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IOT BASED UNDERGROUND CABLE FAULT DETECTION

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***Abstract*—The primary objective of this project is to design and develop a system that utilizes Arduino to detect faults and anomalies in underground cables. The fundamental concept guiding the operation of this project is Ohm's law, which states that the current value changes depending on where the cable fault lies when a DC voltage is supplied. The Arduino's integrated ADC detects the voltage change across the resistor in the event of a short circuit, such as an L-G or L-L fault. The detected value is then processed by the Arduino, and the defect is identified in relation to the base station's distance. The system is designed to transmit the precise location of the defect in relation to the base station for each phase in kilometres to the LCD interface on the Arduino board. To achieve this, a set of resistors that indicate the length of the cable are used, and fault switches are installed at each known kilometer to manually cause faults. This way, the fault distance can be determined accurately. By detecting faults and anomalies in underground cables, this system aims to improve the reliability and safety of electricity distribution networks. It can prevent power outages, equipment damage, and safety hazards, which can have significant economic and social impacts. The use of Arduino in this project makes it cost-effective and efficient, making it an attractive solution for electricity providers looking to improve the dependability and safety of their networks. Overall, this project presents a practical solution to the problem of detecting faults and anomalies in underground cables using Arduino. The system's accuracy and efficiency make it a valuable tool for maintaining the stability and continuity of power supply in modern societies.**

***Index Terms*—Underground Cable, Arduino Uno, LCD, Fault detection, ESP8226**

I. INTRODUCTION

Underground cable fault detection is an essential task in the maintenance and operation of power distribution systems. Faults in cables can lead to power outages, equipment damage, and safety hazards. With the advent of Arduino, an open-source microcontroller platform, it has become possible to build low-cost, high-accuracy underground cable fault detection systems. An Arduino-based underground cable fault detection system typically involves a set of resistors and switches that represent a cable to monitor various electrical parameters such as voltage, current, and resistance. The data is then processed and analyzed by the Arduino microcontroller, which uses the relation between the length and resistance to detect and locate any faults in the cable. he use of IoT in underground cable fault detection has several benefits, including reduced downtime, increased reliability, and improved safety. By detecting faults early, maintenance crews can quickly repair the cable before it leads to a major outage. Additionally, IoT-based systems can provide real-time monitoring, enabling operators to make informed decisions and take proactive measures to prevent faults

A. Fault Types in Cables

1) Open Circuit Fault: An open circuit is a fault that happens when the conductor is broken or interrupted, resulting in a loss of continuity and obstructing the flow of electricity. Corrosion, mechanical stress, or design flaws can all result in open circuits.

2) Short Circuit: When two or more conductors come into contact, a short circuit takes place. This fault results in a high current flow that could harm the cable and the surrounding equipment. Insulation failure, mechanical damage, or outside elements like moisture, dust, or animals can all result in short circuits.

3) Ground Fault: When one or more conductors make contact with the ground or another earthed item, a fault known as a "ground fault" develops. This fault results in a current flow that could harm the cable and other equipment. Ground faults can be brought on by deteriorating insulation, inadequate grounding, or outside forces like lightning.

II. LITERATURE SURVEY

S. B. Sahu et al [1] present a low-cost underground cable fault detection system based on Arduino. The system involves a set of sensors that monitor voltage, current, and resistance and an Arduino micro controller that processes and analyzes the data. The system can detect and locate faults with high accuracy and provide alerts to maintenance crews. S. K. Singh et al [2] present an Arduino-based underground cable fault detection system that involves a set of sensors that monitor various electrical parameters and an Arduino board that processes and analyzes the data. The system can detect and locate faults with high accuracy and provide alerts to maintenance crews. Abhishek Pandey et al [3] In order to detect faults, implement a passive optical network based on various problems with wireless fibre to the residential building. These days, optical

fibre is employed as a design medium for both short- and long-distance networks that can sustain large amounts of capacity. The author described how to plan an optical network using wireless fibre to residential buildings. Future research into additional optical network parameters and the use of other units for measurement are both beneficial. S. Mary Praveena et al [4] The Robotic Platform was described in this paper as a tool for setting up cable systems underground. In order to inspect underground power distribution cable networks, the author explained that robotic sensors had been designed. Signal processing based on sensor data, data fusion, and signal collection may be included in the future. Swapnil Gaikwad et al [5] This research presented a microcontroller-based model for problem location in subterranean power cables. This author pinpoints the precise position of the short circuit issue. T.Nandhini et al [6] This paper introduced an Aurdino-based approach for locating underground cable faults. Using an Arduino board, the author calculated the underground cable fault's kilometers-from-base station distance. This works well and drastically cuts down on time. This makes it possible to locate an open circuit fault. The server unit can identify where the trouble is.

These studies demonstrate the effectiveness and potential of using IoT and Arduino in underground cable fault detection. By leveraging the power of these technologies, it is possible to build low-cost and efficient systems that can detect and locate cable faults.

III. BLOCK DIAGRAM

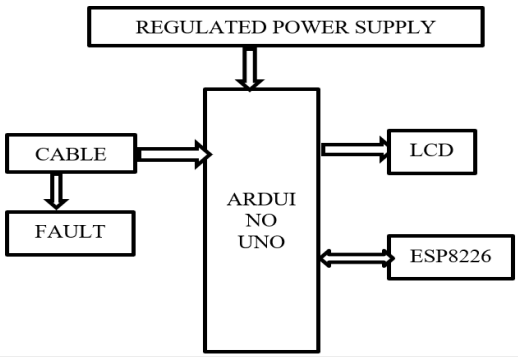

Fig. 1. Model Architecture

A. ARDUINO UNO

The Arduino Uno is an open-source microcontroller board based on the ATmega328P. It is a well-known development board that is used by both novices and experts to construct and prototype electrical products. The board features a number of input and output pins, including digital and analogue pins, that may be used to connect to sensors, actuators, and other electrical components. The board also has a USB connector, allowing it to be programmed and powered by a computer. Arduino Uno is used for a wide range of projects, including robotics, home automation, and IoT applications. It is often used by hobbyists, students, and professionals to prototype and develop electronic devices and systems. Arduino has a large community of users and developers who share their projects and collaborate on open-source libraries, making it a versatile and accessible tool for electronic prototyping and experimentation.

IV. IoT BASED FAULT DETECTION METHOD

IoT works by using various communication technologies, such as Wi-Fi, Bluetooth, cellular, and satellite networks, to connect the devices to the internet. This allows the devices to send and receive data, which can be analyzed and used to make decisions or trigger actions.IoT devices can be remotely controlled and monitored through web or mobile applications, allowing users to access and manage them from anywhere with an internet connection. They can also be integrated with other systems, such as cloud services, data analytics platforms. Due to subsurface tensions, wear and tear, rats, and other factors, underground wires are vulnerable to a number of blights. Finding the fault's causes is also delicate. To inspect and fix the failure, the entire line must be dug up. The area merely has to be dug up because the renovators already know which component is broken. This saves time, plutocrat, and trouble while also allowing for simple underground string conservation. This saves time, plutocrat, and trouble while also allowing for easy string conservation in the resistance. Using the future string-wide divisor network, the machine detects crimes.

A. MOBILE TELNET

Telnet is a network protocol used to virtually access a computer and to provide a two-way, collaborative and text-based communication channel between two machines.It follows a user command Transmission Control Protocol/Internet Protocol (TCP/IP) networking protocol for creating remote sessions.On a server, Telnet can be used for a number of tasks, such as file editing, running different programmes, and checking email.some servers allow remote connections via Telnet so users can access hese functions are still functional in older systems that require access to certain data or are there for nostalgic enjoyment.Telnet allows users to connect to any programme, including web servers and ports, that uses text-based, unencrypted protocols. The telnet connection will ping the port to determine whether it is open or not when users open a command prompt on the remote machine, type the word telnet, and the name or IP address of the remote machine.

Network Control Programme (NCP) protocols were initially used by Telnet. Later, it was referred known as TONP, or Teletype Over Network Protocol. Although it has been used indiscriminately for some time, it was formally formed on March 5, 1973, in papers that were published.

Early versions of Telnet allowed remote computers to connect with simple text by using American Standard Code for Information Interchange (ASCII) sent over an 8-bit channel.Numerous Telnet extensions have been developed throughout time. Telnet has been a resource for programmers for many years. For the Advanced Research Projects Agency Network (ARPANET), the forerunner to the current internet, the first Telnet version was developed in the 1960s. It was one of the first devices made to remotely connect computers over vast distances.

V. WORKING OF UNDERGROUND CABLE FAULT DETECTION

The circuit needs 12V of power in order to locate the fault. The circuit will work and was built on the premise that there will be a red phase cable. In general, a conductor's resistance varies depending on whether it has a flaw or not. Push buttons, or switches, were employed to cause the faults while resistors served as the cable, keeping this in mind as well as the properties of a cable. The Resistance Rule principle is used to calculate the distance when a fault (induced by the switches) happens because the failure in the conductor alters its resistivity. When a fault (caused by the switches) occurs, the flow of electricity through the cable changes.Thus, a phase is represented by three resistors, each of which has a 220 ohm resistance equal to a cable length of two kilometres, for a total length of six kilometres. When a problem occurs, the switch at a different place divides the voltage supplied to the cable and then transforms it using the voltage divider concept to the Arduino. The code for detecting this distinct voltage is written using the Arduino IDE, and the voltage value is detected as an analogue signal by the built-in ADC in Arduino. And the 16*2 LCD display module displays the digitally converted analogue value that was converted by the ADC, which is then used. The display shows NF, which stands for No Fault, along with the phase name when there are no conductor faults, and the phase name and the distance gone in miles when there are faults. Following that, the information is shown on the LCD whenever a fault occurs. The rule of Voltage Divider states that "The voltage is divided between two resistors that are connected non parallel is direct proportion to their resistance."

Fig. 3. Connecting to IP address

VI. RESULTS AND DISCUSSIONS

Underground cable fault detection is developed using Arduino Uno , ESP8266 , LCD, FaultSwitch, Battery, Adaptor are connected. The implementation of an IoT based underground cable fault detection system offers numerous benefits. Firstly, it allows for real-time monitoring and detection of faults in underground cables, which can help prevent power outages and reduce downtime. This system can accurately locate the fault and send the information to the control room, where operators can take appropriate action to rectify the problem.

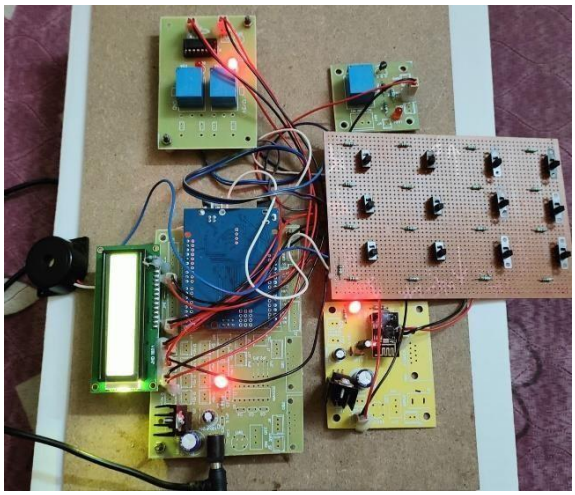

Fig. 2. Hardware connection

The adaptor is connected to the Arduino board in which the code is already dumped. The LCD displays "Welcome to underground cable fault detection" as shown in the figure below. In addition, an IoT based system can significantly reduce the time taken to identify and repair cable faults. This is because the system provides detailed information on the location and type of fault, enabling technicians to quickly identify the problem and take necessary action. This can help reduce repair costs, as well as minimize the impact of outages on customers.

Fig. 4. LCD display

When a defect occurs, the phase name and the kilometres (km) of the fault are displayed. After then, the information is presented on an LCD as soon as a fault occurs.

Fig. 5. Exact Detection of Fault

When there are no faults in any conductors, NF, which stands for No Fault, is displayed along with the appropriate phase name.

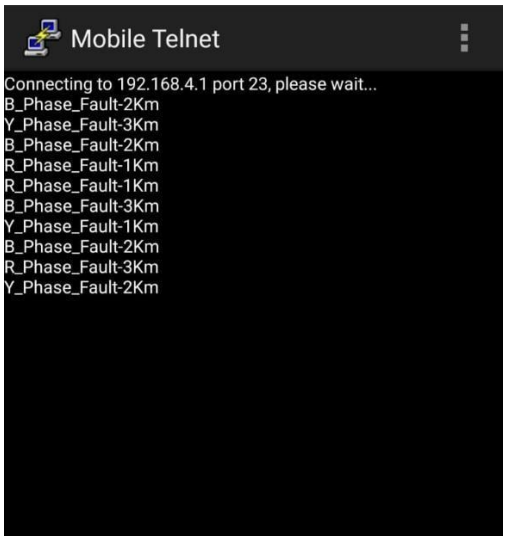

Fig. 6. Mobile telnet showing fault distance

VII. CONCLUSION

In conclusion, the use of Arduino for detecting underground cable failures presents a promising and cost-effective solution to enhance the dependability and safety of electricity distribution networks. Arduino, with its versatility and affordability, enables the creation of efficient systems that can detect and locate cable faults, preventing power outages, equipment damage, and safety issues. With the potential to process large amounts of data and provide real-time feedback, Arduino-based cable failure detection systems offer a reliable and accurate way to monitor the status of underground cables, which is critical for maintaining the stability and continuity of power supply in modern societies. By implementing such systems, electricity providers can ensure uninterrupted service to customers and reduce repair and maintenance costs, thus improving their bottom line. Overall, the use of Arduino for underground cable failure detection is a promising technology that could help enhance the reliability and safety of electricity distribution networks while reducing costs and increasing efficiency

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