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STRENGTHENING INFRASTRUCTURE: UNDERGROUND CABLE FAULT DETECTION USING IOT TECHNOLOGY

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ABSTRACT: An overhead or subterranean transmission line transports electricity generated in a power system to a customer's home or business. While the underground system has several advantages over the overhead system, it also has a significant disadvantage: it cannot pinpoint the specific position of a defect. We devised a novel solution to this problem, which we refer it as Underground Cable Fault site using IOT. Using this approach, we can exactly locate the fault site in kilometers, beginning from the base point.
Keywords- Underground Cable, IOT Module, Arduino Uno, Fault detection, LCD, LED, Buzzer.

1. INTRODUCTION

Every day, more people require energy. We are developing a variety of solutions to fulfill demand, and it is critical that we always have electricity at the customer's location. Natural calamities, such as earthquakes and tsunamis, are more likely to cause difficulties with overhead transmission networks than underground transmission systems. Additionally, this approach is harmful to living creatures. These kind of difficulties are uncommon in the underground system, thus they only cause a few issues. The key challenge is identifying the weaknesses. Transmission lines are easily identified with an overhead configuration since they are visible to people. Underground cables, on the other hand, prevent this because the entire connection is buried. As a result, it is difficult to accurately determine the location of the fault from the base station. Previously, to discover the problem, the entire cable from the base station to the problem site had to be inspected. However, this technique was time-consuming and expensive. To address this issue, we developed a novel concept called Underground Cable Fault Finding Using the Internet of Things (IoT). This method employs Ohm's law to provide an exact measurement of the fault's distance in kilometers. The primary takeaway is that resistance is exactly proportional to length. We were able to program the Arduino Uno with just one line of code thanks to this link. This project utilizes an Arduino Uno microcontroller, an Internet of Things (IoT) module, and various components such as an LCD screen, LED lights, and a buzzer as signs.

2. EXISTING FAULT DETECTION METHODS

Underground cables are used in electrical power networks to transport electricity from generator stations to distribution terminals, where it is then distributed to end customers. Underground wires can suffer a variety of problems as they age and develop defects. A lot of research has already been conducted on how to tackle these cable issues. We come up with a solution to these problems here. Previously, there were numerous methods for identifying problems. People utilize these methods to locate broken cables that are buried beneath. They're

- Murray Loop method
- Sectionalizing method
- Thumping method

Murray Loop Method:

The primary goal of this procedure is to identify faults in the earth wire. The Wheatstone Bridge is

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the most significant component of this plan. A Wheatstone bridge can be put up to precisely locate a problem in an earth cable. To identify difficulties, the Murray loop method is employed. This is a very simple method to do things. This technique is used to identify short circuits in buried lines. The loop test is commonly used to detect faults in the earth line. This legal disagreement is founded on the Wheatstone Bridge Law. A Wheatstone bridge is used in this experiment to precisely locate a fault in an earth wire. The initial step in this procedure is to connect a sound line with the same length as the broken wire. We need to develop a technique to link the ends of both broken and working wires that do not pass via the typical circuit. Sound cables are sometimes known as "wrong cables." At the present, we're attaching a galvanometer to the starting sites of both the operational and inoperative lines. To ensure that both resistors are adjustable, we connect two of them in parallel to both the working and non-functioning wires. Now the loop as a whole will form a Wheatstone bridge. Following that, one battery is connected to ground. We alter the values of both resistors until the galvanometer reads "null". This restores the bridge to equilibrium. By studying resistances, we will be able to identify and investigate weak points. We need to know what both resistances are.

Sectionalizing Method:

This procedure may reduce the reliability of the cable because it must be cut and joined immediately. To identify the problem, the wire must be chopped into smaller pieces using this procedure. For example, a 400-foot wire is cut into 200-foot portions, and measurements are taken with an Ohmmeter or a high voltage insulation resistance (IR) tester in both directions. If the IR tester returns a low value, it indicates that the cable is broken. This procedure must be performed repeatedly until the specific location of the problem is identified.

Thumping:

This problem-solving strategy relies heavily on sound. When a wire that isn't working properly is exposed to high voltage, intense electric currents create an arc. This curve creates a loud enough sound to be heard. This strategy is simpler to understand than sectionalization. However, pounding requires a powerful electrical current with a voltage of up to 25 KV to generate a subterranean noise. When subjected to intense currents, the wire's temperature rises. The excessive temperature will damage the cables' coating.

3. IOT BASED FAULT DETECTION METHOD

The "Internet of Things" refers to a network of interconnected gadgets that may wirelessly transmit and store data over the internet. A cellular network is required for the Internet of Things to function. The Internet of Things (IoT) is critical for detecting and predicting problems with real-world devices since it allows for device testing without disrupting the manufacturing process. Mice, for example, have caused damage to underground wiring. They could be defective in different ways. It is difficult to identify the source of errors. The entire pipeline must be removed in order to determine the source of the problem and repair it. As a result, we offer an Underground Cable Fault Detector that uses the Internet of Things to pinpoint the problem and simplify the repair procedure. To determine the source of the problem, the personnel only need to look into that one spot again, as they already know which part is broken. This reduces the amount of time, money, and effort required to maintain underground cables and simplifies the procedure. This requires far less time, money, and effort, making it easier to maintain wires underground. The Arduino board, as the primary working unit, receives and processes data from sensors. It is a key component of the Internet of Things. Ohm's law is applied in this example to allow allowed parties to detect and confirm problems from a distance via the internet. The tool will identify faults using the new cable-wide divisor network. Depending on how the

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resistance network is configured, a specific voltage is produced when two lines break and split. This energy is captured by the microcontroller, which then modifies its state. The consumer is provided the distance that this voltage corresponds to, and the microcontroller collects fault line data, which is then shown on an LCD screen before being transferred to and accessed on the internet.

Block diagram:

The block diagram for this system depicts a variety of components, including the Arduino Uno, LCD, buzzer, IOT, switch, LED indicator, power supply, and more. The key component of the system is the Arduino Uno, which does all of the operations that the user requests. Programming an Arduino Uno requires a simpler piece of software. To start the kit, turn on the power source. If there are no problems, no signs will be displayed via the buzzer, LED, LCD, or any other means. When something goes awry, the tools listed above provide us with hints. Users can also get information on their phones by using an Internet of Things (IoT) device. The first warning alerts the user to a voltage problem in a variety of methods, including sound, light, a digital display, and information sent to their phone. This allows them to change the source and keep the system operational while it is down. The second signal alerts the user to a cable defect and assists them in determining the distance between the problem and the base station. This information activates a light, a buzzer, an LCD screen, and the user's phone. The circuit schematic below depicts an Internet of Things (IoT)-based device for detecting faults with underground wires.

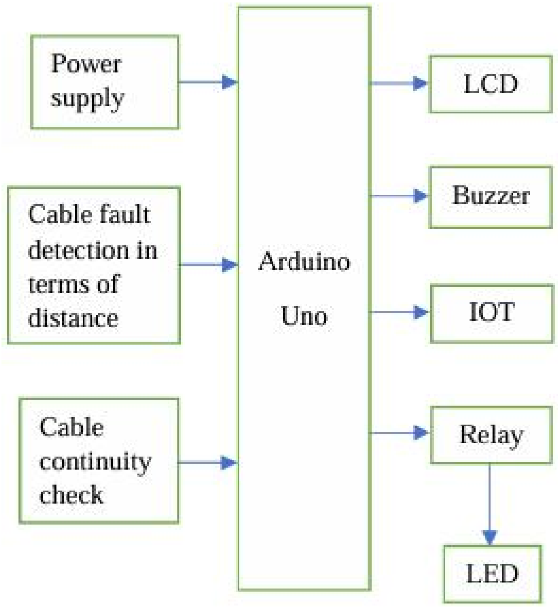

Fig 3.1: Block diagram of Underground Cable fault detection using IOT

Circuit Diagram:

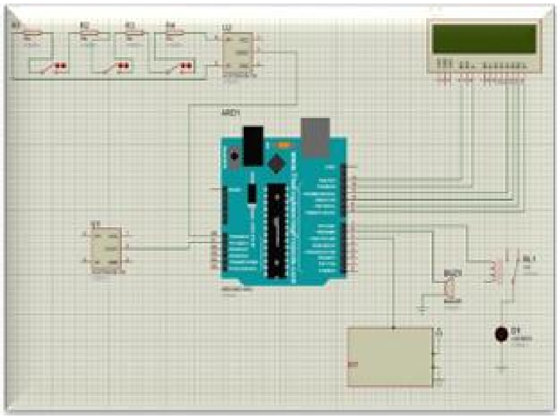

Fig 3.2: Circuit diagram of Underground Cable fault detection using IOT

The image above depicts a circuit diagram for leveraging the Internet of Things (IoT) to detect underground cable faults. The Arduino Uno, as the system's "brain" or main working unit, is the circuit's most significant component. The diagram depicts how the buried wire serves as a barrier that must be overcome.

The kit can be charged either a barrel jack (alternating current) or a USB cable (direct current). An alert for a cable failure is delivered to

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the Arduino Uno. As indicated in the image, the Arduino output signal is then routed across the Internet of Things to devices such as LCDs, LEDs, buzzers, and cell phones.

Major Components:

Components	Type	Ratings in DC
Arduino	Uno R3	5V
IOT Module	ESP8266	5V
Power Supply	DC	5V
LCD	16x2 Display	5V
Buzzer	Electromagnetic	up to12V
LED	White LED 8mm	3.4V
Relay	Single-Channel	5V
Sensor	Voltage Sensor	up to 25V
Switches	SPDT	up to 240V
Wire Jumpers	Female/Male	12V

Arduino IDE Software:

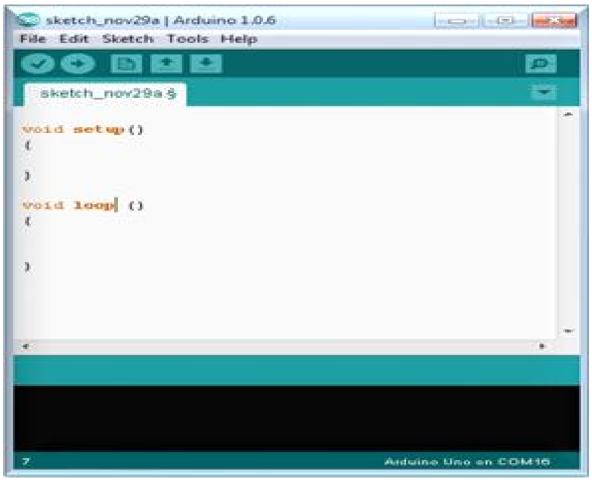

Fig 3.3: Arduino IDE

We utilize the Arduino software, also known as the Arduino IDE (Integrated Development Environment), to create code for the Arduino board that functions exactly as we want it. This program includes a text editor for writing code, a message box, a text console, a toolbar with commonly used action buttons, and additional options. A USB cable is used to connect to the Arduino, allowing applications to be uploaded and hardware to be interacted with. C++, an extension of the C computer language, is the primary programming language used to create this software. The diagram below explains how the Arduino program works.

4. RESULTS

The Underground Cable Fault Detection using IOT Kit was created utilizing the circuit design (Fig. 2) discussed in the "Proposed system" chapter. The kit you want can be found below.

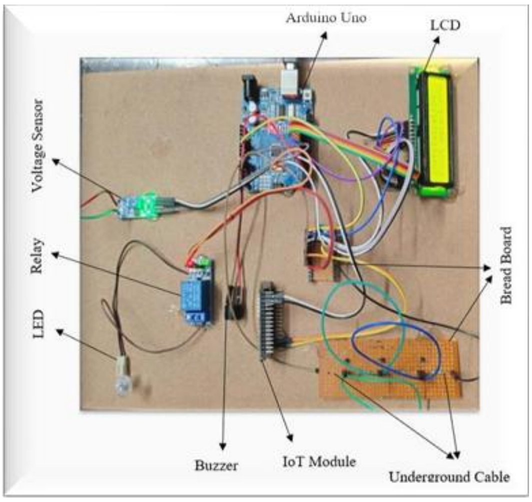

Fig 4.1: Underground Cable fault detection using IOT

Underground cables are less likely to be disrupted than overhead electricity lines. When an underground cable fault occurs, it causes two types of impacts. Under normal conditions, the screen appears at first.

Fig 4.2: LCD display without any fault.

At first, the LCD screen indicates that there is a power outage and transmits this information to our phone. To keep the system running, it instructs you to replace the broken wire with a working one.

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Fig 4.3: LCD shows Voltage fault.

The second indicator is an LCD panel that tells exactly where the problem is in kilometers from the base station. In other words, the broken wire should be repaired right away.

Fig 4.4: LCD shows Line fault at 1 km.

All of the information displayed on the LCD panel above is delivered to the user's phone. The person can obtain the information using the Blynk app. The primary purpose of the Blynk app is to control and manage a variety of electronic equipment such as air conditioners, washing machines, fans, and tube lights. It is also used to ensure that research or student project results are genuine. The Blynk app icon and mobile site are seen below.

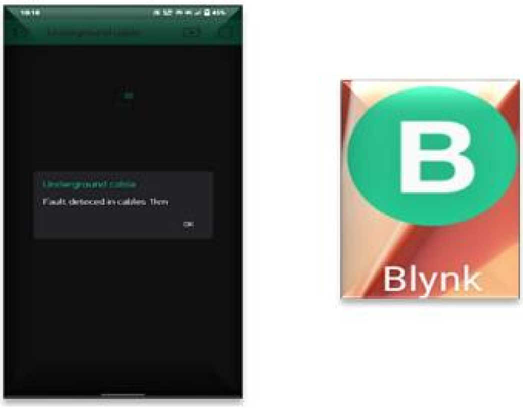

Fig 4.5: Figure shows Fault indication on Mobile Screen and Blynk app Icon

5. CONCLUSION

One issue with Underground Cable transmission method is that the base unit cannot always determine the exact location of a breakdown. Using this method, we can correctly determine the distance between the fault and the base station in kilometers, thereby resolving the issue. It makes it easy for specialists to correct errors rapidly.

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