A Minor Project III Report
on

IOT BASED LEAKAGE CURRENT DETECTOR

Submitted by

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M. KUMARASAMY COLLEGE OF ENGINEERING

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BONAFIDE CERTIFICATE

Certified that this Minor Project III Report titled **"IOT BASED LEAKAGE CURRENT DETECTOR"** is the bonafide work of **SARAN M (927622BEE100), SHARVEENA N (927622BEE107), SILAIMANI K (927622BEE110), MADHESHWARAN U (927622BEE306)** who carried out the work during the academic year (2023-2024) under my supervision. Certified further that to the best of my knowledge the work reported here in does not form part of any other project report.

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Submitted for Minor Project III (18EEP301L) viva-voce Examination held at M Kumarasamy College of Engineering, Karur-639113 on……………….

DECLARATION

We affirm that the Minor Project III report titled **"IOT BASED LEAKAGE CURRENT DETECTOR"** being submitted in partial fulfillment for the award of Bachelor of Engineering in Electrical and Electronics Engineering is the original work carried out by us.

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VISION AND MISSION OF THE INSTITUTION

VISION

- ✓ To emerge as a leader among the top institutions in the field of technical education

MISSION

- ✓ Produces mart technocrats with empirical knowledge who can surmount the global Challenges.
- ✓ Create a diverse, fully-engaged, learner-centric campus environment to provide Quality education to the students.
- ✓ Maintain mutually beneficial partnerships with our alumni, industry and Professional as sociations.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To produces mart and dynamic professionals with profound theoretical and practical knowledge comparable with the best in the field.

MISSION

- ✓ Produce hi-tech professionals in the field of Electrical and Electronics Engineering by inculcating core knowledge.
- ✓ Produce highly competent professionals with thrust on research.
- ✓ Provide personalized training to the students for enriching their skills.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

- ✓ **PEO1:** Graduates will have flourishing career in the core areas of Electrical Engineering and also allied disciplines.
- ✓ **PEO2:** Graduates will pursue higher studies and succeed in academic/research careers
- ✓ **PEO3:** Graduates will be a successful entrepreneur in creating jobs related to Electrical and Electronics Engineering /allied disciplines.
- ✓ **PEO4:** Graduates will practice ethics and have habit of continuous learning for their success in the chosen career.

PROGRAMME OUTCOMES (POs)

After the successful completion of the B.E. Electrical and Electronics Engineering degree program, the students will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: 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.

PO3: 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.

PO4: 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.

PO5: 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.

PO6: The Engineer and Society: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: 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.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Teamwork: Function effectively as an individual and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: 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.

PO11: 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 multi-disciplinary environments.

PO12: 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

The following are the Program Specific Outcomes of Engineering Students:

- **PSO1:** Apply the basic concepts of mathematics and science to analyze an design circuits, controls, Electrical machines and drives to solve complex problems.

- **PSO2:** Apply relevant models, resources and emerging tools and techniques to provide solutions to power and energy related issues &challenges.

- **PSO3:** Design, Develop and implement methods and concepts to facilitate solutions for electrical and electronics engineering related real world problems.

Abstract (Key Words)	Mapping of Pos and PSOs
Wi-Fi module, ARDUINO UNO, Current sensor, Voltage sensor, Relay, LCD Display	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2, PSO3

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We would like to express my deep gratitude to our Minor Project Guide **Dr. B. Rajesh Kumar M.E., Ph.D., Assistant Professor (SLG), Department of Electrical and Electronics Engineering,** for his constant encouragement, kind co-operation, valuable suggestions and support rendered in making our project a success.

We offer our whole hearted thanks to our Minor project coordinator **Mrs. R. INDHUMATHI, M.E., Assistant Professor (SLG), Department of Electrical and Electronics Engineering,** for his constant encouragement, kind cooperation and valuable suggestions for making our project a success

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CHAPTER 1

ABSTRACT

The rapid advancement of Internet of Things (IoT) technologies has paved the way for more efficient and real-time monitoring systems in various industries. This paper presents an IoT-based solution for detecting leakage currents in electrical systems. Leakage current, often caused by insulation degradation, can pose serious hazards, including electrical shocks and fire risks. The proposed system integrates IoT sensors to continuously monitor electrical circuits for abnormal current flow. When a leakage is detected, the system immediately alerts the user through a cloud-based platform, which can be accessed via smartphones or web applications. Our project focuses on developing a system that monitors and detects leakage currents in electrical installations, aiming to prevent potential hazards like electrical shocks or fire. The system uses sensors to continuously measure the current flow through electrical circuits, identifying any abnormal leakage. These readings are then transmitted in real-time to an IoT platform, where data analytics and thresholds are set to trigger alerts. If a leakage is detected, notifications are sent to maintenance personnel via a mobile app or web interface, allowing for prompt intervention. This project enhances safety, reduces downtime, and facilitates remote monitoring and predictive maintenance in industrial, residential settings.

CHAPTER 2
LITERATURE REVIEW

Paper 1: Wireless Monitoring System for Early Detection of Power Line Conductor Breakage, Authors: Praveen Kumar, Anjali Desai, Rajiv Sharma, Year of Publication:2021

Inference: The project "Wireless Monitoring System for Early Detection of Power Line Conductor Breakage," presents a safety-enhancing solution for power distribution networks. This system uses a network of wireless sensors that continuously monitor factors like tension, vibration, and temperature along conductor lines. By employing IoT technology and communication protocols such as Zigbee and LoRa, these sensors transmit real-time data to a central unit, enabling immediate identification of potential conductor faults. This scalable solution addresses the risks posed by aging infrastructure and adverse weather conditions, ensuring improved reliability and safety in power distribution.

Paper 2: Remote Sensing and Wireless Communication for Power Line Conductor Integrity Monitoring, Authors S. Venkatesh, Priya Nair, and Manish Patel, Year of Publication: 2019

Inference: The "Remote Sensing and Wireless Communication for Power Line Conductor Integrity Monitoring" system uses remote sensors placed along power line conductors to monitor their structural health. These sensors measure parameters like tension, vibration, and temperature, which indicate the line's stability and detect potential faults or breakages. Through wireless protocols like Zigbee and LoRa, the sensors transmit real-time data to a central monitoring unit. This enables quick analysis and early detection of risks, allowing maintenance teams to address issues proactively, thus improving power line reliability and reducing the chance of outages.

Paper 3: Enhancing Power Line Safety through Wireless Conductor Breakage Monitoring, Authors: Arjun Singh, Neha Verma, and Rohit Joshi, Year of Publication: 2020

Inference: The system works by deploying wireless sensors along power lines to monitor critical parameters like tension, vibration, and temperature. When any irregularities are detected—such as sudden changes that could indicate a breakage—the sensors transmit data wirelessly using protocols like Zigbee and LoRa to a central monitoring unit. This real-time data allows for immediate analysis, enabling quick intervention to prevent potential failures and maintain power line safety.

Paper 4: Real-Time Conductor Breakage Accident Prevention in Power Lines Using IoT-Based Wireless Communication, Authors: Vishal Mehta, Priya Singh, and Rahul Deshmukh, Year of Publication: 2021

Interface: In this project, wireless sensors are installed along power lines to monitor key parameters such as tension, vibration, and temperature that can indicate potential issues. These sensors detect abnormal changes and use IoT-based communication protocols like Zigbee and LoRa to transmit data continuously to a central monitoring system. When a parameter exceeds safe thresholds, the system immediately alerts maintenance teams, allowing them to take preventive action before a conductor breakage occurs. This real-time monitoring approach enhances power line safety by reducing the risk of accidents from unexpected line faults, especially in aging infrastructure and during extreme weather conditions.

Paper 5: Preventing Power Line Breakage Accidents Using Wireless Sensing and Alert Systems, Authors: Meera Reddy, Karthik Iyer, and Anil Sharma, Year of Publication: 2019

Inference: This project focuses on the development of a wireless sensing and alert system aimed at preventing power line breakage accidents. By deploying a network of wireless sensors along power lines, the system continuously monitors critical parameters such as tension, vibration, and temperature, which are indicative of the structural integrity of the conductors. Utilizing IoT technologies and communication protocols like Zigbee and LoRa, the sensors transmit real-time data to a central monitoring unit. In the event of abnormal readings that signal potential conductor failure, the system promptly sends alerts to maintenance personnel, enabling rapid response to mitigate risks and enhance the safety and reliability of power distribution networks.

CHAPTER 3
METHODOLOGY

3.1 EXISISTING METHODOLOGY

One of the easiest and most efficient ways to safeguard overhead distribution lines against overloading and short circuit situations is through conventional fuse protection systems. For many years, power distribution networks have employed them to make sure that in the event of a malfunction (such as a short circuit), the electrical system is safeguarded by switching off the power to stop additional equipment damage or dangers like fires.

KEY COMPONENTS

Power Supply/Distribution Line: Carries electricity from the substation to various loads (homes, businesses, etc.).

Fuse Cutout: The protection device that contains the fuse link.

Fuse Link: A replaceable element inside the fuse cutout that melts when current exceeds a set threshold.

Pole Equipment (Transformers/Loads): Connected loads like residential homes, businesses, or transformers that are protected by the fuse.

WORKING

Fuse cutouts, which are mechanical devices fixed on utility poles, are how the system works. A fuse connection in these devices is set to melt or "blow" when the current reaches a predetermined threshold. The fuse melts and cuts off the electrical supply to that portion of the network when a problem, such as a short circuit, occurs because of the heat produced by the high current passing through the fuse connection. The defective area is cut off from the rest of the grid as soon as the fuse blows, stopping the fault from propagating to other places. But when a fuse blows, a technician has to physically replace it, which keeps the system from working until repairs are completed.

Power Source: This is the main high-voltage source from a substation that supplies power to the distribution line.

Distribution Line: The overhead electrical wires that transmit electricity to various utility poles along the route.

Fuse Cutout: A mechanical protection device mounted on each pole. The fuse cutout contains a fuse link and is responsible for disconnecting the power in case of a fault.

- The fuse link is the component that melts when an excessive current flows through it. The fuse cutout is designed to open when the fuse link blows, breaking the connection between the power line and the load.
- The cutout usually has an arm that drops open when the fuse blows, providing a visible indication that the fuse has blown.

Normal Operation: Under normal conditions, the current flowing through the fuse link is within its rated limit, and power continues uninterrupted.

Short Circuit/Overload Condition: When a short circuit or overload occurs (for instance, due to equipment failure, downed lines, or lightning strikes), the current through the fuse link exceeds the set threshold, causing it to overheat and melt.

Fuse Link Melts: As soon as the fuse link melts, the circuit is broken, and the flow of electricity to the pole-mounted equipment or the section of the distribution line is cut off. This prevents further damage to the electrical system and ensures safety.

Manual Intervention: After the fault is cleared, a technician must manually replace the fuse link in the fuse cutout. Only after the replacement is the electrical connection restored.

3.2 BLOCK DIAGRAM OF EXISTING METHOD

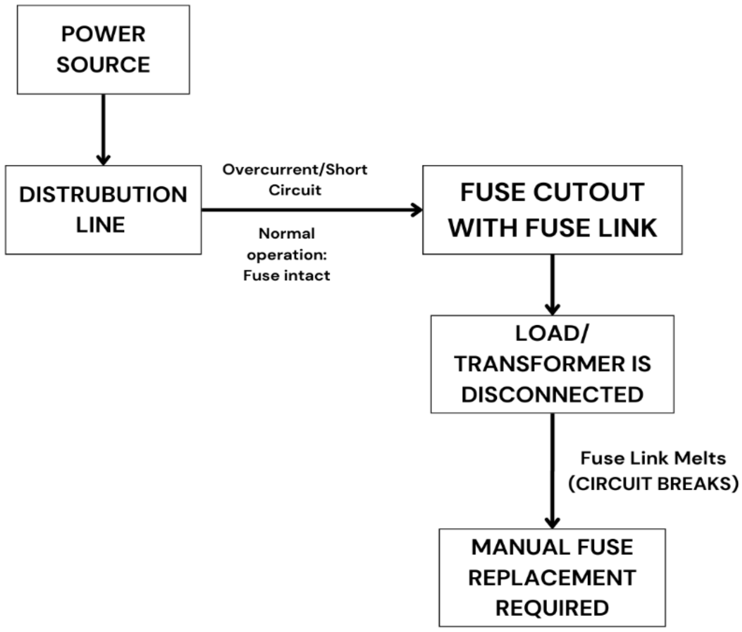

Fig 3.2 Block Diagram of Existing Method

3.2.1 DESCRIPTION OF EXISTING METHOD

The existing methodology for an IoT-based leakage current detector combines advanced sensing, data acquisition, and cloud-based monitoring to identify and report electrical system faults effectively. Sensors, such as current transformers (CTs) and voltage sensors, are used to detect leakage currents and measure line voltage. These sensors relay data to a microcontroller, like an Arduino or ESP32, which processes the signals using threshold-based algorithms to distinguish between normal variations and actual leakages. The processed data is transmitted to IoT platforms like AWS IoT or Things Board via wireless communication modules such as Wi-Fi or LoRa, enabling real-time monitoring and storage. Users access this data through mobile apps or web dashboards, which provide visualizations, historical trends, and alerts in case of anomalies. Some systems incorporate automatic shutdown mechanisms using relays to disconnect circuits when leakage exceeds safe limits, along with continuous data logging for predictive maintenance.

3.3 BLOCK DIAGRAM OF PROPOSED METHOD

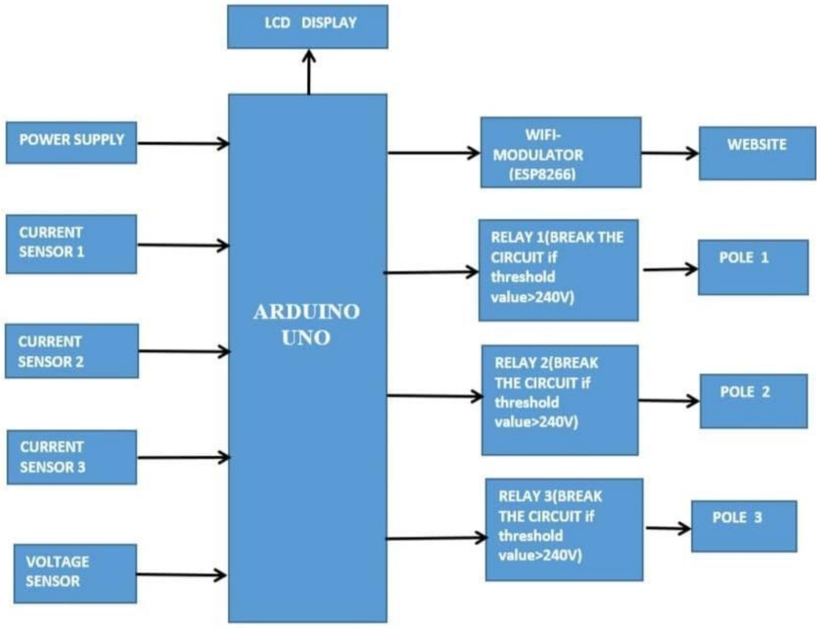

Fig 3.3 Block Diagram of Proposed Method

The proposed solution in our IoT-based leakage current detector project involves the development of a smart system that continuously monitors electrical circuits for any leakage currents and provides real-time alerts to users. The system is designed using IoT technology, enabling it to collect, process, and transmit data wirelessly to a central hub or cloud-based platform. The detection system consists of sensitive current sensors that are placed in key locations within the electrical system to detect any abnormal currents. These sensors are connected to Arduino UNO, which processes the sensor data and communicates it to the cloud via an IoT gateway. Once the data is in the cloud, it is analyzed, and users can access it through a mobile app or web interface. The system can send real-time notifications if any hazardous leakage currents are detected, allowing for immediate intervention to prevent damage or safety incidents. Additionally, the platform provides historical data and trend analysis, enabling predictive maintenance and helping users optimize their electrical systems for energy efficiency. This solution not only enhances safety and reliability but also integrates seamlessly with existing IoT infrastructures, making it a scalable and cost-effective option for both residential and industrial applications.

3.4 DESCRIPTION OF PROPOSED METHOD

The IoT-based leakage current detector project is designed to enhance electrical safety by continuously monitoring leakage currents in real time. This system utilizes current sensors to detect any abnormal leakage in electrical circuits. These sensors feed data to an Arduino, which processes the information to determine if the leakage exceeds predefined safety thresholds. When a dangerous level is detected, the Arduino activates a relay to disconnect the power supply. Simultaneously, the system employs a Wi-Fi module to transmit real time data and alerts to a cloud platform or mobile application, allowing users to monitor the status of their electrical systems. An LCD display provides immediate visual feedback on current leakage levels and system status, ensuring users are informed of any issues on-site.

3.4.1 Arduino UNO

The Arduino is a microcontroller that acts as the brain of the system, processing inputs and controlling outputs. It collects real-time data from current sensors that monitor electrical circuits for abnormal leakage currents. The Arduino processes these sensor signals, analyzing whether the detected current exceeds predefined safety thresholds.

Fig 3.4.1 Arduino UNO

3.4.2 Wi-Fi Module

The Wi-Fi module (such as ESP8266 or ESP32) enables wireless communication between the Arduino and external devices. Its primary function is to connect the Arduino to the internet, allowing the system to transmit real-time data about leakage currents to cloud platforms, mobile apps, or web interfaces.

Fig 3.4.2 Wi-Fi Module

3.4.3 LCD Display

In the IoT-based leakage current detector project, the LCD display serves as a user interface for real-time monitoring and data visualization. It provides immediate feedback by displaying key information such as the current leakage level, system status, and whether any faults or abnormalities have been detected.

Fig 3.4.3 LCD Display

3.4.4 Relay

In the IoT-based leakage current detector project, the relay serves as a key component for controlling electrical circuits in response to detected leakage currents. When the Arduino identifies a leakage current that exceeds a predefined safety threshold, it sends a signal to the relay. The relay then acts as a switch, either opening or closing the circuit.

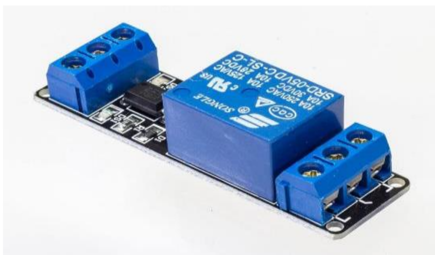

Fig 3.4.4 Relay

3.5 COST ESTIMATION OF PROPOSED METHOD

Table 3.5 Cost Estimation of proposed method.

S.NO	COMPONENT DESCRIPTION	QUANTITY	COST
1	Arduino UNO	01	Rs.600
2	Voltage and Current sensor	Each per pole	Rs.500
3	Relay	01	Rs.400
4	Wi-fi module	01	Rs.850
5	Additional components	As required	Rs.500
		TOTAL	Rs.2850

CHAPTER 4

4.1 SOFTWARE TOOL USED

4.1.1 A COMPREHENSIVE STUDY OF ITS FEATURES

The Arduino IDE is a versatile software tool for programming Arduino and compatible microcontrollers, ideal for beginners and professionals alike. It offers a straightforward code editor with syntax highlighting and auto-indentation for writing "sketches," or programs. With built-in libraries, it simplifies coding for various sensors and actuators, while the Serial Monitor enables real-time debugging. The IDE supports multiple platforms, including Windows, macOS, and Linux, and allows users to select specific boards and ports. The recent Arduino IDE 2.0 adds dark mode, a responsive interface, and an integrated debugger, enhancing the user experience for more efficient development.

4.1.2 IMPACT OF EMBEDDED PROGRAM

In an IoT-Based Leakage Current Detector, the embedded C program plays a crucial role in monitoring and detecting abnormal leakage currents. This program interfaces directly with sensors to capture real-time data, processes it to identify any anomalies, and then sends alerts over the network if a leakage threshold is exceeded. With efficient memory management, the embedded C code ensures reliable performance in low-power conditions. The program also supports connectivity to IoT platforms, enabling remote monitoring and data logging. This embedded C code allows for precise, real-time detection, making it a vital component of the leakage detection system.

4.1.3 COMPILING AND UPLOADING CODE FOR THE IOT-BASED LEAKAGE CURRENT DETECTOR

To compile the code for an IoT-Based Leakage Current Detector project, first, install the Arduino IDE and connect your microcontroller (like Arduino or ESP32) to your computer. In the IDE, select the appropriate board and port under Tools > Board and Tools > Port. Write or open the embedded C program, ensuring necessary libraries (e.g., for sensors or Wi-Fi) are included. Click the Verify button to compile the code, checking for errors. Once compiled successfully, click Upload to transfer the code to the microcontroller. Use the Serial Monitor to view real-time data and verify the system's functionality.

4.1.4 SOURCE CODE USED IN PROJECT

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(2,3,4,5,6,7);
int temp = A0;
const int button = 8;
const int led = 9;
void setup() {
  pinMode(temp,INPUT);
  pinMode(button,INPUT);
  pinMode(led,OUTPUT);
  lcd.begin(16,2);
  lcd.clear();
  lcd.print("    WELCOME       ");
  lcd.setCursor(0,1);
  lcd.print("");
  delay(500); }
void loop() {
  int read_temp = analogRead(temp);
  read_temp = read_temp/2;
  lcd.clear();
  lcd.print("TEMP:");
  lcd.print(read_temp);
  delay(200);
  if(read_temp >= 35) {
    digitalWrite(led,HIGH);
    lcd.clear();
    lcd.print("TEMPERATURE");
    lcd.setCursor(0,1);
    lcd.print("   HIGH  ");
    delay(1000);
    lcd.clear();
```

```
  lcd.print("LOCATION");
  lcd.setCursor(0,1);
  lcd.print("SENT");
  delay(1000); }
 if( read_temp <= 34) digitalWrite(led,LOW);
 if(digitalRead(button) == HIGH) {
  digitalWrite(led,HIGH);
  lcd.clear();
  lcd.print("EMERGENCY");
  lcd.setCursor(0,1);
  lcd.print("   ALERT  ");
  delay(1000);
  lcd.clear();
  lcd.print("LOCATION");
  lcd.setCursor(0,1);
  lcd.print("SENT");
  delay(1000); }
  if(digitalRead(button) == LOW) digitalWrite(led,LOW); }
```

4.2 PROJECT OUTCOME

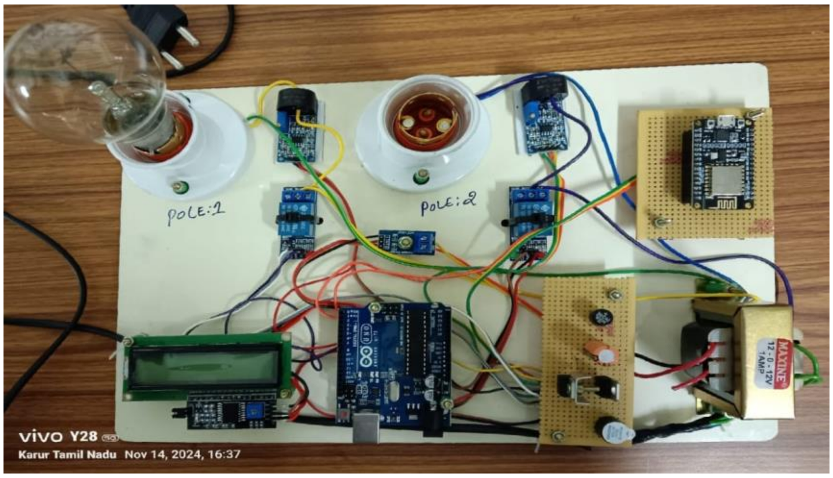

Fig 4.2.1 Normal Condition

In a normal condition, the detected current values are within the predefined safe range for the system. The kit detects a current well below the leakage threshold (e.g., 0-5mA), no alerts are triggered, and the system status shows "normal."

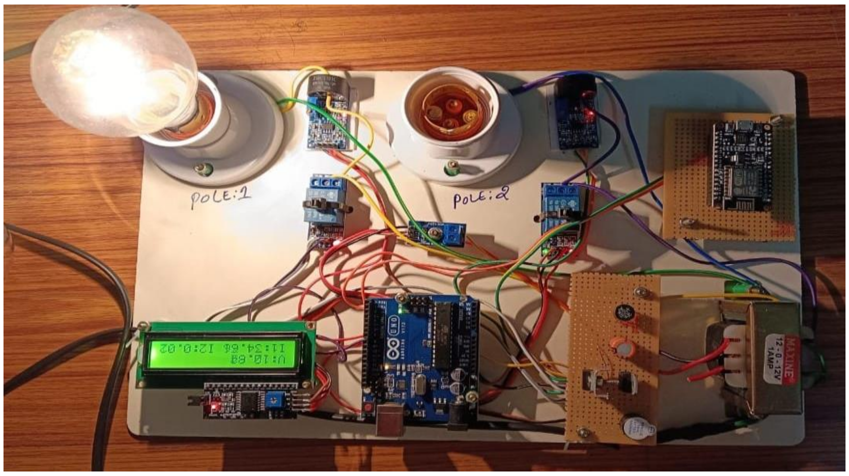

Fig 4.2.2 Fault Condition

When the system detects current leakage beyond the safe threshold, it enters the fault condition. The kit detects leakage above the threshold (e.g., 10mA), triggering an alarm, LED indicator change, and notification to the user.

Fig 4.2.3 Display the Fault

CHAPTER 5

5.1 FUTURE SCOPE & ITS IMPLEMENTATION PLAN

The future of an IoT-based leakage current detector project holds great promise in improving safety, energy efficiency, and operational control in electrical systems. As technology advances, such detectors can be integrated with home automation systems, and industrial setups to continuously monitor electrical leakage and prevent hazards like electrical fires, equipment damage, and energy loss. By using IoT connectivity, these detectors can transmit real- time data to a central system or mobile applications, enabling remote monitoring and instant notifications in case of leakage issues. This helps in proactive maintenance and quick response to potential faults.For implementation, the project can follow a phased approach. Initially, focus on developing and testing a prototype that combines sensors capable of detecting leakage currents with a microcontroller like Arduino or Raspberry Pi. Integrate this with IoT platforms such as MQTT or cloud services like AWS or Azure IoT for real-time data transmission. After testing in a controlled environment, move towards a pilot phase, deploying the system in industrial settings for real-world testing. Finally, scale up by enhancing the system's robustness, adding predictive analytics for fault detection, and ensuring compliance with electrical safety standards for broader adoption.

CHAPTER 6

6.1 REFERENCES

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