Excellence in Higher Education
AKSHAYA
COLLEGE OF ENGINEERING AND TECHNOLOGY
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Kinathukadavu, Coimbatore-642109. www.acetcbe.edu.in
AN AUTONOMOUS INSTITUTION

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

TECHNICAL MAGAZINE

ACADEMIC YEAR 2025-2026 [EVEN SEMESTER]

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ABOUT THE DEPARTMENT:

The department of Electrical and Electronics Engineering (EEE) at Akshaya College of Engineering and Technology offers an undergraduate programme in B.E (Electrical and Electronics Engineering), with an annual intake of 30 students. The department is dedicated to provide a comprehensive understanding of Electrical and Electronics Engineering built upon the principles of physical science, mathematics, computing, and technology. Approved by AICTE, New Delhi, and affiliated with Anna University Chennai, the department focuses on practical training in Electrical engineering, emphasizing experimental design and communication skills throughout the academic years.

Dr.M.Sundar Rajan,
ASSOCIATE PROFESSOR & HEAD

1. Vision and Mission of the Department

VISION

To produce globally competent Electrical and Electronics Engineering graduates through quality education, innovation, and professional ethics.

MISSION

DM 1: To achieve academic excellence in Electrical and Electronics Engineering through innovative, outcome-based teaching–learning practices enabled by using effective ICT tools.

DM 2: To develop industry-ready and employable graduates through focused career guidance, skill-based training, and effective industry collaboration.

DM 3: To enhance effective research and innovation in Electrical and Electronics engineering area through creative and project incubation.

2. Program Educational Objectives – PEOs

- **PEO 1:** The graduates will be able to apply domain knowledge in electrical and electronics engineering for providing solutions to complex problems in power system, renewable energy systems, power electronics and drives.
- **PEO 2:** The graduates will be able to fulfil the role and responsibility of the professional electrical engineers in their chosen career with a mind to serve the industry and society.
- **PEO 3:** The graduates will be able to work as an electrical engineering professional or perform as a researcher pursuing higher education in reputed institutions, thereby encouraging life-long learning, keeping pace with technological developments in Electrical Engineering.

3. Program Specific Outcomes – PSOs

PSO 1: Employ fundamental electrical engineering concepts to identify, formulate and solve power systems and power electronics challenges.

PSO 2: Apply modern intelligent computational tools to solve electrical engineering problems and engage in lifelong learning to adapt to technological advancements.

4. 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 modelling 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 delighted to present the second issue of the EEE Department Technical Magazine for the academic year **2025–2026 (Even Semester).** This edition stands as a testament to the talent, commitment, and perseverance of our students, highlighting their outstanding achievements in both co-curricular and extra-curricular activities.

The magazine aims to showcase the **innovative projects, emerging research initiatives, and technical competencies** developed by our students throughout the semester. We believe that the exchange of knowledge, ideas, and experiences plays a significant role in advancing the field of **Electrical and Electronics Engineering** and fostering future technological progress.

We express our heartfelt gratitude to the **Management and our respected Principal** for their constant support, guidance, and encouragement, which have been instrumental in the successful publication of this magazine.

We hope that this edition serves as a source of inspiration and learning, while strengthening the **culture of creativity, collaboration, and innovation** within the EEE Department. Through this platform, we Associate Professorire to motivate students to continue exploring new ideas and contributing meaningfully to the engineering community.

Faculty Editor: Mrs.G.Balambigai AP/EEE

Student Editors: S.J.Charu Harshini (II-EEE), Manikandan A (III-EEE), Nisha R (III-EEE)

TABLE OF CONTENTS

1. SIMPLE AI-BASED SMART CIRCUIT BREAKER

OBJECTIVE:

- To design and develop an AI-based smart circuit breaker that can automatically detect abnormal electrical conditions such as overload, short circuit, and fault currents.
- To improve electrical system safety by using artificial intelligence for real-time monitoring and decision-making.
- To reduce equipment damage and power interruptions through intelligent fault prediction and automatic tripping.
- To provide efficient protection with faster response compared to conventional circuit breakers.
- To enable remote monitoring and fault analysis for better maintenance and reliability.

ABSTRACT:

The Simple AI-Based Smart Circuit Breaker is an intelligent protection system designed to enhance the safety and reliability of electrical installations. Unlike conventional circuit breakers that operate only when preset current limits are exceeded, the proposed system uses Artificial Intelligence (AI) techniques to continuously monitor electrical parameters such as current, voltage, and power consumption.

The AI algorithm analyzes real-time data to identify abnormal operating conditions, including overloads, short circuits, and potential equipment failures. When a fault is detected, the system automatically trips the circuit breaker to isolate the faulty section and prevent damage to electrical equipment. The system can also store fault data and provide alerts for maintenance purposes.

The proposed smart circuit breaker offers improved protection, reduced downtime, enhanced energy management, and predictive maintenance capabilities. Due to its simplicity, low cost, and intelligent operation, it is suitable for residential, commercial, and small industrial applications. This project demonstrates the integration of AI with electrical protection systems to create a safer and more efficient power distribution environment.

Keywords

Artificial Intelligence (AI), Smart Circuit Breaker, Fault Detection, Overload Protection, Short Circuit Protection, Predictive Maintenance, Electrical Safety, Intelligent Monitoring.

WORKING METHODOLOGY OF THE PROJECT:

An AI-based smart circuit breaker is an advanced protection system designed to improve the safety and reliability of electrical systems. Traditional circuit breakers usually work with fixed limits for current and voltage. Because of this, they sometimes trip unnecessarily during temporary overloads or fail to react quickly to certain faults. To overcome these limitations, an AI-based smart circuit breaker uses sensors, a microcontroller, and intelligent algorithms to monitor the system continuously and make smarter protection decisions. The working process starts with collecting data from the electrical circuit. Different sensors are used to measure important parameters of the system. A current sensor measures the amount of current flowing through the load, while a voltage sensor measures the supply voltage. In addition, a temperature sensor is used to monitor the heat produced in the circuit or electrical components. These sensors continuously observe the condition of the electrical system and send their signals to the controller.

The signals obtained from the sensors are usually analog signals. These signals are first converted into digital data using the Analog-to-Digital Converter (ADC) present in the microcontroller, such as an ESP32 or Arduino board. The controller then processes this data and calculates electrical values like current level, voltage variation, and temperature changes. This information represents the real-time operating condition of the circuit. After processing the sensor data, the AI algorithm analyzes the system behaviour. During normal operation, the system records the typical values of current, voltage, and temperature.

Over time, the AI system learns the normal working pattern of the electrical load. When new data is received, the system compares it with the previously learned patterns. If the values are significantly different from the normal condition, the AI system identifies it as a possible fault. Once a fault is detected, the decision-making stage begins. If the system detects a small or temporary overload, it may wait for a short period before taking action to avoid unnecessary tripping. However, if a serious fault such as a short circuit or excessive overheating is detected, the controller immediately sends a signal to activate the protection mechanism.

The protection mechanism works through a relay module connected to the microcontroller. When the relay is activated, it disconnects the electrical load from the power supply. This isolates the faulty circuit and prevents damage to electrical devices or wiring. After the breaker trips, the system provides alerts to the user. This can be done through a display, LED indicators, or a buzzer. In advanced systems, the information can also be sent to a mobile phone through IoT applications.

Once the problem is fixed, the circuit breaker can be reset either manually or automatically. Overall, the AI-based smart circuit breaker provides better protection, faster fault detection, and adaptive operation compared to conventional breakers. By learning the behaviour of the electrical system and responding intelligently, it helps improve safety, reduce power interruptions, and make electrical systems more reliable.

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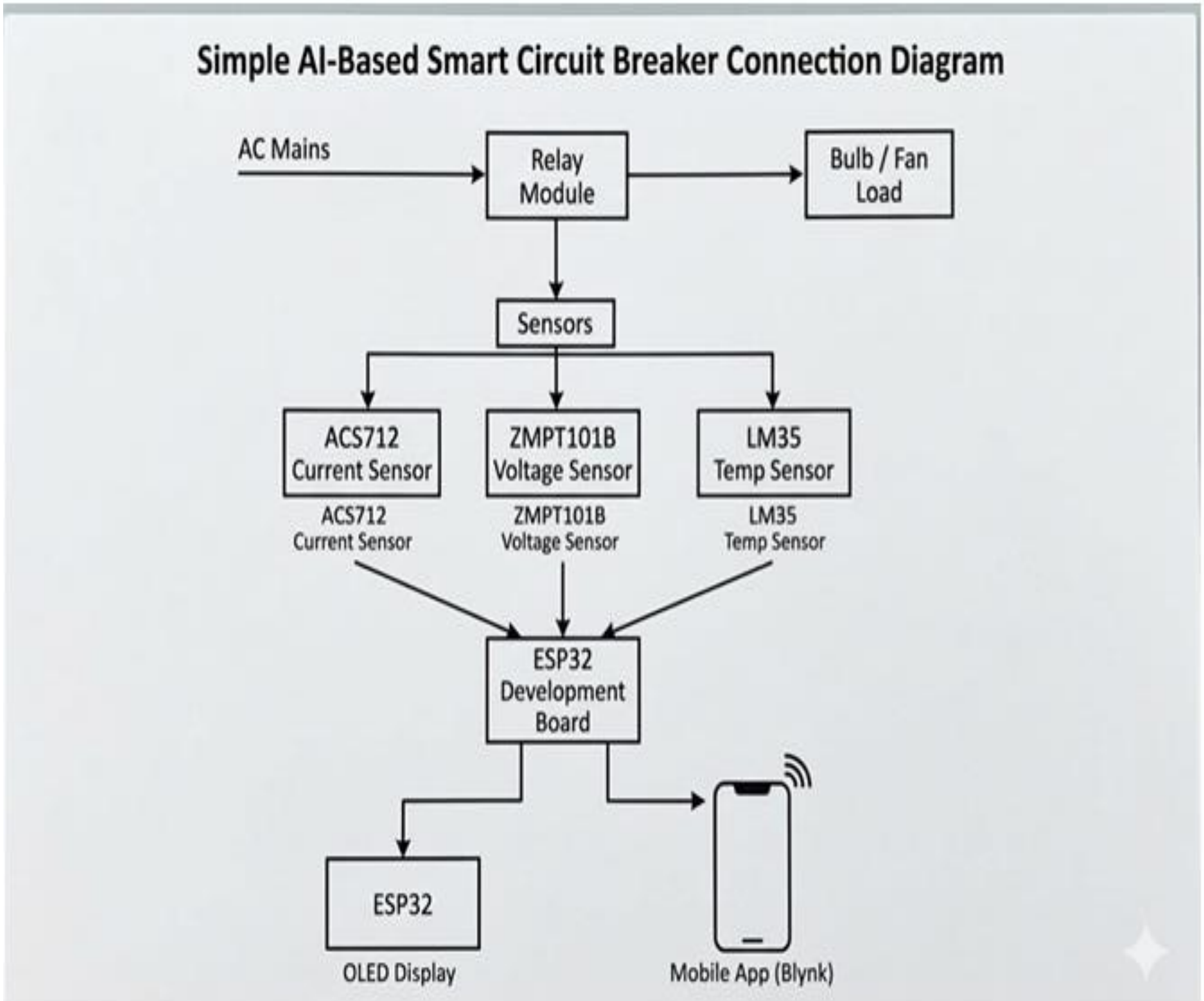
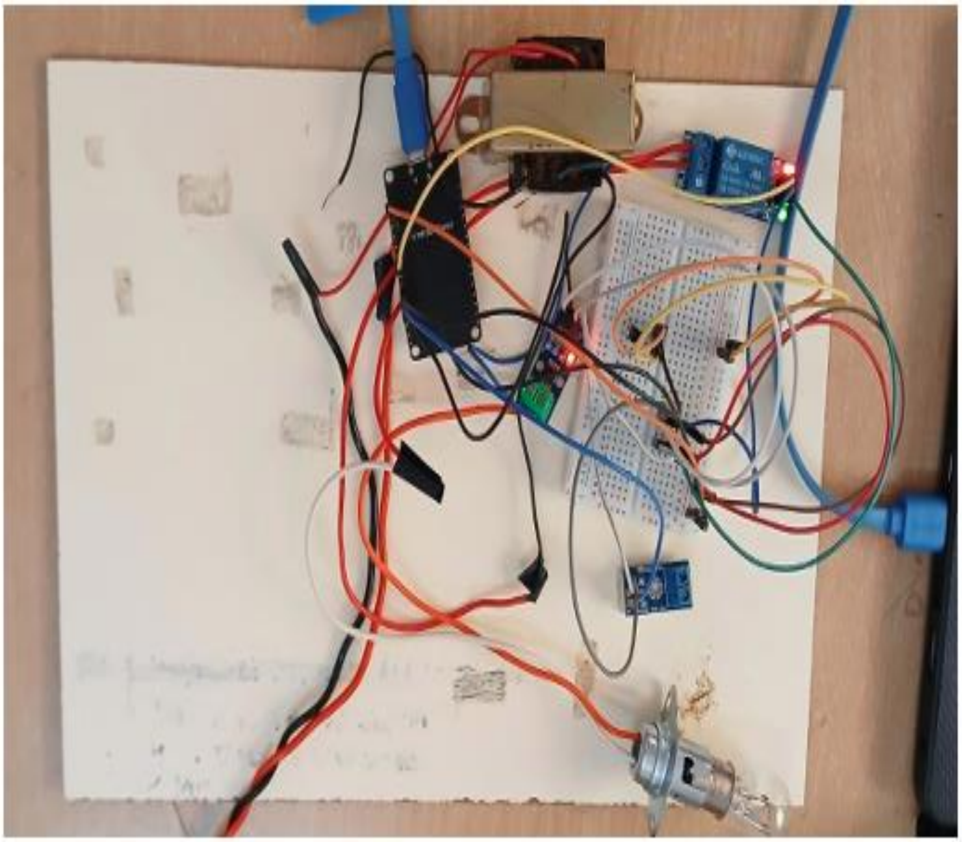


WORKING MODULE:



HARDWARE REQUIREMENTS:

S.No	Component	Specification	Quantity
1	ESP32 Development Board / Node MCU	Wi-Fi Enabled Microcontroller	1
2	Relay Module	5V Single Channel Relay	1
3	Current Sensor	ACS712 Current Sensor Module	1
4	Voltage Sensor Module	0–25V Voltage Sensor	1
5	Breadboard	Solderless Breadboard	1
6	Load	DC Lamp/Bulb	1
7	Power Supply	5V/12V DC Adapter	1
8	Jumper Wires	Male-to-Male and Male-to-Female	As Required
9	USB Cable	Micro USB/Type-C	1
10	Indicator LEDs	Red/Green LEDs	2
11	Resistors	220Ω, 1kΩ	As Required
12	Mounting Board	Acrylic/Foam Board	1

SOFTWARE REQUIREMENTS:

S.No	Software	Purpose
1	Arduino IDE	Program Development and Uploading
2	ESP32 Board Package	ESP32 Programming Support
3	Embedded C/C++	Coding Language
4	Arduino Libraries	Sensor and Relay Control
5	Serial Monitor	Real-Time Data Monitoring
6	ThingSpeak / Blynk (Optional)	IoT Monitoring and Data Visualization
7	TinyML Library (Optional)	AI-Based Fault Prediction
8	Proteus (Optional)	Circuit Simulation
9	MATLAB/Python (Optional)	AI Model Development and Training

RESULTS:

The **Simple AI-Based Smart Circuit Breaker** was successfully developed and tested to monitor electrical parameters and detect abnormal conditions such as overloads and short circuits. The system accurately identified fault conditions and automatically tripped the circuit breaker, thereby enhancing electrical safety, reducing equipment damage, and ensuring reliable power system protection.

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Mrs.G.Balambigai
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2. RC SENSOR CAR CONTROLLER USING MOBILE

OBJECTIVE:

- To design and develop a remotely controlled (RC) car that can be operated using a mobile phone.
- To enable wireless control of the vehicle's movement through Bluetooth or Wi-Fi communication.
- To demonstrate the application of sensors and microcontrollers in intelligent vehicle systems.
- To provide an affordable and user-friendly platform for learning embedded systems, robotics, and wireless communication.
- To enhance automation and control techniques for future smart transportation systems.

ABSTRACT:

The **RC Sensor Car Controller Using Mobile** is an intelligent robotic vehicle that can be controlled wirelessly through a smart phone application. The system employs a microcontroller such as Arduino Uno or ESP32, a motor driver module, and Bluetooth/Wi-Fi communication for receiving commands from the mobile device. The user can control the movement of the car, including forward, reverse, left, right, and stop operations, using a dedicated mobile application.

Additionally, sensors can be integrated into the vehicle for obstacle detection and collision avoidance, improving safety and autonomous functionality. The project demonstrates the integration of wireless communication, embedded systems, and sensor technology in modern robotic applications. This system can be utilized for educational purposes, surveillance, industrial automation, and smart vehicle development.

Keywords: RC Car, Mobile Control, Bluetooth, ESP32, Arduino, Motor Driver, Wireless Communication, Obstacle Detection.

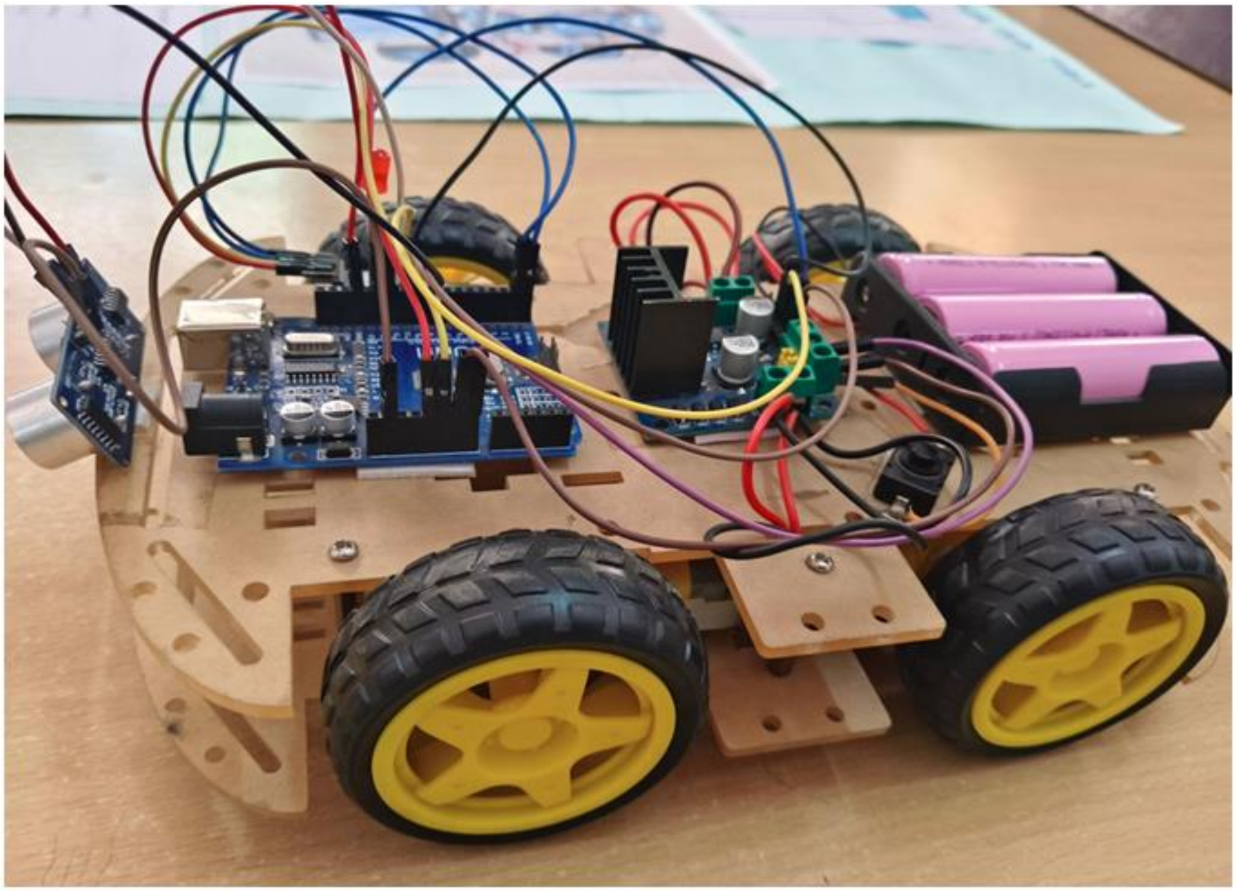
WORKING PRINCIPLE:

1. The user opens the mobile application on a smart phone.
2. The smart phone sends control commands through Bluetooth or Wi-Fi.
3. The microcontroller (Arduino/ESP32) receives the commands.
4. Based on the received command, the microcontroller activates the motor driver.
5. The motor driver controls the speed and direction of the DC motors.
6. The RC car moves according to the commands:
   - Forward
   - Backward
   - Left Turn

- Right Turn
- Stop

7. If obstacle sensors are included, the system detects nearby objects and can automatically stop the vehicle to avoid collisions.
8. The entire operation occurs wirelessly, allowing convenient remote control from a mobile device.

WORKING MODULE:



HARDWARE REQUIREMENTS:

- Arduino Uno / ESP32 Development Board
- L298N Motor Driver Module
- Bluetooth Module (HC-05) or ESP32 Wi-Fi
- DC Geared Motors
- Robot Chassis
- Wheels
- Ultrasonic Sensor (HC-SR04) (Optional)
- Battery Pack (7.4V/12V)
- Jumper Wires
- Mobile Phone

SOFTWARE REQUIREMENTS:

- Arduino IDE
- Embedded C/C++
- Bluetooth Controller Mobile App
- ESP32 Board Package (if ESP32 is used)

APPLICATIONS:

- Robotics Projects
- Surveillance Vehicles
- Industrial Material Handling
- Smart Transportation Systems
- Educational and Research Applications
- Military and Rescue Robots

RESULTS:

The **RC Sensor Car Controller Using Mobile** was successfully designed and implemented, enabling wireless control of the vehicle through a smart phone application. The system effectively performed forward, reverse, left, right, and stop operations, while the sensor-based obstacle detection improved safety and demonstrated reliable real-time remote control.

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Guide with Designation
Mr.M.Santhoshkumar
(Assistant professor/EEE)

3. AI BASED TEMPERATURE AND OVERLOAD FAULT DETECTION AND SAFETY SHUTDOWN FOR MOTOR

OBJECTIVE:

- To design and develop an AI-based motor protection system that continuously monitors motor temperature and load conditions.
- To detect abnormal operating conditions such as overheating and overload, and automatically shut down the motor to prevent damage and improve safety.

ABSTRACT:

The AI-Based Temperature and Overload Fault Detection System is designed to enhance the safety, reliability, and lifespan of electric motors. The system uses temperature and current sensors to continuously monitor the operating condition of the motor. Sensor data is collected and processed by a microcontroller, which employs AI-based decision-making techniques to identify abnormal conditions such as excessive temperature rise or overload currents.

When the system detects a fault condition beyond predefined thresholds, it automatically triggers a relay mechanism to disconnect the motor from the power supply, thereby preventing equipment damage and reducing maintenance costs. The system can also display real-time operating parameters and fault status on a monitoring interface or IoT dashboard. This intelligent protection system ensures efficient motor operation, minimizes downtime, and provides enhanced safety in industrial and domestic applications.

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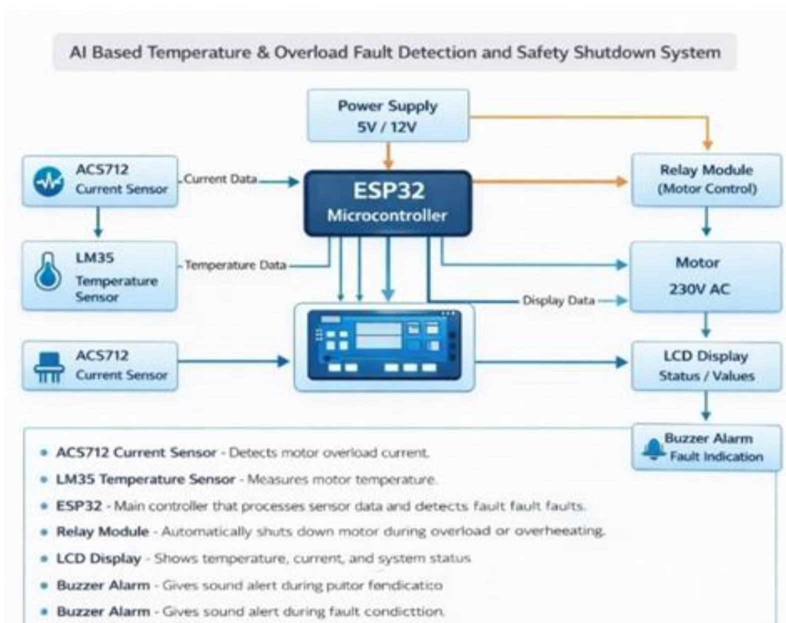


WORKING METHODOLOGY OF THE PROJECT:

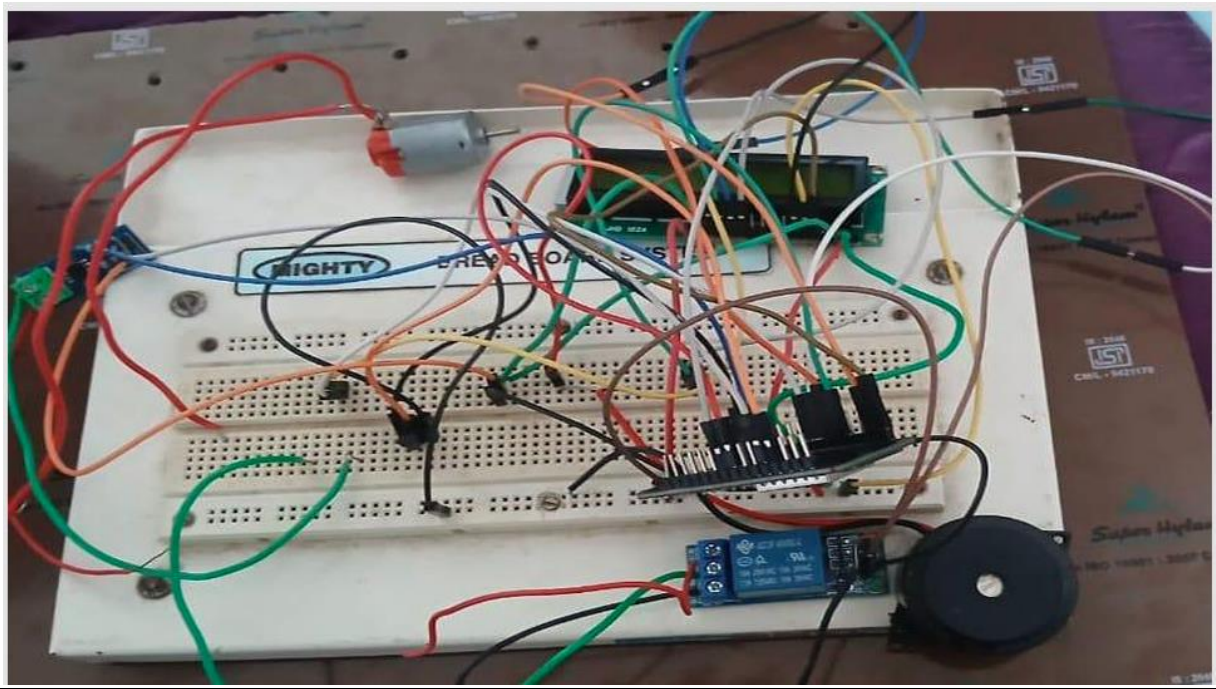
The proposed system AI Based Temperature and Overload Fault Detection and Safety Shutdown System is developed to monitor the operating condition of an electrical motor and protect it from damage caused by excessive temperature and overload current. The system mainly consists of ESP32 microcontroller, ACS712 current sensor, LM35 temperature sensor, relay module, LCD display, buzzer, and a regulated power supply. Initially, the system is powered using a 5V/12V regulated power supply, which provides the required voltage for all the components. When the system is switched ON, the ESP32 microcontroller initializes all the connected devices and starts monitoring the motor condition continuously. The ESP32 acts as the central controller that receives data from the sensors and processes it.

The LM35 temperature sensor is used to measure the temperature of the motor. It is a precision analog sensor that produces an output voltage directly proportional to the temperature in degree Celsius. The sensor generates 10 mV for every 1°C increase in temperature. This analog signal is given to the analog input pin of the ESP32, where it is converted into digital form using the internal Analog to Digital Converter (ADC). The ESP32 processes this value and calculates the motor temperature.

The ACS712 current sensor is used to measure the current flowing through the motor. It works based on the Hall Effect principle and provides an analog voltage output proportional to the current passing through it. This signal is also sent to the ESP32 where the microcontroller calculates the current value and monitors the load condition of the motor. The ESP32 continuously compares the measured temperature and current values with predefined safe limits.

If both parameters remain within the safe range, the motor operates normally. The LCD display shows real-time information such as temperature, current value, and system status so that the user can easily monitor the motor condition. If the temperature exceeds the safe limit or the motor current becomes higher than the present overload value, the ESP32 detects it as a fault condition. Immediately, the controller sends a signal to the relay module, which disconnects the motor from the power supply and stops its operation to prevent damage.

WORKING MODULE:



HARDWARE REQUIREMENTS:

- ESP32 / Arduino Uno Microcontroller
- Current Sensor (ACS712)
- Temperature Sensor (LM35 / DHT22 / DS18B20)
- Relay Module
- DC/AC Motor
- Power Supply Unit
- LCD Display (16×2) or OLED Display
- Buzzer for Fault Indication
- Connecting Wires and Breadboard
- Wi-Fi Module (Optional for IoT Monitoring)

SOFTWARE REQUIREMENTS:

- Arduino IDE
- Embedded C Programming
- Blynk IoT Platform (Optional)
- ThingSpeak Cloud Platform (Optional)
- Python (for AI Model Development)
- TensorFlow Lite / TinyML (Optional)
- Serial Monitor for Testing and Debugging

RESULTS:

The system successfully detected motor overheating and overloads conditions in real time and automatically shut down the motor to prevent damage. AI-based fault analysis improved motor protection, enhanced operational safety, and reduced maintenance requirements through early fault detection.

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Associate Professor/EEE

4. AI-BASED SMART HOME AUTOMATION WITH (IOT)

OBJECTIVE:

- To design and develop an AI-based smart home automation system using IoT technology for monitoring and controlling household appliances remotely.
- To improve energy efficiency, security, and user convenience through intelligent automation and real-time decision-making.

ABSTRACT:

The AI-Based Smart Home Automation with IoT system enables users to monitor and control home appliances through the internet using smart phones or computers. The system employs IoT-enabled sensors and controllers to collect real-time data such as temperature, motion, light intensity, and appliance status. Artificial Intelligence algorithms analyze the collected data and automatically operate devices based on user preferences and environmental conditions. The system enhances comfort, energy management, and home security while providing remote accessibility and intelligent decision-making capabilities.

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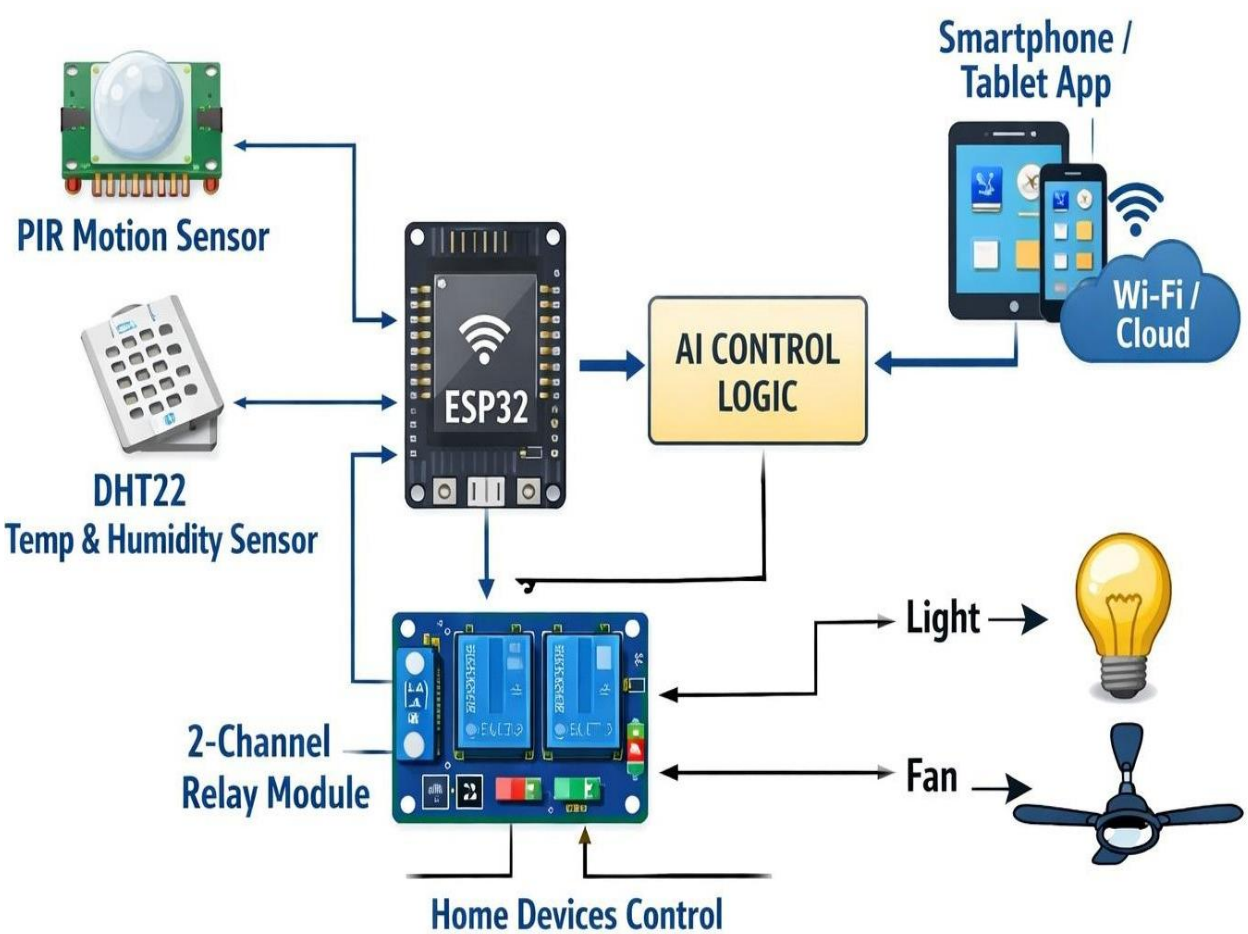


WORKING METHODOLOGY OF THE PROJECT:

This project presents an AI-based Smart Home Automation System that utilizes Internet of Things (IoT) technology to monitor and control household appliances remotely. The system is built around the ESP32 microcontroller, which serves as the central controller connecting sensors, relays, and cloud services. With its built-in Wi-Fi capability, the ESP32 communicates with the Blynk cloud platform, enabling users to monitor and control home appliances through a smart phone application from anywhere.

The system incorporates a DHT22 sensor to measure environmental parameters such as temperature and humidity inside the home. The sensor continuously collects data and transmits it to the ESP32, which uploads the information to the Blynk cloud server. Users can view real-time temperature and humidity readings through the Blynk mobile application, allowing convenient remote monitoring of indoor conditions.

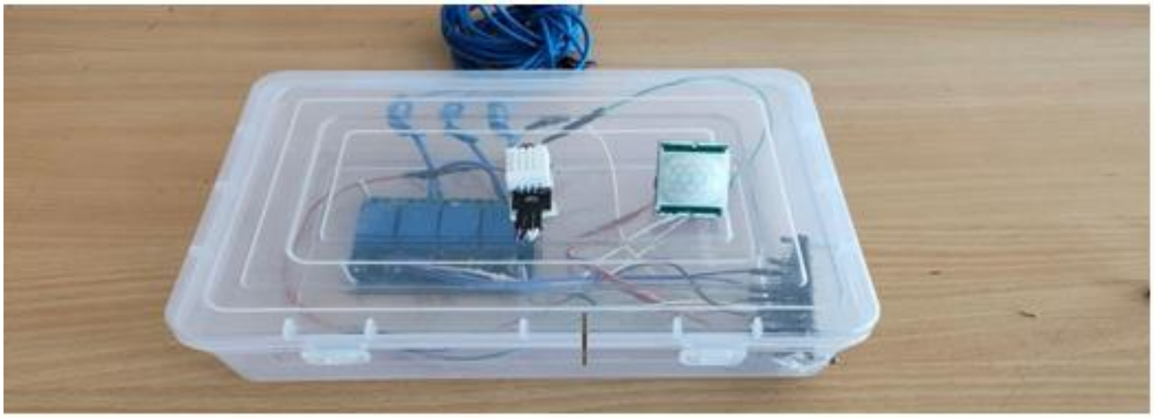
A PIR (Passive Infrared) sensor is used for motion detection within the house. When human movement is detected, the PIR sensor sends a signal to the ESP32 controller. Based on the received signal, the ESP32 can automatically operate connected appliances such as lights and fans through a 2-channel relay module. The relay module functions as an electronic switching device, enabling the low-voltage controller to safely control high-voltage electrical appliances.

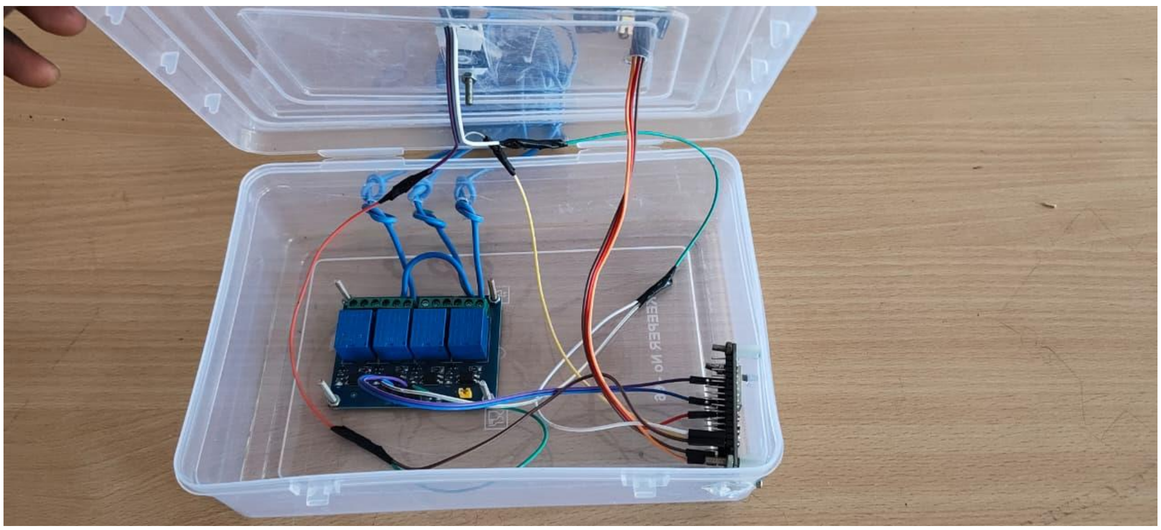
The system also provides remote appliance control through the Blynk mobile application. Users can manually switch appliances ON or OFF using virtual control buttons available within the application. Furthermore, voice control functionality is implemented using a program developed in Visual Studio. The voice recognition system converts spoken commands into digital instructions and transmits them via the Internet to the ESP32, which then controls the connected appliances through the relay module.

The implementation methodology involves interfacing sensors and relay modules with the ESP32, programming the controller using IoT development tools, establishing Wi-Fi connectivity, and integrating the Blynk cloud platform for remote monitoring and control. Sensor data is continuously collected and transmitted to the cloud, while control commands received from the mobile application or voice assistant are processed by the ESP32 to operate the appliances accordingly.

Overall, the proposed smart home automation system enhances user convenience, energy efficiency, and home security. It enables real-time environmental monitoring, motion detection, remote appliance management, and voice-based control. This project demonstrates the effective integration of IoT and AI technologies to create an intelligent, secure, and energy-efficient smart home environment.

WORKING MODULE:





HARDWARE REQUIREMENTS:

- ESP32 / Node MCU (ESP8266) Development Board
- Arduino Uno (Optional)
- Relay Module (4-Channel or 8-Channel)
- Temperature and Humidity Sensor (DHT11/DHT22)
- PIR Motion Sensor
- Light Dependent Resistor (LDR)
- Wi-Fi Module (Built-in ESP32/ESP8266)
- Smart Bulbs / Electrical Appliances
- Power Supply Unit
- Connecting Wires and Breadboard
- Smartphone or Laptop

SOFTWARE REQUIREMENTS:

- Arduino IDE
- Blynk IoT Platform / MQTT Dashboard
- Embedded C Programming
- ThingSpeak Cloud Platform
- Firebase (Optional)
- Android Application for Monitoring and Control
- AI/ML Libraries (Tensor Flow Lite or TinyML - Optional)

RESULTS:

The developed system successfully monitored and controlled home appliances remotely through the Internet. AI-based automation improved energy efficiency, enhanced home security, and provided intelligent device management with real-time monitoring.

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Guide Details with Designation
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5. AUTOMATIC LOAD MANAGEMENT SYSTEM USING ARDUINO UNO

OBJECTIVE:

- To design and develop an Automatic Load Management System using Arduino Uno for efficient power utilization.
- To monitor electrical loads and automatically control them based on predefined priorities.
- To prevent overloading of the power system by disconnecting non-essential loads during peak demand conditions.
- To improve energy efficiency and ensure uninterrupted supply to critical loads.
- To reduce power wastage and enhance the reliability of electrical distribution systems.
- To provide a low-cost and intelligent solution for load management in residential, commercial, and industrial applications.

ABSTRACT:

The **Automatic Load Management System Using Arduino Uno** is a smart energy management solution designed to optimize power consumption and prevent system overloading. The system continuously monitors the electrical load and compares it with a predefined threshold value. When the total load exceeds the permissible limit, the Arduino Uno automatically disconnects low-priority loads through relay modules while ensuring that essential loads remain operational.

The system utilizes current sensors to measure load consumption and relay circuits to control electrical appliances. The Arduino Uno serves as the central controller, processing sensor data and making decisions based on programmed load management algorithms. Once the load demands decreases and returns to a safe level, the disconnected loads are automatically restored.

This project helps in efficient energy utilization, reduces the risk of power outages due to overload conditions, and improves the overall stability of electrical systems. The proposed system is economical, easy to implement, and suitable for smart homes, commercial buildings, and industrial energy management applications.

Keywords: Arduino Uno, Load Management, Energy Management, Current Sensor, Relay Module, Overload Protection, Smart Grid, Power Monitoring.

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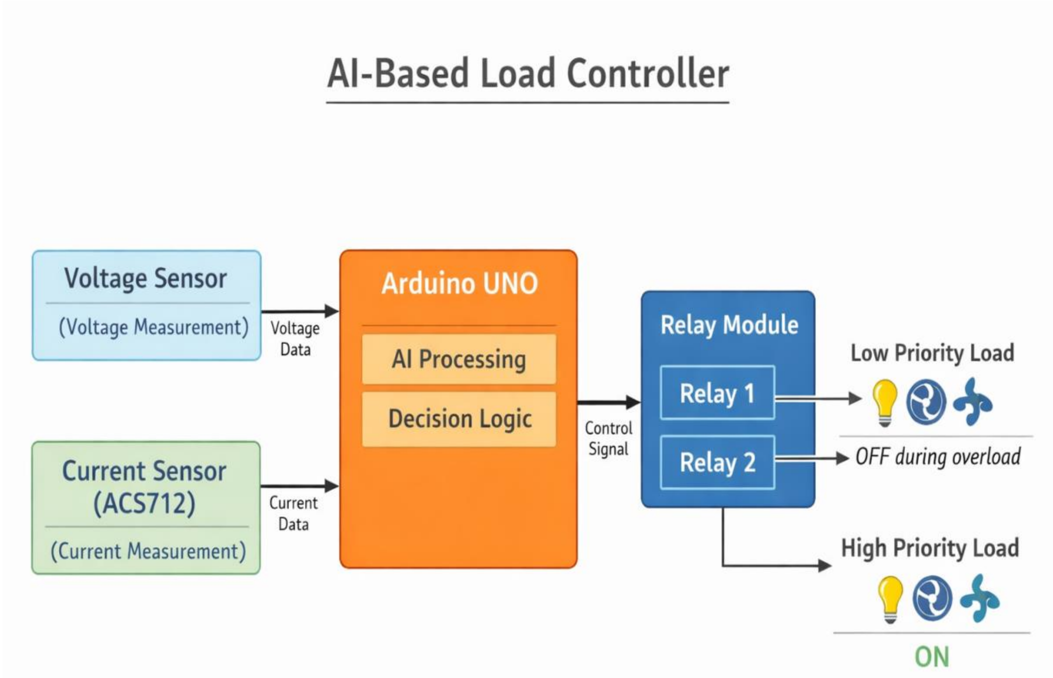


WORKING METHODOLOGY OF THE PROJECT:

The AI-Based Smart Load Controller is designed to manage electrical loads efficiently and protect electrical systems from overload conditions. The system mainly uses an **Arduino Uno microcontroller** along with several supporting components such as the **ACS712 Current Sensor Module, 0–25V Voltage Sensor Module, and a 2-Channel 5V Relay Module**. These components work together to monitor the electrical parameters of the load and control the power supply when necessary.

When the system is powered ON, the **Arduino Uno initializes and begins reading data from the connected sensors**. The ACS712 current sensor measures the amount of electrical current flowing through the load connected to the system. At the same time, the voltage sensor module monitors the supply voltage provided to the load. These sensors continuously send real-time data to the Arduino. By collecting this information, the system can understand how the electrical load is behaving at any moment.

After receiving the sensor values, the Arduino processes the information and uses it to make decisions about the system's operation. The controller uses a programmed formula or algorithm to analyze the current and voltage readings. Based on these values, the Arduino calculates a score or threshold value that helps determine whether the electrical system is operating under normal conditions or if there is an overload situation. This decision-making process allows the controller to intelligently manage the connected loads.

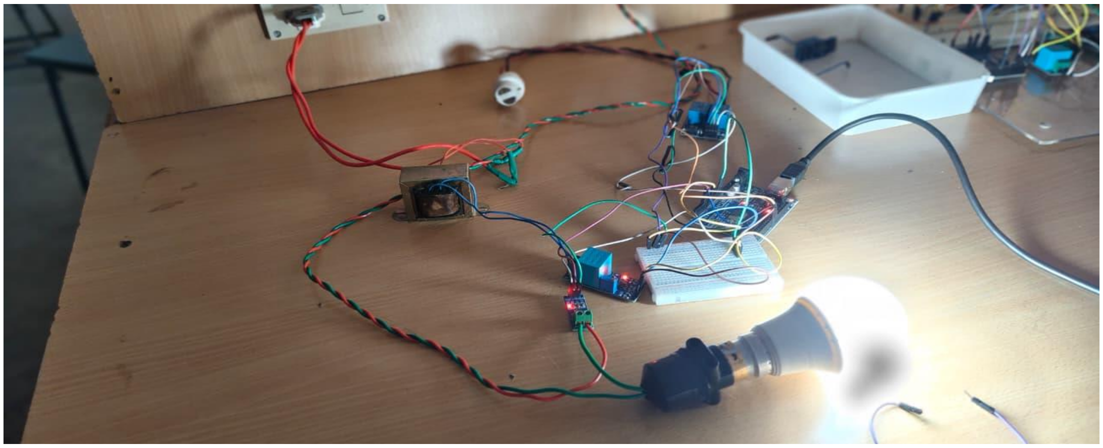
When the system detects that the electrical load is within the safe operating range, both the **priority load and the low-priority load remain active**. In this condition, the Arduino allows power to continue flowing through the relay module without interruption, ensuring that all connected devices function normally.

However, if the system detects an overload condition where the current or voltage exceeds the safe limit, the Arduino immediately sends a control signal to the **relay module**. The relay module then disconnects the **low-priority load**, while keeping the **high-priority load active**. This action reduces the total electrical load on the system and prevents damage to electrical components or wiring. By removing only the low-priority load, the system ensures that essential devices continue to operate without interruption.

This intelligent load management method helps protect the electrical system from overheating, equipment failure, and other safety risks caused by excessive load conditions. In simple terms, the load controller acts like a **smart assistant** that constantly monitors the system and takes quick action whenever it detects a potential problem. By using the Arduino Uno and its connected sensors and relays, the load controller provides an effective and reliable way to maintain electrical safety and efficiency.

Overall, the smart load controller plays an important role in modern electrical systems by preventing overloads, improving system reliability, and ensuring that critical loads remain powered even during high demand conditions.

WORKING MODULE:



HARDWARE REQUIREMENTS:

S.No	Component	Specification	Quantity
1	Arduino Uno	ATmega328P Microcontroller Board	1
2	Current Sensor	ACS712 Current Sensor Module	1
3	Relay Module	4-Channel/8-Channel Relay Module	1
4	LCD Display	16×2 LCD Display (Optional)	1
5	Voltage Sensor Module	0–25V Voltage Sensor (Optional)	1
6	Power Supply	5V DC Supply	1
7	Loads	Lamps/Fans/Appliances	As Required
8	Breadboard	Solderless Breadboard	1

9	Jumper Wires	Male-to-Male/Female Wires	As Required
10	LEDs	Status Indication LEDs	2–4
11	Resistors	220Ω, 1kΩ	As Required
12	Connecting Cables	USB and Power Cables	As Required

SOFTWARE REQUIREMENTS:

S.No	Software	Purpose
1	Arduino IDE	Program Development and Uploading
2	Embedded C/C++	Programming Language
3	Arduino Libraries	Sensor and Relay Interfacing
4	Serial Monitor	Real-Time Monitoring and Debugging
5	Proteus (Optional)	Circuit Simulation
6	MATLAB/Simulink (Optional)	System Analysis and Testing
7	Fritzing (Optional)	Circuit Diagram Design
8	PLX-DAQ (Optional)	Data Logging to Excel

RESULTS:

The Automatic Load Management System using Arduino Uno successfully monitored the connected loads and automatically disconnected non-essential loads when the power demand exceeded the preset limit. The system effectively prevented overloading, improved energy utilization, and ensured uninterrupted operation of priority loads.

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6. POWER FACTOR MEASUREMENT AND CORRECTION SYSTEM

OBJECTIVE:

- To measure the power factor of an electrical load in real time.
- To improve the power factor by automatically connecting or disconnecting capacitor banks.
- To reduce reactive power consumption and improve system efficiency.
- To minimize power losses and voltage drops in electrical systems.
- To enhance the overall performance and reliability of power distribution networks.

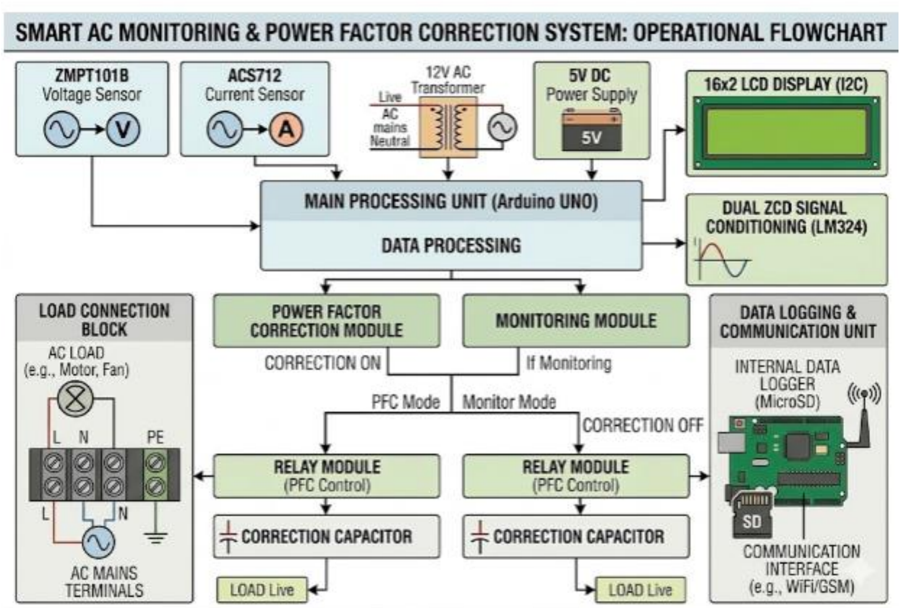
ABSTRACT:

The **Power Factor Measurement and Correction System** is designed to monitor and improve the power factor of electrical loads automatically. In many industrial and domestic applications, inductive loads such as motors and transformers cause the power factor to decrease, resulting in increased power losses and reduced system efficiency. This system uses an Arduino Uno microcontroller to continuously measure voltage and current signals and calculate the power factor.

When the measured power factor falls below a predetermined value, the controller automatically switches capacitor banks through relay modules to compensate for the reactive power demand. As a result, the power factor is improved, reducing energy losses and enhancing the efficiency of the electrical system. The system provides an economical and reliable solution for power factor correction in industrial, commercial, and residential applications.

Keywords: Power Factor, Arduino Uno, Capacitor Bank, Reactive Power Compensation, Energy Efficiency, Power Quality.

BLOCK DIAGRAM OF THE PROJECT:



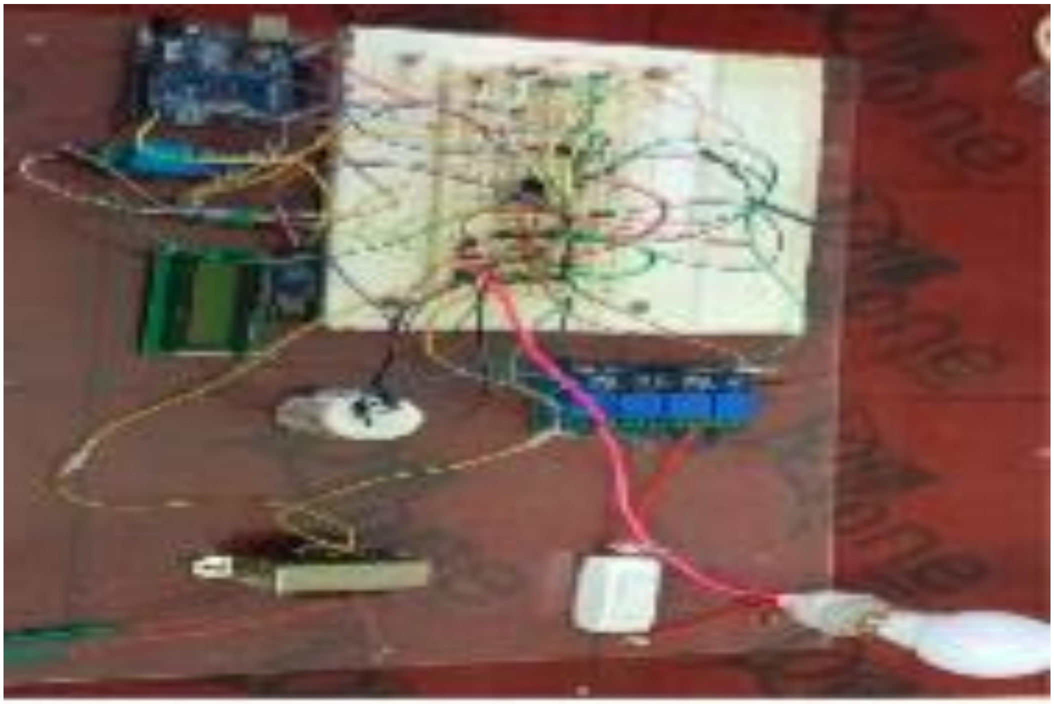
WORKING METHODOLOGY OF THE PROJECT:

The Arduino-based Power Factor Measurement and Correction System is designed to monitor electrical parameters of a load and automatically improve the power factor of the system. The circuit mainly uses Arduino uno, ACS712 Current Sensor, ZMPT101B Voltage Sensor, LM324N, and a 16x2 LCD I2C to display the measured voltage, current, and power factor of the load.

When the system is powered ON, the Arduino initializes all connected components such as the voltage sensor, current sensor, zero-crossing detector circuit, relay module, and LCD display. The AC voltage from the transformer is sensed using the ZMPT101B voltage sensor, while the current flowing through the load is measured using the ACS712 current sensor. These sensors convert the electrical parameters into small analog voltage signals that can be read by the Arduino. The signals obtained from the sensors are then processed using the LM324 operational amplifier which acts as a zero-crossing detector. This circuit detects the exact point where the voltage and current waveforms cross the zero level and produces digital pulses corresponding to these crossings.

These pulses are sent to the Arduino, which measures the time difference between the voltage and current zero-crossing signals to determine the phase angle between them. Using this phase difference, the Arduino calculates the power factor of the system. If the power factor becomes lower than the desired level, the Arduino activates a relay module that connects a capacitor bank to the circuit. The capacitor compensates the reactive power in the system and improves the power factor closer to unity. The LCD display continuously shows the measured voltage, current, and power factor values, allowing the user to monitor the system in real time while the Arduino keeps checking the conditions and performing automatic correction whenever required.

WORKING MODULE:



HARDWARE REQUIREMENTS:

S.No	Component	Specification	Quantity
1	Arduino Uno	ATmega328P Microcontroller	1
2	Current Sensor	ACS712 Current Sensor	1
3	Voltage Sensor Module	AC Voltage Sensor	1
4	Relay Module	4-Channel Relay Module	1
5	Capacitor Bank	Power Factor Correction Capacitors	As Required
6	LCD Display	16×2 LCD Display	1
7	Power Supply	5V DC Supply	1
8	Breadboard/PCB	Circuit Assembly	1
9	Connecting Wires	Jumper Wires	As Required
10	Inductive Load	Motor/Fan/Transformer	1

SOFTWARE REQUIREMENTS:

S.No	Software	Purpose
1	Arduino IDE	Program Development and Uploading
2	Embedded C/C++	Programming Language
3	Arduino Libraries	Sensor and LCD Interfacing
4	Serial Monitor	Real-Time Data Monitoring
5	Proteus (Optional)	Circuit Simulation
6	MATLAB/Simulink (Optional)	System Analysis and Validation
7	Fritzing (Optional)	Circuit Diagram Design

RESULTS:

The **Power Factor Measurement and Correction System** successfully measured the power factor of the connected load and automatically switched capacitor banks to improve it. The system effectively increased the power factor close to unity, reduced reactive power consumption, and enhanced the overall efficiency of the electrical system.

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7. AI BASED WATER QUALITY PREDICTOR

OBJECTIVE:

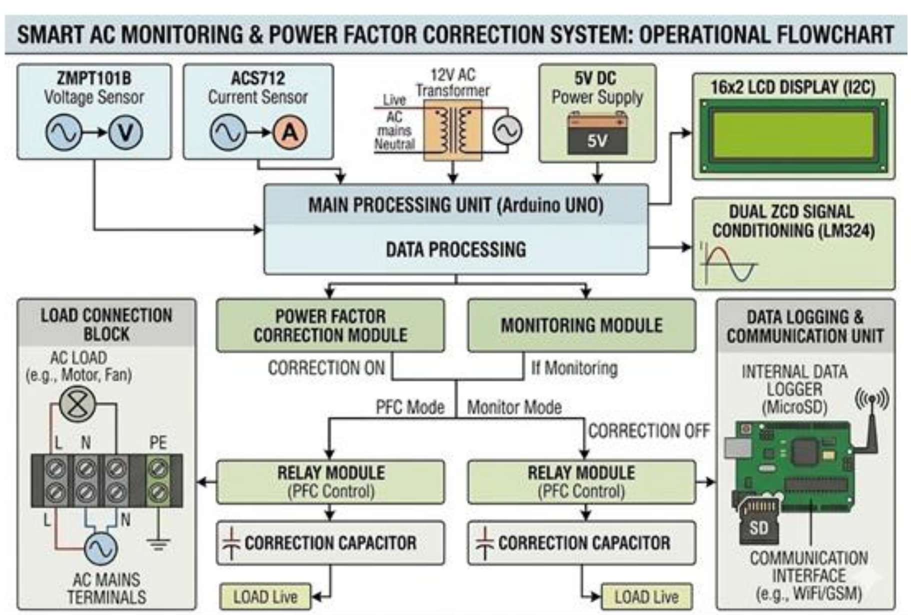
- To develop an AI-based system for monitoring and predicting water quality parameters in real time.
- To ensure safe water usage by detecting contamination levels and forecasting water quality trends using Artificial Intelligence techniques.

ABSTRACT:

The AI-Based Water Quality Predictor is an intelligent monitoring system designed to assess and predict the quality of water using sensor data and machine learning algorithms. The system measures important water quality parameters such as pH, turbidity, temperature, dissolved oxygen, and Total Dissolved Solids (TDS) through various sensors. These parameters are continuously collected and processed by a microcontroller such as ESP32 or Arduino.

The collected data is transmitted to a cloud platform for storage and analysis. Artificial Intelligence and machine learning models analyze historical and real-time sensor data to predict future water quality conditions and identify potential contamination risks. Users can monitor water quality through a web or mobile application, receiving alerts whenever water quality falls below acceptable standards. This system helps ensure safe drinking water, supports environmental monitoring, and improves water resource management through accurate and intelligent predictions.

BLOCK DIAGRAM:



WORKING METHODOLOGY OF THE PROJECT:

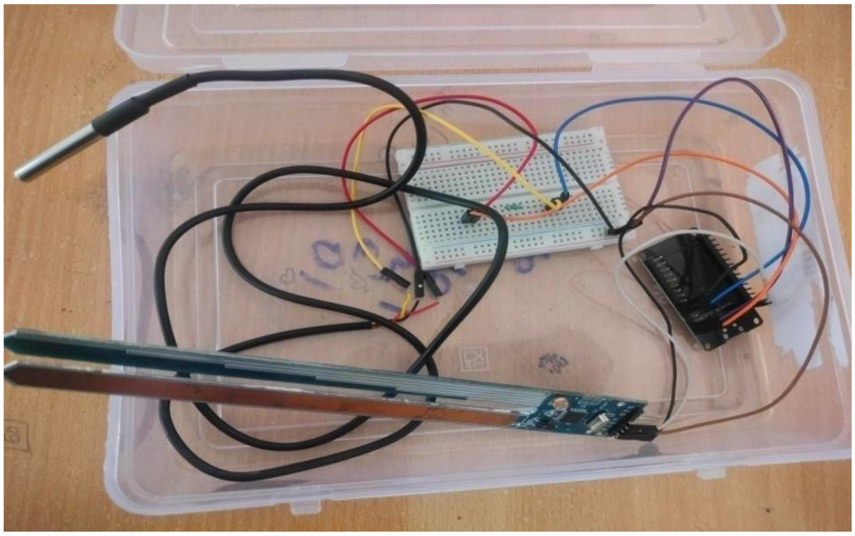
The **AI-based water quality predictor** works by collecting important water parameters such as pH, turbidity, temperature, dissolved oxygen, and other chemical properties using sensors or existing datasets. These parameters provide information about the condition of the water. The collected data is then processed and cleaned to remove errors or missing values so that it can be used effectively by the system. After pre-processing, the data is given to a machine learning model that has been trained using previous water quality datasets.

During training, the AI model learns the relationship between different water parameters and the overall quality of water. When new data is provided, the trained model analyzes the input values and predicts the water quality level, such as whether the water is safe, moderately polluted, or highly polluted. The predicted results are then displayed on a monitoring system or application, which helps users easily understand the water condition and take necessary actions if the water quality is poor

The **AI-based water quality predictor** works by collecting important water parameters such as pH, turbidity, temperature, and dissolved oxygen using sensors. These parameters provide information about the condition and purity of the water. The collected data is then processed and cleaned to remove errors or unwanted values so that it can be used efficiently. After pre-processing, the data is given to a trained machine learning model. The AI model is trained using previous water quality datasets so that it can understand the relationship between different water parameters and the overall quality of water. When new data is provided, the trained model analyzes the input values and predicts the water quality level, such as whether the water is safe, moderately polluted, or highly polluted.

The predicted results are then displayed on a monitoring system or application, allowing users to easily observe and analyze the condition of the water. This system helps in continuous monitoring and early detection of water contamination, making water management more efficient and reliable. The main components used in this project include a **microcontroller such as an ESP32 or Arduino, water quality sensors (pH sensor, turbidity sensor, and temperature sensor), a power supply, and software tools such as Python and machine learning algorithms** to process the data and generate predictions.

WORKING MODULE:



HARDWARE REQUIREMENTS

- ESP32 / Arduino Uno Microcontroller
- pH Sensor
- Turbidity Sensor
- TDS (Total Dissolved Solids) Sensor
- Temperature Sensor (DS18B20 / DHT11)
- Dissolved Oxygen Sensor (Optional)
- Wi-Fi Module (Built-in ESP32)
- LCD/OLED Display
- Power Supply Unit
- Connecting Wires and Breadboard
- Water Sample Container

SOFTWARE REQUIREMENTS:

- Arduino IDE
- Embedded C Programming
- Python
- Machine Learning Libraries (Scikit-learn, TensorFlow)
- Blynk IoT Platform / ThingSpeak

- Google Colab or Jupyter Notebook
- Firebase or Cloud Database (Optional)
- Data Visualization Tools

RESULTS:

The system successfully monitored key water quality parameters and predicted water quality conditions with high accuracy using AI algorithms. Real-time monitoring and early contamination detection improved water safety, environmental protection, and decision-making for water management.

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8. SMART AI VOICE ASSISTANT USING ESP32

OBJECTIVE:

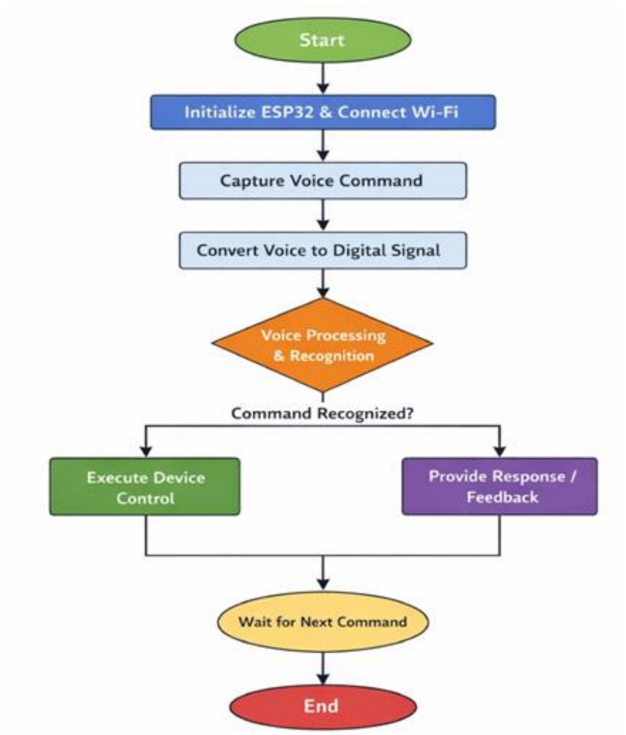
- To design and develop a smart AI voice assistant using ESP32 that can recognize voice commands and perform various tasks automatically.
- To provide a hands-free, intelligent, and user-friendly interface for controlling devices, accessing information, and home automation applications.

ABSTRACT:

The Smart AI Voice Assistant using ESP32 is an intelligent system that enables users to interact with electronic devices through voice commands. The ESP32 microcontroller acts as the central processing unit, integrating voice recognition, wireless communication, and IoT functionalities. A microphone module captures the user's speech, which is processed using AI-based speech recognition algorithms. The recognized commands are then interpreted and executed by the ESP32 to control connected devices such as lights, fans, and other home appliances.

The system can be integrated with cloud-based AI services and IoT platforms to provide advanced functionalities such as answering queries, controlling smart home devices, sending notifications, and retrieving real-time information. With Wi-Fi connectivity, the assistant supports remote operation and seamless communication with cloud services. This project demonstrates the integration of Artificial Intelligence, speech processing, and IoT technologies to create a smart and interactive voice-controlled assistant.

BLOCK DIAGRAM:



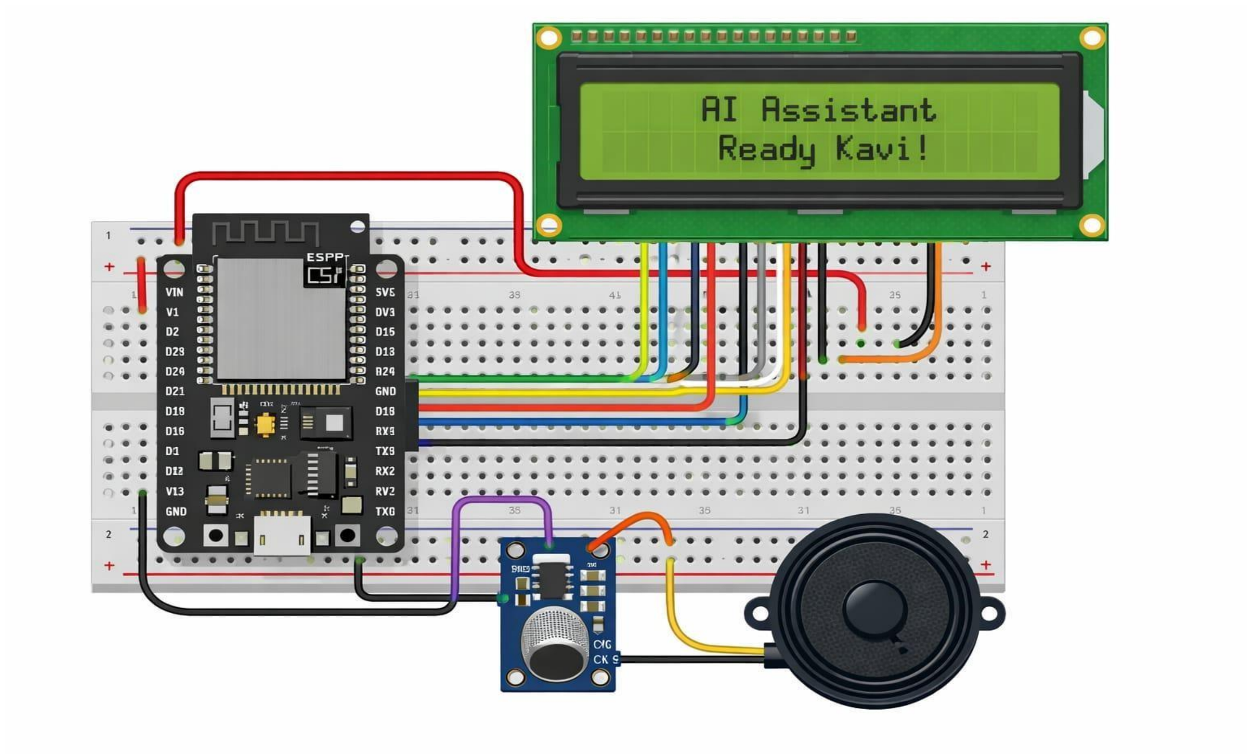
WORKING METHODOLOGY OF THE PROJECT:

The proposed Smart AI Voice Assistant system is developed using the ESP32 microcontroller as the main processing unit. The system uses a microphone module to capture the user's voice commands. These voice inputs are then received and processed by the ESP32. The ESP32 is connected to the internet through Wi-Fi, which allows it to interact with AI or cloud-based voice processing services.

When the user gives a voice command, the microphone converts the sound signals into electrical signals and sends them to the ESP32. The ESP32 processes the command using embedded programming and AI-based voice recognition techniques. After identifying the command, the microcontroller performs the required action.

Depending on the command given by the user, the system can control connected devices such as lights, fans, or other appliances through relay modules. The ESP32 may also send responses or feedback to the user through a speaker or connected application interface. This system enables users to control electronic devices using voice commands, making the interaction simple, efficient, and hands-free. The integration of ESP32, Wi-Fi connectivity, and AI-based voice processing makes the system suitable for smart home automation and intelligent assistant applications.

WORKING MODULE:



HARDWARE REQUIREMENTS:

- ESP32 Development Board
- Microphone Module (MAX9814 / INMP441)
- Speaker Module or Audio Amplifier (MAX98357A)
- Relay Module
- OLED/LCD Display (Optional)
- Wi-Fi Connectivity (Built-in ESP32)
- LEDs and Home Appliances for Demonstration
- Power Supply Unit
- Breadboard and Connecting Wires
- Push Button (Optional for Voice Activation)

SOFTWARE REQUIREMENTS:

- Arduino IDE
- Embedded C/C++
- ESP32 Board Package
- Speech Recognition Libraries
- TensorFlow Lite / TinyML (Optional)
- Blynk IoT Platform (Optional)
- Google Speech API / OpenAI API (Optional)
- Visual Studio Code
- Firebase or Cloud Database (Optional)

RESULTS:

The developed AI voice assistant successfully recognized voice commands and controlled connected devices with high accuracy. The system provided real-time voice interaction, improved user convenience, and demonstrated effective integration of AI, IoT, and speech recognition technologies.

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9. SMART AI VOICE ASSISTANT USING ESP32

OBJECTIVE:

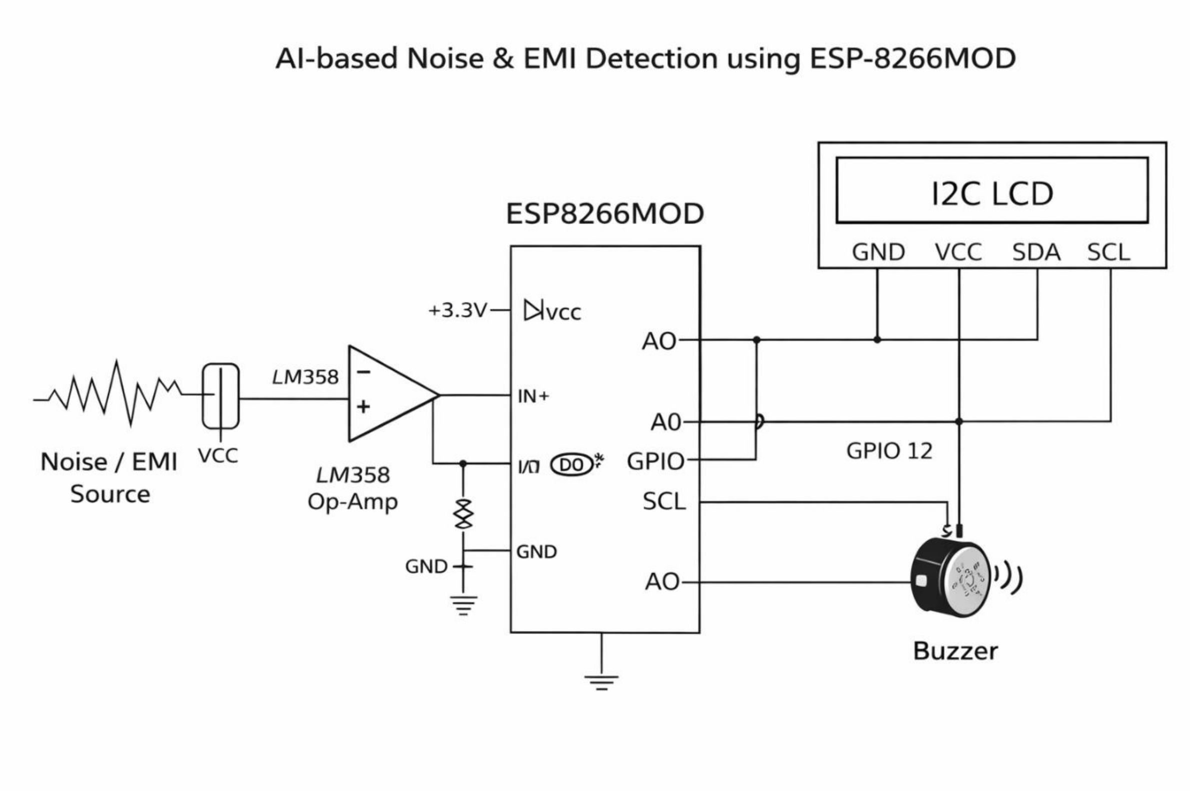
- To design and implement an AI-based Noise and Electromagnetic Interference (EMI) Detection System using the ESP8266MOD, LM358 operational amplifier, LCD display, and buzzer for real-time monitoring, detection, and alert generation.
- The system aims to identify abnormal noise and EMI levels, display the measured values, and provide instant alerts when interference exceeds predefined thresholds.

ABSTRACT:

Noise and Electromagnetic Interference (EMI) are major concerns in electronic and communication systems, affecting signal quality and device performance. This project presents an AI-based Noise and EMI Detection System using the ESP8266MOD microcontroller. A sensor captures ambient noise and EMI signals, which are amplified using an LM358 operational amplifier. The processed analog signal is fed to the ESP8266MOD for analysis and classification.

The microcontroller continuously monitors the signal levels and determines whether the detected noise or EMI exceeds acceptable limits. An I2C LCD module displays the measured values and system status in real time. When excessive interference is detected, a buzzer generates an audible warning to alert users. The system can be further enhanced with machine learning algorithms and IoT connectivity for remote monitoring and predictive analysis. This solution provides an effective and low-cost method for monitoring electromagnetic disturbances in industrial, commercial, and residential environments.

BLOCK DIAGRAM:



WORKING METHODOLOGY OF THE PROJECT:

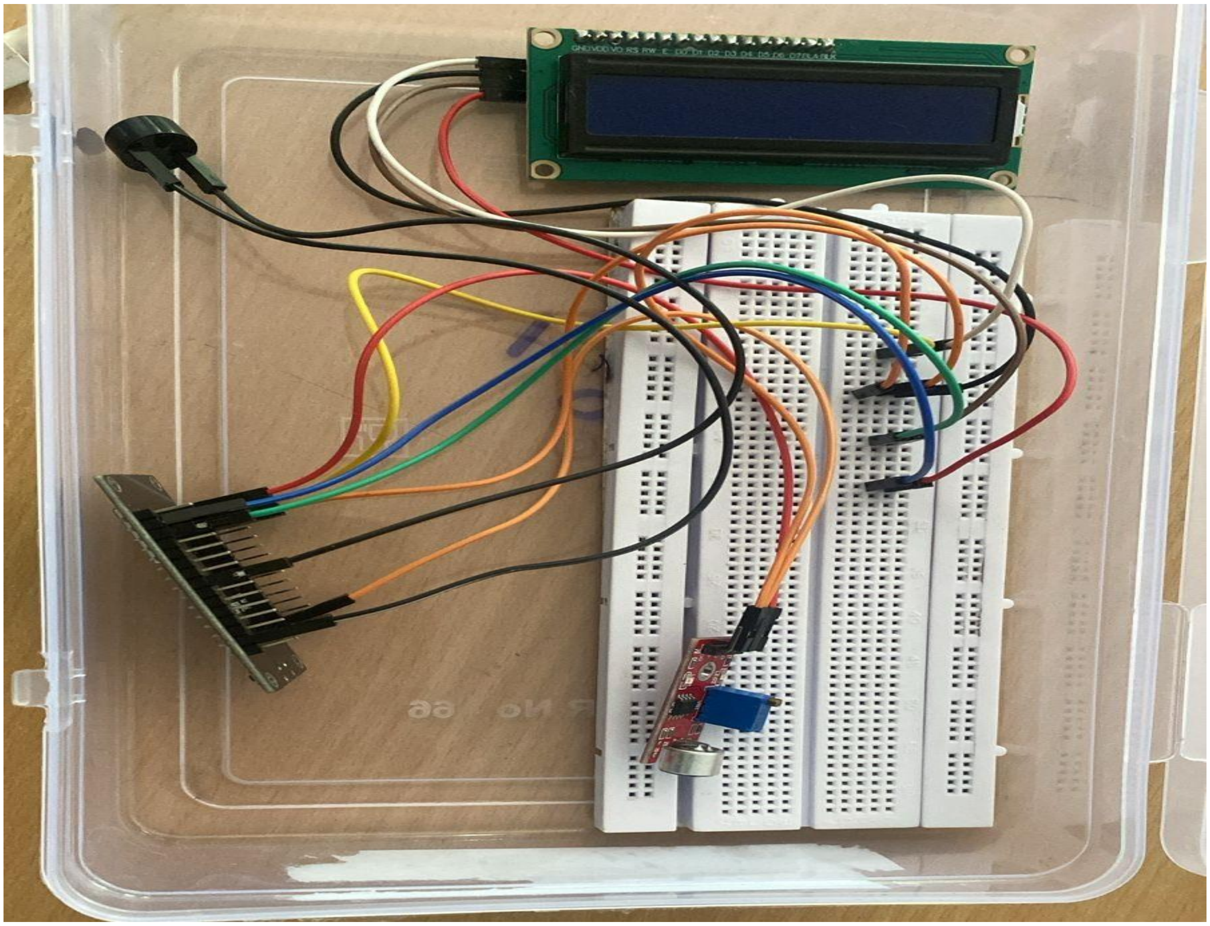
The AI-Based Noise and EMI Detection System works on the principle of detecting unwanted electromagnetic disturbances and environmental noise that may affect the proper functioning of electrical and electronic devices. Electromagnetic Interference (EMI) is commonly produced by electrical equipment such as motors, switching circuits, power lines, and communication systems.

In this system, a sensor module such as KY-018 or KY-038 is used to detect noise or electromagnetic signals present in the environment. The detected signal is usually very weak, so it is amplified using an operational amplifier like LM358 to make it suitable for processing. The amplified analog signal is then sent to the ESP8266 microcontroller, where it is converted into digital form using the Analog-to-Digital Converter (ADC).

The microcontroller processes the digital signal and compares it with a predefined threshold value using simple AI-based decision logic or programmed algorithm. If the detected noise or EMI level exceeds the threshold limit, the system identifies it as interference and activates an alert mechanism. A buzzer is triggered to provide an audible warning, and the I2C LCD display shows the detected EMI or noise level.

If the noise level is within the safe limit, the system indicates normal operation on the display. The entire process occurs continuously, allowing the system to monitor environmental noise and electromagnetic disturbances in real time.

WORKING MODULE:



HARDWARE REQUIREMENTS:

S.No	Component	Quantity
1	ESP8266MOD (NodeMCU/ESP8266 Module)	1
2	LM358 Operational Amplifier	1
3	Noise/EMI Sensor	1
4	I2C LCD Display (16×2)	1
5	Buzzer	1
6	Resistors	As Required
7	Capacitors	As Required
8	Breadboard/PCB	1
9	Connecting Wires	As Required
10	3.3V Power Supply	1

SOFTWARE REQUIREMENTS:

S.No	Software	Purpose
1	Arduino IDE	Programming ESP8266MOD

2	ESP8266 Board Package	ESP8266 Support
3	Embedded C/C++	Coding Language
4	Wire Library	I2C Communication
5	LiquidCrystal_I2C Library	LCD Interface
6	Serial Monitor	Debugging and Testing
7	Machine Learning/AI Algorithm (Optional)	Signal Classification

RESULTS:

The AI-based Noise and EMI Detection System was successfully designed and tested using the ESP8266MOD. The Noise/EMI sensor detected interference signals, which were amplified by the LM358 op-amp for accurate analysis. The ESP8266MOD continuously monitored the signal levels and displayed the readings on the I2C LCD. When the detected noise or EMI exceeded the preset threshold, the buzzer generated an alert. The system demonstrated reliable real-time detection, making it suitable for industrial, communication, and electronic monitoring applications.

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