IJCRT.ORG **ISSN : 2320-2882**

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Advanced System For Fault Detection In Underground Cables Using IOT

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Abstract- In this paper the aims is to develop smart and real time monitoring for detecting and locating faults in underground power cables. Traditional methods of fault detection often involve manual inspection and are time-consuming, leading to prolonged power outages and costly repairs. This system leverages the Internet of Things (IoT) to automate and improve the accuracy of fault detection processes. The proposed solution utilizes a network of IoT-enabled sensors deployed along underground cables to monitor various parameters such as voltage, current, and temperature. In the event of a fault, the system detects anomalies in where advanced algorithms analyse the fault type and severity, providing detailed insights for maintenance crews.

The paper aims to enhance the reliability of power distribution networks, reduce downtime, and minimize operational costs associated with manual fault detection. By incorporating IoT technology, this system represents a advancement in the field of electrical fault management, offering a scalable and cost-effective solution for modern power infrastructure.

Keywords-Underground, Fault, Detect, Money

I. INTRODUCTION

The reliability of electrical power distribution networks is crucial for the seamless operation of industries, businesses, and households. Underground cables play a significant role in modern power grids, offering advantages such as reduced exposure to environmental hazards and lower maintenance requirements compared to overhead lines. However, underground cables are not immune to faults, which can occur due to aging, insulation degradation, physical damage, or environmental conditions. Detecting and locating these faults in underground cables is challenging and often involves complex, time-consuming manual processes that can lead to extended power outages and increased repair costs. Traditional fault detection methods rely on physical inspections or specialized equipment, which may not always provide precise results, especially in urban areas where underground cable networks are extensive and densely packed. These limitations highlight the need for an advanced, automated approach to fault detection that can quickly identify the exact location and nature of the fault, thereby reducing downtime and maintenance costs. The "Advanced System for Fault Detection in Underground Cables Using IoT" addresses these challenges by employing the Internet of Things (IoT) to modernize the fault detection process. By integrating IoT-enabled sensors along the cable network, the system continuously monitors key parameters such as voltage, current, and temperature. When a fault occurs, the system can detect abnormal changes in these parameters, locate the fault's position, and alert the central monitoring system in real time.

II. LITERATURE SURVEY

UNDERGROUND CABLE FAULT DETECTION

This system helps find the exact location of a short circuit fault in an underground cable. It does this by measuring the resistance of the cable and calculating the distance of the fault in kilometres from the starting point. It is useful because it saves time and effort, as there is no need to dig up the entire cable to find the fault.

It works for all cables with voltage from 1kV to 500kV. It also requires less maintenance, has high efficiency, and reduces damage. Additionally, it can detect many faults such as short circuits, cable cuts, partial discharge, and other issues.

The system consists of an Arduino, a power supply, a display, and a resistance measurement circuit. There are 12 fault switches (4 for each phase: R, Y, and B), which can be in No Fault (NF) or Fault (F) positions. When a fault occurs, the resistance of the cable changes. The Arduino reads this change and calculates the fault's distance.

The result is then displayed, showing the exact location of the fault. In the future, this system can be improved to find open circuit faults using a capacitor in AC circuits. It can also be connected to the internet (IoT) for remote monitoring, and a mobile app can be developed to send fault details to a phone.

ADVANCED FAULT DIAGNOSIS IN UNDERGROUND CABLE USING IOT

This paper addresses the pressing issue of timely and accurate This system helps find the exact location of a short circuit fault in an

underground cable. It does this by measuring the resistance of the cable and calculating the distance of the fault in kilometres from the

starting point [1].

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voltage from 1kV to 500kV. It also requires less maintenance, has high efficiency, and reduces damage. Additionally, it can detect many

faults such as short circuits, cable cuts, partial discharge, and other issues [2].

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The Arduino reads this change and calculates the fault's distance. The result is then displayed, showing the exact location of the fault

[3].

This paper's main goal is to use Internet of Things (IoT) technology to design, develop, and implement an underground cable fault

detector. The overarching goal is to address the critical challenge of timely and accurate identification and localization of faults in underground power cables. By leveraging IoT, the paper aims to create a comprehensive and real-time monitoring apparatus that can

detect anomalies such as insulation degradation, environmental influences, or physical damage in the underground cable network.

SMART MONITORING FAULT DETECTOR USING IOT

The main goal of this paper is to build a smart system that can detect electrical faults or smoke in an urban area and quickly alert people

using IoT (Internet of Things) technology. This system is especially useful in places like homes, offices, or buildings where early

detection of electrical issues or smoke can help prevent bigger problems like fires.

The brain of the system is an Arduino microcontroller. It connects and controls other components like sensors and a GSM module. The

current sensor is used to monitor the flow of electricity. If there is an abnormal current, like a sudden drop or surge, it can mean there's

a fault in the system. At the same time, the smoke sensor checks the air for signs of smoke, which could be an early warning of a fire.

When the system detects either a fault in the electrical current or the presence of smoke, it sends a warning message using a GSM

module. The GSM module works like a mobile phone and can send text messages (SMS) to a specific number, like a homeowner's or

building manager's phone. This makes sure that the person is informed right away, even if they are not near the system.

Overall, this smart monitoring fault detector helps improve safety by detecting problems early and sending alerts through mobile

networks. It's a simple but powerful way to protect buildings and people from electrical faults or fire risks.

ENHANCING POWER DISTRIBUTION NETWORK : AN ADVANCE SYSTEM FOR UNDERGROUND CABLE FAULT
MONITORING SYSTEM USING IOT

In this , the cable fault detection system built using Arduino technology is an effective way to improve the reliability of underground

power cables. It can simulate and detect faults, send real-time updates through the Things Board platform, and provide alerts when issues

are found. This helps reduce downtime and keeps the cables in better condition.

The system combines hardware, smart coding, and clear data display, making it useful in real-world situations. Its ability to send quick

notifications ensures fast action, and it can also be adapted for use in industries. Overall, the project shows how well hardware and

software can work together to make underground cable systems more efficient and last longer. It not only adds to research in this field

but also shows promise for wider industrial use.

III. OBJECTIVE

To accurately detect the occurrence and location of faults in underground cables using sensors and Raspberry Pi Pico, ensuring timely of issues. Multi-Channel Fault Display: To display detected faults on multiple platforms including an LCD screen, IoT website, and SMS alerts to provide users with instant fault updates. IoT Integration for Remote Monitoring: To implement an IoT platform where data from sensors is transmitted via the GSM module, allowing remote monitoring and management of cable faults through an online dashboard. Automated SMS Alert System: To send automatic SMS alerts to predefined users or technicians using the GSM module, ensuring quick action for repair and minimizing downtime. Low-Power, Cost-Effective Design: To develop a power- efficient and budget-friendly solution using the Raspberry Pi Pico, reducing the overall cost and complexity of underground cable fault monitoring.

IV. METHODLOGY

The system is designed to detect and display faults in underground cables. It uses the Raspberry Pi Pico as the main controller, interfacing with fault-detecting switches, an LCD display, a GSM module, and an IoT webpage to monitor faults in real-time. We have used an app to turn on and off the switches which means it will operate wireless . Fault Detection: The system continuously monitors the status of the switches. Automatic Switches: Controlled via a mobile application to turn the switches on and off to create fault When a switch is triggered, it simulates a fault in the corresponding section of the cable. Local Display and Alerts: Upon detecting a fault, the fault location is displayed on the LCD, and the buzzer is activated. Different coloured LEDs (red, yellow, blue) may be used to represent different fault types (e.g., open, short).SMS Alert: Simultaneously, the GSM module sends an SMS alert to a predefined phone number with details of the fault location. IoT Webpage: The system uploads fault data to a webpage in real-time via the Raspberry Pi Pico, providing remote monitoring. This can be done using a Wi-Fi module if the IoT functionality is included .Programming the Raspberry Pi Pico: The Pico is programmed to continuously monitor the switch inputs and trigger appropriate actions (LCD display, buzzer, LEDs, GSM SMS).LCD Interface: Code for displaying fault status and location on the LCD is written using libraries that support the LM016L.GSM SMS Functionality: The SIM900D GSM module is programmed to send a formatted SMS alert containing the fault location when triggered. IoT Webpage: Use a lightweight web server hosted on the Raspberry Pi Pico or a remote server to display real-time updates of fault conditions. HTTP POST requests are made from the Pico to the server. Test the system by simulating different types of faults using the switches. Ensure that the correct fault location is displayed on the LCD, the SMS is sent, and the IoT webpage updates in real-time. Fine-tune the thresholds for detecting faults and optimize the GSM module's communication reliability. Once the system is calibrated and tested, it can be deployed for monitoring underground cables. The system will alert the maintenance team via SMS and provide real-time monitoring through the IoT webpage. This methodology ensures a systematic approach for fault detection and alerting using the Raspberry Pi Pico.
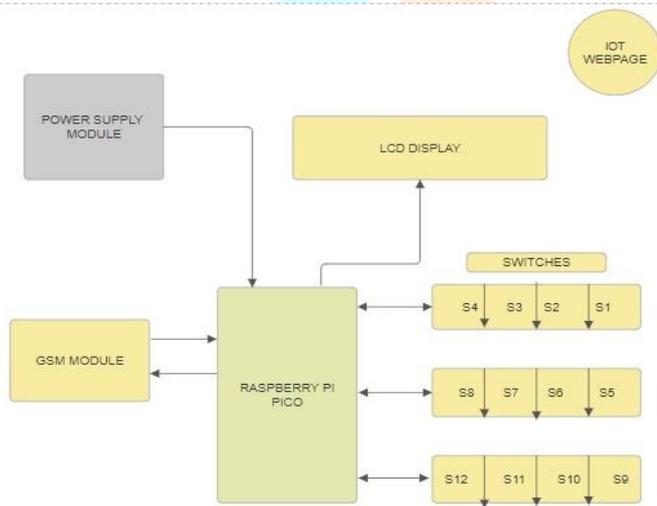
V . BLOCK DIAGRAM

Fig 1: Block Diagram for Underground Cable Fault Detection

Power Supply: Provides the necessary power (typically +5V and +12V) to all components, including the microcontroller, GSM module, LCD, and sensors.

Microcontroller (Raspberry Pi Pico): Acts as the main control unit of the system, receiving and processing signals from fault detection circuits. It interfaces with sensors, the GSM module, and an LCD.

Fault Detection Circuit with Switches: This consists of switches that simulate fault occurrences. When a fault is detected in the cable, a corresponding switch sends a signal to the microcontroller.

LCD Display: Shows real-time information about the status of the underground cable. This includes the fault location and any relevant system messages.

. GSM Module (SIM900D): This module sends SMS alerts to the registered user's phone when a fault is detected. It receives fault information from the microcontroller and transmits it through cellular networks.

Buzzer and LEDs: An audio-visual alert system that indicates when a fault is detected. Different LEDs (Red, Yellow, Blue) could be used to indicate variousconditions or faults.- The system operates by using switches to detect faults in underground cables. When a switch is triggered due to a fault (such as short circuits or breaks), it sends signals to the microcontroller.
- The microcontroller then processes these signals to determine the fault's type and location. Based on this, it updates the LCD with a corresponding message.
- Simultaneously, it activates the buzzer and lights up a specific LED to alert the operator visually.
- The GSM module receives the fault data from the microcontroller and sends an SMS alert to a predefined phone number, informing the user about the detected fault and its location.
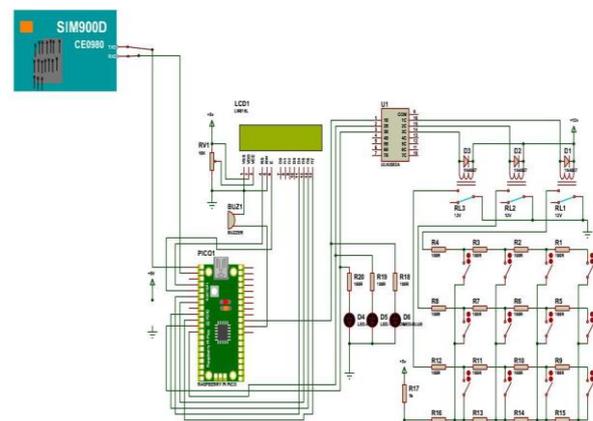
VI. CIRCUIT DIAGRAM

Fig 2: Circuit diagram for Underground Cable Fault Detection

Working of the Circuit: Monitoring and Fault Detection:The Raspberry Pi Pico continuously monitors voltage drops across different cable segments. If a voltage anomaly or break is detected in a section, the corresponding relay triggers.

Alert Mechanism. The LCD display shows the fault status and location in real time. The buzzer sounds to notify local operators.. Simultaneously , the GSM module sends an SMS alert with fault details to a predefined number. Remote Monitoring via IoT The fault information is transmitted to an IoT webpage, providing remote monitoring capabilities. This feature allows technicians to assess the fault remotely and take necessary action
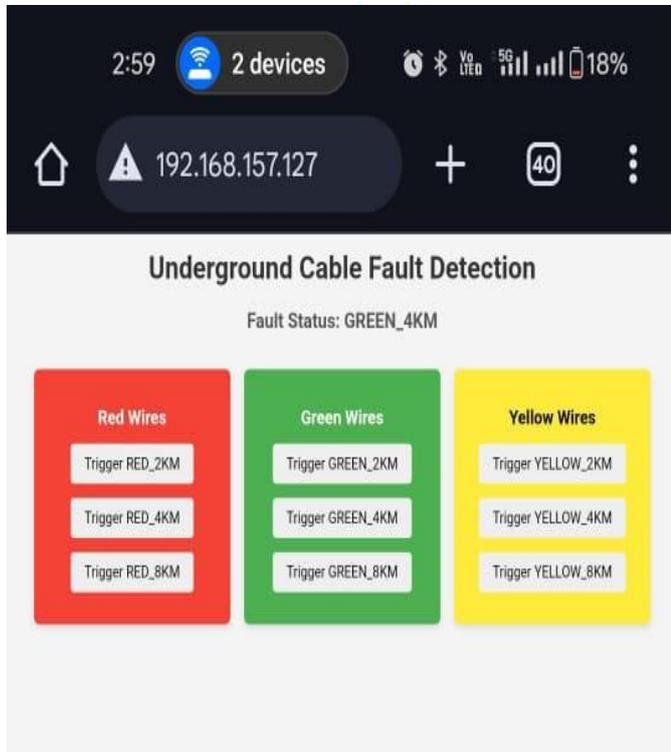
VII.RESULT
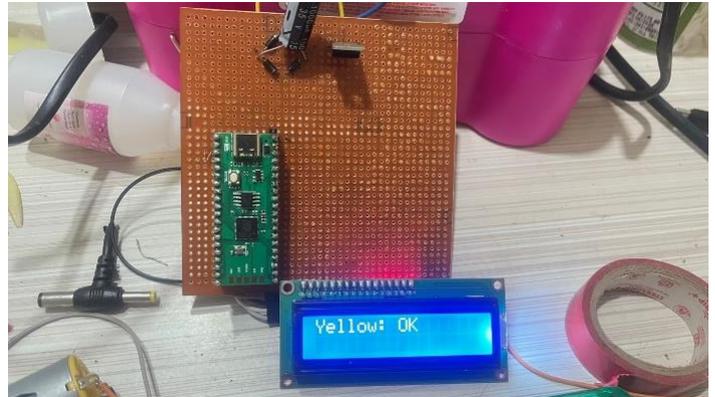

Fig 3: LCD showing underground cable fault

Fig 4: Hardware Implementation of Underground Cable Fault Detection
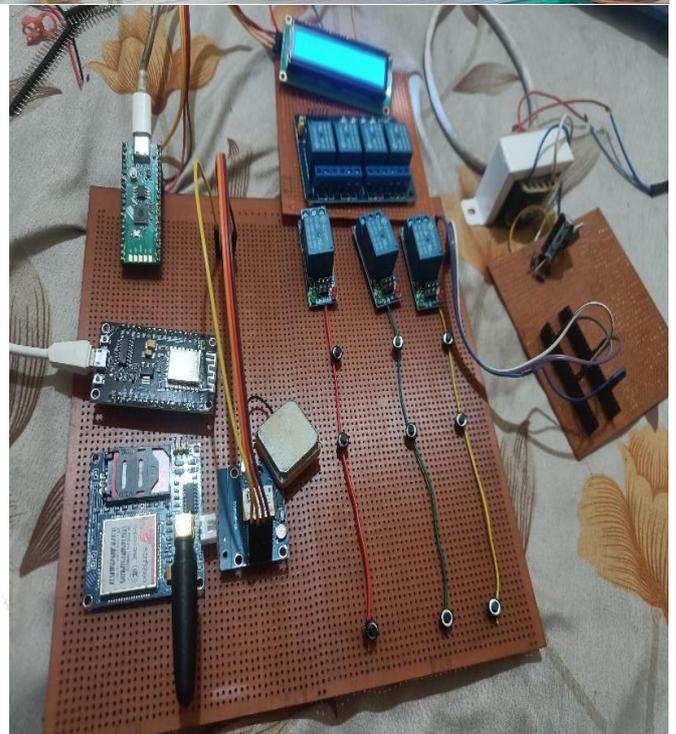
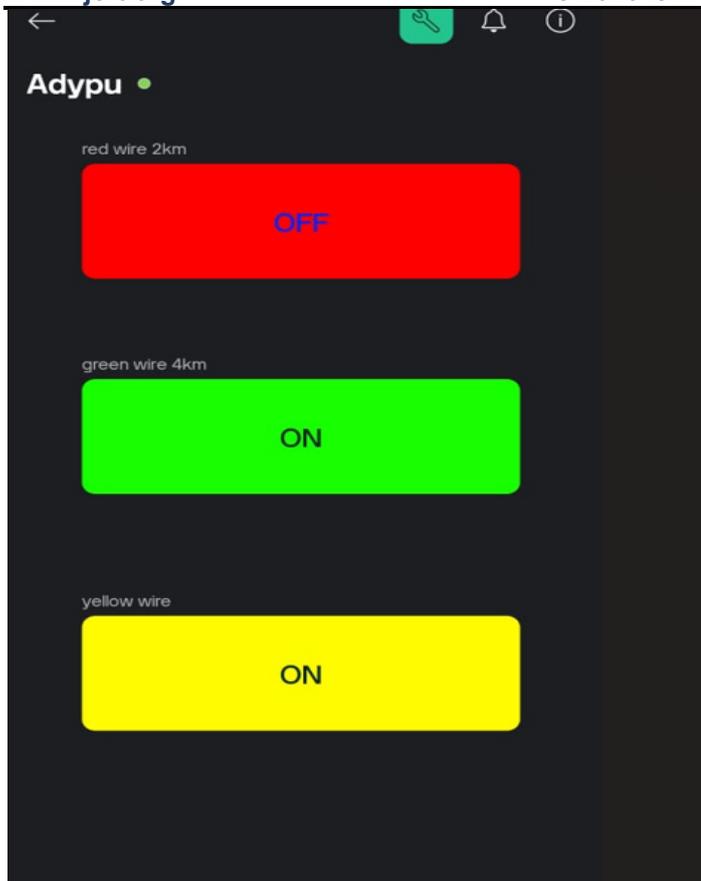Fig 5: Mobile Application Controlling Switches

Fig 6: Webpage indicating Underground Cable Fault

VII. FUTURE SCOPE

The future scope of an Advanced system for Underground Cable Fault Detection system is promising due to its significant utility in infrastructure and smart city developments. In future Integration of IoT-enabled sensors for real-time fault detection and monitoring and incorporate the fault detection system into smart grid architectures for automated power restoration and efficient grid management. We can also use machine learning algorithms to predict potential faults before they occur by analysing historical data and environmental factors. Integration with renewable energy sources like solar and wind to ensure uninterrupted fault monitoring.

VIII. CONCLUSION

The Underground Cable Fault Detection System using Raspberry Pi Pico, IoT integration, LCD display, and SMS alerts via GSM module is an efficient and cost-effective solution for detecting faults in underground cables. By leveraging modern technology, the system provides real-time fault detection, instant alerts, and a user-friendly display, significantly reducing the downtime and maintenance costs associated with underground cable faults. Its ability to remotely monitor cable conditions through IoT and provide precise fault locations enhances the safety and reliability of power and communication networks.

Despite limitations such as environmental sensitivity, GSM dependency, and distance coverage, the system's scalability and ease of integration into various applications make it a valuable tool for power distribution, telecommunication, and industrial infrastructures. The implementation of such a system can greatly improve the efficiency of maintenance operations, ensuring quicker fault repairs and reducing the risk of prolonged service interruptions. In summary, this technology brings tangible benefits to any organization that relies on underground cable networks.

IX. ACKNOWLEDGEMENT

We would like to express our sincere gratitude to everyone who contributed to the successful completion of this research paper. First and foremost, we extend our heartfelt appreciation to our institution and Guide for their valuable guidance, encouragement, and technical support throughout this study. Their insightful feedback and expertise have greatly enhanced the quality of our research.

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