THE TECHNOCRACY
STUDENTS' TECHNICAL COMMITTEE, NIT RAIPUR

AAVARTAN'25-26

VIGYAAN

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROBLEM STATEMENTS

ECE01: Edge-AI Predictive Maintenance for Rotating Machinery

Develop an intelligent edge-computing system capable of predicting faults in industrial rotating machinery by continuously analyzing real-time sensor data. The solution should detect early signs of bearing wear, imbalance, misalignment or overheating issues that traditionally cause unexpected machine failures and costly downtime. Using compact motors to emulate industrial conditions, teams must build a small-scale prototype that demonstrates continuous health monitoring, on-device signal processing and timely anomaly detection to enhance equipment reliability and maintenance efficiency.

ECE02: Affordable EEG-Based Brainwave Control System

Develop a low-cost Brain–Computer Interface system that captures and interprets EEG brainwave signals to control external assistive devices in real time. Using accessible EEG hardware such as NeuroSky MindWave or OpenBCI, the system should acquire and process neural activity, classify simple cognitive states (attention, relaxation), and translate them into actionable control commands. The goal is to demonstrate how affordable neurotechnology can support assistive, rehabilitation and human–machine interaction applications by enabling users to operate devices using only their mental state.

ECE03: IoT-Based Early Fire Detection Network with Edge AI

Develop an intelligent IoT-based fire detection system that uses Edge AI to identify early fire hazards through continuous environmental

monitoring and on-device visual analysis. The system should combine multi-parameter sensing including temperature, humidity, smoke and combustible gas indicators with an embedded camera module that performs lightweight, on-board image inference for visual confirmation of fire signatures. Upon detecting abnormal conditions, the system must transmit real-time alerts and evidence snapshots to a dashboard or mobile interface, enabling rapid response and preventing escalation. The goal is to demonstrate a cost-effective, scalable safety network suitable for homes, industries, and public infrastructure.

ECE04: IoT + AI Solution for Pet Activity and Stress Monitoring

Develop an IoT- and AI-enabled wearable system that monitors a pet's wellness, activity patterns and stress indicators in real time. Using embedded sensors such as an accelerometer for motion tracking and a heart-rate sensor for physiological monitoring, the device should collect and analyze behavioural data locally on an ESP32 or Raspberry Pi. A lightweight Edge AI model must classify states such as resting, active, or stressed, and communicate insights to a mobile dashboard via Wi-Fi or Bluetooth. Demonstrated through a wearable collar prototype or a simulated pet model, the project highlights how IoT and Edge AI can advance smart pet care, improve health awareness, and enable early stress detection.

ECE05: LoRa-Based Fault Detection and Monitoring System for Off-Grid Microgrids

Develop a LoRa-enabled IoT monitoring system that ensures reliable operation of off-grid solar microgrids by continuously tracking key electrical parameters and detecting early-stage faults. The system should measure voltage, current and power across solar panels, battery banks and connected loads, transmitting data over long-range, low-power LoRa communication to a central base station. At the base station, the data must be analysed to identify anomalies such as panel underperformance, battery degradation, or load overload, and generate timely maintenance alerts. Designed for rural or remote settings, the solution demonstrates how LoRa technology can provide robust, energy-efficient monitoring for standalone renewable energy systems.

ECE06: Edge AI Smart Irrigation Controller for Micro Farms

Develop an intelligent irrigation controller that uses Edge AI to automate water distribution in micro-farms or greenhouse environments. The system should monitor soil moisture, temperature and humidity across multiple zones and process this data locally on a microcontroller running lightweight AI models. Based on real-time predictions of water requirements, the controller must optimize pump and valve operation to minimize wastage while maintaining plant health. A local dashboard or mobile interface should deliver live updates, trend visualization and system alerts, demonstrating how AI-driven automation can enhance precision agriculture and resource efficiency on a small scale.

ECE07: IoT-Based Gas Leakage Detection and Alert System

Develop a real-time IoT-enabled safety system capable of detecting hazardous gas leaks in homes, industries, and laboratory environments. The system should continuously monitor the concentration of gases such as LPG, methane or carbon monoxide using suitable gas sensors and immediately respond when unsafe levels are detected. Upon detection, it must activate visual and audible alarms and transmit alerts to a remote dashboard or mobile device via Wi-Fi or GSM, ensuring timely intervention even when users are away. The prototype should demonstrate how IoT and embedded sensing can enhance safety, automation, and environmental monitoring.

ECE08: Smart Library Book Tracking and Management System

Develop an IoT-enabled library automation system that streamlines book tracking and user transactions using smart identification technologies such as RFID, barcode, or NFC. The system should automatically record check-ins and check-outs without manual entry, ensuring accuracy and minimizing human error. Each book and user must be uniquely tagged, with all transactions stored locally for offline operation and synchronized securely once network connectivity is restored. A dashboard should provide real-time visibility into book availability, borrowing history, and inventory status, demonstrating how embedded systems can modernize library management in educational institutions.

ECE09: IoT-Based Street Light Fault Detection and Location System

Develop an IoT-enabled monitoring system that detects operational faults in street lighting infrastructure and reports precise location data for rapid maintenance response. Each streetlight node should continuously measure key performance indicators such as brightness, current flow, or power status and automatically flag issues like lamp failure, wiring faults, or power drops. Upon detection, the system must transmit fault details along with GPS or network-based location information to a centralized dashboard, enabling efficient diagnostics, reduced manual inspection and improved reliability of urban lighting networks.

ECE10: IoT System for Real-Time Air Quality Monitoring

Develop an IoT-enabled environmental monitoring system capable of measuring and analysing air quality across urban and rural environments. The system should integrate sensors for pollutants such as CO_2, CO, NO_2 and particulate matter (PM2.5/PM10) and transmit processed data to a dashboard or mobile application for real-time visualization. By combining embedded sensing, wireless communication and data analytics, the system aims to support pollution mapping, environmental awareness and smart city sustainability initiatives through reliable, accessible air-quality insights.

ECE11: High-Speed AGV Path Planning and Simulation System

Develop a high-speed Automated Guided Vehicle prototype capable of intelligent path planning and real-time autonomous navigation within a controlled environment. The AGV should integrate IR and ultrasonic sensors for obstacle detection and situational awareness, allowing it to react dynamically to environmental changes. Using pathfinding algorithms such as A*, Dijkstra, or other heuristic techniques, the system must compute the shortest and safest route between predefined waypoints. A complementary simulation module should visualize AGV movement, route optimization and dynamic obstacle handling, demonstrating how embedded systems, robotics, and AI-based optimization enable efficient autonomous mobility in industrial and warehouse settings.