UNDERGROUND CABLE FAULT DETECTION

Ankit Bawne [1], Apeksha Karosiya[2], Shruti Manwatkar[3], Rahul Gawande[4],

Ganesh Belsare [5], Prof. Rajendra Bhombe[6], Prof Meena Gaurkar[7]

Students, Electrical Engineering, Guru Nanak Institute of Engineering and Technology, Nagpur, India[1]

Students, Electrical Engineering, Guru Nanak Institute of Engineering and Technology, Nagpur, India[2]

Students, Electrical Engineering, Guru Nanak Institute of Engineering and Technology, Nagpur, India[3]

Students, Electrical Engineering, Guru Nanak Institute of Engineering and Technology, Nagpur, India[4]

Students, Electrical Engineering, Guru Nanak Institute of Engineering and Technology, Nagpur, India[5]

Associate Professor, Electrical Engineering, Guru Nanak Institute of Engineering and Technology, Nagpur, India[6]

Assistant Professor, Electrical Engineering, Guru Nanak Institute of Engineering and Technology, Nagpur, India[7]

Abstract: Underground power cables are widely used in power distribution systems because they are safer and more reliable than overhead lines. However, detecting faults in underground cables is difficult due to limited accessibility and high repair costs.

This project proposes an efficient underground cable fault detection system that can identify faults such as short circuit, open circuit, and earth fault. The system works on the principle of impedance measurement and voltage drop analysis to determine the distance of the fault from the source end using Ohm's law.

A microcontroller-based circuit continuously monitors the cable parameters. When a fault occurs, the system calculates the fault distance and displays it on a digital display. This helps in quickly locating the fault, reducing downtime, and improving the reliability of the power distribution system

I. INTRODUCTION

Underground cables play a major role in modern power distribution systems because they are safe, visually appealing, and protected from environmental conditions. However,detecting faults in underground cables is challenging because the faults are not visible and the cables are buried deep under the ground.Faults commonly occur due to insulation failure, moisture entry, aging of cables, digging activities, and short circuits. When a fault occurs, it disrupts power flow and causes long downtime if not located quickly. Traditional fault detection methods are slow, costly, and require extensive manual inspection. Therefore, a reliable Underground Cable Fault Detection System is essential. This project aims to detect the type of fault and determine location using electrical principles, making maintenance faster, easier, and more efficient.

II. OBJECTIVE

The primary objectives of this project are:
1. **To design and develop** an efficient underground cable fault detection system capable of identifying different types of faults such as short circuit, open circuit, and earth faults.

2. **To accurately determine the fault location** along the cable length using electrical parameter analysis.

3. **To reduce fault detection time** and minimize manual inspection efforts in underground power distribution systems.

4. **To implement a cost-effective and reliable solution** using a microcontroller-based architecture.

5. **To enhance power system reliability** by enabling quick maintenance and reducing system downtime.

III. METHODOLOGY

The underground cable fault detection system is developed using a structured method based on **Ohm's Law**, where cable resistance is proportional to its length. Any fault changes the resistance, which helps determine the fault location.

1. System Design

The system includes a microcontroller, resistor network (to represent cable length), voltage sensing circuit, Analog-to-Digital Converter (ADC), LCD display, and power supply unit.

2. Fault Simulation

Different faults such as short circuit, open circuit, and earth fault are created using switches at predefined distances in the cable model.

3. Fault Detection Mechanism

A low DC voltage is applied to the cable. Under normal conditions, voltage drops uniformly. When a fault occurs, voltage changes are detected by the microcontroller through the ADC, and the fault distance is calculated based on resistance per unit length.

4. Display and Monitoring

The calculated fault distance is shown on the LCD display, allowing real-time monitoring and quick identification of the fault location.

5. Testing and Validation

The system is tested under different fault conditions. The measured fault distances are compared with actual distances to verify accuracy and evaluate system performance.

Block Diagram
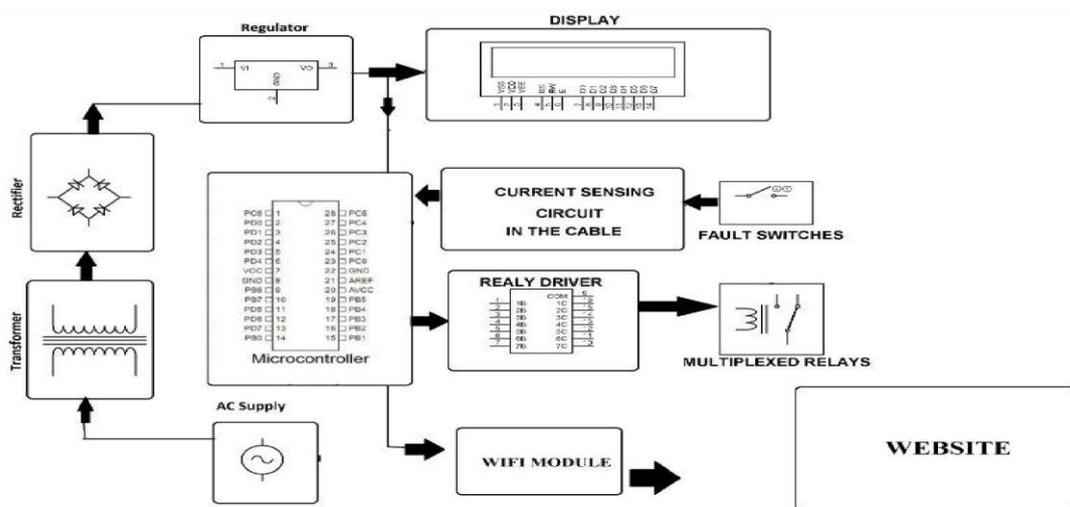
IV. CONCLUSION

The proposed Underground Cable Fault Detection system provides an efficient and reliable method for identifying and locating faults in underground power cables. By applying the principle of Ohm's Law and monitoring voltage variations, the system accurately determines the fault distance from the source end. The microcontroller-based design ensures fast processing, real-time monitoring, and reduced dependency on manual inspection.

Experimental results demonstrate that the system can effectively detect short circuit, open circuit, and earth faults with satisfactory accuracy. The implementation is cost-effective, simple to operate, and suitable for practical deployment in power distribution networks. Overall, the proposed system enhances maintenance efficiency, minimizes downtime, and improves the reliability of underground cable systems.

REFERENCES

[1]. A. K. Sahoo and S. K. Mohapatra, "IoT Based Transformer Health Monitoring System," *IEEE International Conference on Power Electronics and Renewable Energy Systems*, 2019.

[2]. J. Yick, B. Mukherjee and D. Ghosal, "Wireless Sensor Network Survey," *Computer Networks*, vol. 52, no. 12, pp. 2292– 2330, 2008.

[3]. M. Erol-Kantarci and H. T. Mouftah, "Wireless Sensor Networks for Smart Grid Applications," *IEEE Communications Magazine*, vol. 49, no. 11, pp. 130–137, 2011.

[4]. Espressif Systems, "ESP32 Technical Reference Manual," 2023.

[5]. InvenSense Inc., "MPU6050 Product Specification," 2013.

[6]. R. Kumar and S. Singh, "Real-Time Transformer Monitoring Using IoT Technology," *International Journal of Engineering Research & Technology (IJERT)*, vol. 9, issue 6, 2020.

[7]. ThingSpeak IoT Analytics Platform Documentation, MathWorks, 2024.