, and scalability for multi-antenna (MIMO) systems. This project bridges the gap between digital logic design and real-time communication requirements in advanced cellular networks.

- HARIBALAJI. R
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MADHAN.S
SANJAY.R
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11.REAL-TIME NEURAL SIGNAL PROCESSOR ASIC FOR BRAIN–MACHINE INTERFACES

Brain–machine interfaces (BMIs) require ultra-low-latency processing of neural signals to enable seamless interaction between the human nervous system and external devices. This work presents the design of a real-time neural signal processor ASIC optimized for continuous decoding of multi-channel neural

recordings. The proposed VLSI architecture integrates a low-noise analog front-end, high-resolution ADCs, and a digital processing pipeline capable of performing real-time spike detection, spike sorting, and feature extraction. Dedicated hardware accelerators are implemented for filtering, thresholding, principal component analysis (PCA), and machine-learning-based classification to achieve deterministic processing latency.

The architecture employs parallel processing units, pipelined data paths, and on-chip SRAM buffers to minimize memory access delays and ensure sustained throughput under real-time constraints. Power-efficient design techniques such as clock gating, voltage scaling, and event-driven computation are incorporated to meet implantable device requirements. Implemented in a 14-nm CMOS process, the ASIC supports hundreds of neural channels with sub-millisecond end-to-end latency and ultra-low energy consumption. The proposed ASIC enables scalable, energy-efficient, and deterministic neural processing for next-generation brain–machine interface applications.

-THULASIDHARAN
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12. A VLSI REAL-TIME PULSE OXIMETER ENGINE FOR WEARABLE HEALTH MONITORING DEVICES

Continuous monitoring of blood oxygen saturation (SpO_2) and pulse rate is essential in wearable healthcare systems for early detection of respiratory and cardiovascular disorders. This work presents a VLSI real-time pulse oximeter engine specifically designed for low-power wearable devices. The proposed ASIC integrates a low-noise analog front-end for photoplethysmography (PPG) signal acquisition, programmable LED driver circuitry, and a digital signal processing pipeline optimized for real-time SpO_2 computation. Dedicated hardware accelerators perform signal conditioning, ambient light cancellation, AC/DC component separation, and peak detection with deterministic latency.

A pipelined architecture and on-chip memory buffers enable continuous real-time processing without data loss. Power-efficient techniques such as duty-cycled LED operation, clock gating, and adaptive voltage scaling are employed to extend battery life. The design is implemented in a 40-nm CMOS technology and supports multi-

wavelength sensing with sub-millisecond processing latency. Experimental evaluation demonstrates high measurement accuracy, low energy consumption, and robust performance under motion artifacts. The proposed VLSI engine provides a scalable and energy-efficient solution for next-generation wearable health monitoring devices and real-time medical sensing applications.

- RAHULPRASATH P
ANGAMUTHU V
SUHASH S
SANJAV
IV ECE

13. A REAL-TIME PREDICTIVE MAINTENANCE SOC FOR INDUSTRIAL ROBOTICS

Industrial robotic systems operate under strict reliability and availability requirements, making early fault detection essential for minimizing downtime and maintenance costs. This work presents a real-time predictive maintenance System-on-Chip (SoC) designed specifically for industrial robotics applications. The proposed SoC integrates multi-channel sensor interfaces for vibration, motor current, torque, and temperature monitoring, along with dedicated hardware accelerators for real-time signal processing and anomaly detection. Custom VLSI blocks implement fast Fourier transform (FFT), statistical feature extraction, and threshold-based health assessment with deterministic latency. An embedded ARM Cortex-M controller manages system control, communication, and configuration tasks, while high-speed on-chip memory and DMA engines ensure continuous data flow under real-time constraints. The architecture supports industrial communication protocols such as Ethernet-TSN and CAN-FD for seamless integration with factory automation networks. Power-efficient design techniques, including clock gating and dynamic voltage scaling, enable sustained operation in harsh industrial environments. Implemented in a 16-nm CMOS technology, the SoC achieves sub-millisecond fault detection latency and high energy efficiency. Experimental evaluation demonstrates reliable early detection of bearing wear, imbalance, and electrical faults. The proposed SoC provides a scalable and deterministic hardware platform for intelligent predictive maintenance in next-generation industrial robotics and Industry 4.0 systems.

-P.SANTHOSHKUMAR
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ABILES.P
BALA.S
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14. LOW-POWER IOT COMMUNICATION SYSTEM USING LORAWAN FOR REAL-TIME SENSOR NETWORKS

Efficient long-range and low-power communication is critical for large-scale Internet of Things (IoT) deployments such as smart agriculture, environmental monitoring, and smart cities. This project presents a low-power IoT communication system based on LoRaWAN, optimized for real-time sensor data acquisition and transmission. The system integrates multiple sensor nodes with an ESP32-S3 or STM32L4 microcontroller interfaced to environmental sensors measuring parameters such as temperature, humidity, soil moisture, and air quality. Each sensor node performs local data pre-processing and periodically transmits packets over the LoRaWAN network to a central gateway.

Real-time data collection is achieved through event-driven scheduling, adaptive data rates (ADR), and time-synchronized transmissions to ensure minimal latency and network reliability.Power consumption is minimized using duty-cycling, deep-sleep modes, and optimized packet scheduling, enabling months of operation on battery or solar-powered setups. The gateway aggregates and forwards sensor data to cloud-based IoT dashboards for visualization, alert generation, and trend analysis. Experimental evaluation demonstrates reliable data delivery over long distances (up to 15 km in rural scenarios) while maintaining ultra-low energy consumption.

-R. KRISHNA VENI
NANABALADILLI
P. V. L. PRASANNA
SHATAKSHI. MD
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15.REAL-TIME VEHICLE-TO-EVERYTHING (V2X) COMMUNICATION SYSTEM FOR INTELLIGENT TRANSPORTATION

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.

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

16.SECURE REAL-TIME IOT COMMUNICATION WITH CLOUD ANALYTICS

IoT deployments in smart cities and industrial automation require real-time data transmission with secure cloud integration. This project presents a secure IoT communication system where sensor nodes transmit data to a cloud platform for storage, visualization, and analytics. An ESP32-S3 embedded controller is used for each sensor node, which implements AES-256 encryption for secure data transfer. Real-time data is transmitted via MQTT or HTTPS to a cloud server where analytics, threshold-based alerts, and predictive insights are generated. The system also employs real-time scheduling on the embedded controller to prioritize critical sensor data. Experimental evaluation shows low latency, secure transmission, and scalable integration with multiple sensor nodes. The project demonstrates how combining embedded real-time communication with cloud computing ensures robust, secure, and intelligent IoT systems.

-MOHAMMED HARIS
SANTHOSHKUM R
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IV ECE

17. SECURE CLOUD-BASED INDUSTRIAL IOT COMMUNICATION WITH BLOCKCHAIN

Industrial IoT systems generate massive sensor data that must be transmitted securely

to cloud servers for monitoring and predictive maintenance. This project integrates blockchain-based security with real-time embedded communication for industrial applications.STM32H7 microcontrollers collect vibration, temperature, and current data from machinery. Real-time tasks prioritize critical fault signals, while blockchain encryption ensures tamper-proof transmission to cloud servers. Cloud-based analytics perform predictive maintenance and anomaly detection. The system demonstrates end-to-end secure, low-latency communication suitable for Industry 4.0 factories, ensuring both reliability and cyber integrity.

-BOYA LOKESH NAIDU
SHAIK ARISH AHMED
M CHAKALI VISHNU
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18. REAL-TIME UAV COMMUNICATION SYSTEM WITH CLOUD-BASED SECURITY ANALYTICS

Unmanned Aerial Vehicles (UAVs) require real-time communication for telemetry, navigation, and obstacle alerts. This project develops a UAV communication system with embedded controllers transmitting encrypted telemetry data to a cloud platform. AES/RSA encryption ensures secure communication, while cloud-based AI analytics detect anomalies and optimize flight paths in real time. RTOS-based multitasking guarantees high-priority message handling for collision avoidance. Field tests demonstrate low-latency, secure cloud-assisted UAV communication suitable for delivery drones and surveillance.

- BANTANAHAL LAKSHMI NARASIMHA
D.KARTHIKEY N
G.HARIHARAN
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19. REAL-TIME FACIAL RECOGNITION USING EMBEDDED CNN ACCELERATORS

Facial recognition is widely used in security, attendance, and access control systems. This project implements a convolutional neural network (CNN) on an NVIDIA Jetson Orin Nano for real-time facial recognition. The pipeline includes face detection, feature extraction, and matching against a database. Hardware acceleration ensures real-time inference (30+ FPS) with low latency. The system is deployed for live video feeds, demonstrating high accuracy and performance in embedded applications.

-J.KISHORE PRIYADHARSHAN
V.ESAKKI

MUTHU
B.ASHOK
REDDY
B.KARTHIK
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20. REAL-TIME LICENSE PLATE RECOGNITION SYSTEM USING FPGA-BASED EMBEDDED ARCHITECTURE.

Automatic License Plate Recognition (ALPR) is critical for traffic management, toll collection, and smart city applications. This project presents a real-time ALPR system implemented on an FPGA-based embedded platform, capable of processing live video streams with minimal latency. The system integrates image acquisition, pre-processing, license plate localization, character segmentation, and recognition modules into a pipelined architecture optimized for hardware parallelism.

Sobel filtering, morphological operations, and thresholding are implemented in FPGA fabric to accelerate image processing, while character recognition employs a lightweight template matching algorithm. Real-time scheduling ensures deterministic processing of each video frame, achieving sub-10 ms latency per frame. The system communicates recognized plate data to external control units or cloud platforms via UART or Ethernet interfaces.

Implementation on a Xilinx Zynq FPGA demonstrates high accuracy in varying lighting and traffic conditions, low power consumption, and scalability for multi-camera setups. This design highlights the advantages of hardware acceleration and embedded FPGA platforms for real-time intelligent transportation systems, providing a reliable and energy-efficient solution for modern traffic monitoring applications.

-S.HEMAVARSHINI
THANGA LAKSHMI
DEVADHARSHINI
SUKANYA
III ECE

21.REAL-TIME OPTICAL CHARACTER RECOGNITION ON EMBEDDED PLATFORMS FOR INTELLIGENT DOCUMENT PROCESSING

Optical Character Recognition (OCR) is essential for automated text extraction from images in applications such as document digitization, license plate recognition, and industrial automation. This project presents a real-time OCR system implemented on embedded platforms using ARM Cortex-M7 and STM32H7 microcontrollers. The system

pipeline integrates image acquisition, pre-processing (grayscale conversion, binarization, noise removal), segmentation, and character recognition using lightweight template matching and neural network-based classifiers optimized for embedded execution.

Hardware acceleration modules handle compute-intensive tasks such as morphological operations and matrix multiplications to reduce processing latency. RTOS-based task scheduling ensures deterministic execution, enabling continuous processing of live camera feeds at frame rates up to 30 FPS. The system supports multiple fonts and varying lighting conditions, providing robust performance in real-world scenarios. Experimental evaluation demonstrates high recognition accuracy with low power consumption, making the system suitable for portable and energy-constrained devices. The project showcases the combination of embedded hardware optimization, real-time processing, and efficient OCR algorithms for intelligent document processing and edge computing applications.

- KAVISRIMATHI
MONALISHA
SWATH
I HARINI
III ECE

22. REAL-TIME LANE DETECTION SYSTEM FOR AUTONOMOUS VEHICLES USING EMBEDDED VISION

Lane detection is a critical component of autonomous vehicles and Advanced Driver-Assistance Systems (ADAS), enabling safe navigation and lane-keeping. This project presents a real-time lane detection system implemented on an embedded vision platform using the NVIDIA Jetson Xavier NX. The system captures live video streams from vehicle-mounted cameras and processes them using a combination of Canny edge detection, region-of-interest (ROI) selection, and Hough Transform algorithms for robust lane line extraction. Hardware-accelerated image processing pipelines and RTOS-based task scheduling ensure deterministic frame processing with latency below 50 ms per frame, suitable for high-speed driving scenarios.

The system also incorporates adaptive thresholding and perspective transformation to handle varying lighting conditions, road curvature, and lane widths. Detected lane information is communicated to the vehicle's control module for real-time steering adjustments or driver alerts. Experimental evaluation demonstrates accurate lane recognition under diverse environmental conditions, low power consumption, and high frame rates. This project highlights the integration of real-time embedded vision, algorithmic optimization, and hardware acceleration for reliable autonomous vehicle navigation and intelligent transportation systems.

S.ANANDKUMAR G
.DHARMESH
R.NIRANJAN
V.LOKESH
III ECE

23. REAL-TIME EDGE-PRESERVING IMAGE DENOISING FOR MEDICAL IMAGING ON EMBEDDED PLATFORMS

High-quality medical imaging is essential for accurate diagnosis, yet noise in images such as ultrasound, MRI, and endoscopy can degrade clinical interpretation. This project presents a real-time edge-preserving image denoising system implemented on an embedded platform using Raspberry Pi 4 with GPU acceleration or ARM Cortex-A72 processors. The system employs a bilateral filtering algorithm optimized for hardware acceleration to suppress noise while retaining critical edges and fine structural details. Real-time processing is achieved through pipelined image acquisition, parallelized filtering, and RTOS-based task scheduling to maintain low-latency processing for live medical imaging streams.

The architecture also incorporates adaptive filtering parameters to handle varying noise levels and tissue textures. Experimental results demonstrate substantial noise reduction without blurring important anatomical features, achieving processing speeds suitable for real-time diagnostic applications. The project highlights the integration of embedded real-time processing, algorithmic optimization, and hardware acceleration to enhance image clarity in telemedicine, surgical guidance, and continuous patient monitoring systems.

-DEVADHARSHINI
THANGA
LAKSHMI
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24.REAL-TIME GESTURE RECOGNITION USING EMBEDDED CONVOLUTIONAL NEURAL NETWORKS

Gesture recognition enables intuitive human-computer interaction in applications such as smart appliances, augmented/virtual reality, and contactless control systems. This project presents a real-time gesture recognition system implemented on embedded platforms using STM32H7 microcontrollers with DSP and hardware acceleration. The system captures live hand movement video streams from a camera, preprocesses the frames for background subtraction and normalization, and employs a lightweight Convolutional Neural Network (CNN) for gesture classification.

Hardware acceleration modules handle convolution and pooling operations, while RTOS-based multitasking ensures deterministic processing of high-priority frames. The system achieves real-time inference at 25–30 FPS with low latency and minimal power consumption. Adaptive thresholding and data augmentation techniques improve recognition robustness under varying lighting and hand orientations. Experimental evaluation demonstrates accurate classification across multiple gesture classes, highlighting the effectiveness of embedded CNNs for low-latency, energy-efficient, real-time gesture recognition in edge computing and IoT-enabled smart devices.

-B.VINU UTHARAMOORTHY
S.MOHAMMED AASIK
B.VISHWA
III ECE

25. REAL-TIME VEHICLE FLEET MONITORING WITH SECURE CLOUD COMMUNICATION

Fleet management requires continuous vehicle tracking and secure data transfer to cloud platforms for route optimization and maintenance alerts. This project develops a real-time embedded system using ARM Cortex-M controllers integrated with GPS, accelerometers, and fuel sensors. Data is encrypted with ECC and AES algorithms and transmitted over LTE/5G networks to cloud servers. RTOS-based multitasking ensures critical alerts (accidents, geofence breaches) are delivered instantly. Cloud dashboards provide real-time analytics for fleet operators, improving safety, efficiency, and security.

-NAGA YASHWANTH
III ECE

26. REAL-TIME OPTICAL CHARACTER RECOGNITION ON EMBEDDED PLATFORMS FOR INTELLIGENT DOCUMENT PROCESSING

Optical Character Recognition (OCR) enables automated text extraction from images for applications such as document digitization, license plate reading, and industrial automation. This project presents a real-time OCR system implemented on embedded platforms using ARM Cortex-M7 and STM32H7 microcontrollers. The system pipeline integrates image acquisition, pre-processing (grayscale conversion, binarization, noise removal), segmentation, and character recognition using lightweight template matching and embedded neural network classifiers. Hardware acceleration modules handle compute-intensive tasks such as morphological operations and matrix multiplications to minimize processing latency. RTOS-based task scheduling ensures

deterministic execution, enabling continuous processing of live camera feeds at 25–30 frames per second. The system supports multiple fonts, varying lighting conditions, and low-power operation for portable devices. Experimental evaluation demonstrates high recognition accuracy with low energy consumption. This project highlights the integration of embedded hardware optimization, real-time processing, and efficient OCR algorithms for intelligent document processing and edge computing applications.

- KAVISRIMATHI
MONALISHA
III ECE

27.IOT-BASED SMART ENERGY METER WITH DEMAND PREDICTION AND LOAD OPTIMIZATION

This project focuses on the design of an intelligent energy metering system integrated with IoT and data analytics. The system measures real-time voltage, current, power factor, and energy consumption using high-precision sensors. Collected data is transmitted to a cloud platform for visualization and analysis. Demand prediction algorithms forecast future energy usage patterns based on historical data. The system enables dynamic load optimization by identifying peak demand periods and suggesting corrective actions. Consumers and utility providers benefit from improved energy efficiency and reduced power wastage. The proposed solution supports smart grid infrastructure and promotes sustainable energy management.

V.ESAKKI MUTHU
B.ASHOK REDDY
B.KARTHIK
III ECE

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

Cognitive Radio Networks (CRN) require dynamic spectral awareness to efficiently share frequency spectrum. This project develops an AI-driven RF signal classification engine using deep learning models trained on diverse modulation and interference patterns. Spectrogram features are extracted from received signals, and convolutional networks achieve accurate classification under noisy environments. Real-time adaptation supports spectrum sensing and channel selection, improving spectral efficiency. The system is implemented on an FPGA for high throughput and low latency. Results show robust performance, enabling smarter spectrum utilization in dense wireless environments.

- SANDHIYADEVI.V
GOWSIKA. S
MEENA. M
IV ECE

29. HYBRID ENERGY HARVESTING SYSTEM FOR SUSTAINABLE WIRELESS SENSOR NODES

Energy autonomy in wireless sensor networks is critical for long-term environmental monitoring. This project designs a hybrid energy harvesting unit combining solar, thermal, and RF energy sources to power low-power sensor nodes. An intelligent energy management circuit dynamically allocates harvested energy based on load demand and environmental availability. Experimental prototypes demonstrate sustained operation over extended periods, even under fluctuating conditions. This sustainable power solution reduces battery dependency and supports remote IoT sensing in ecological, agricultural, and infrastructure applications.

LOKESHWARS
KATHIRVEL S
MANOJ M
IV ECE

30. NEUROMORPHIC COMPUTING ACCELERATOR FOR REAL-TIME SIGNAL PROCESSING

Conventional processors struggle with power and latency demands in modern signal processing tasks. This project introduces a neuromorphic computing accelerator modeled after spiking neural networks (SNNs) for real-time pattern recognition in communication systems. The hardware design employs event-driven processing and asynchronous memory to minimize energy usage. Benchmarks on modulation detection and noise classification show orders-of-magnitude improvements in energy efficiency compared to traditional DSP approaches. The proposed accelerator is promising for next-generation edge AI and ultra-low-power communication devices.

-DHARMARAJU B
AKASH R
IV E