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Underground Cable Fault Detection using Arduino

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ABSTRACT:Underground cables are prone to a variety of defects as a result of the varied environmental conditions they are exposed to on a regular basis. It's tough to find the sources of these faults since the entire line must be dug up to fix the part where the fault occurred. This project presents ARDUINO-based cable fault detection, which determines the fault location and so makes repair work more efficient. This saves a lot of time, money, and effort, as well as allowing for a speedier restoration of the underground cables. The project makes use of ARDUINO technology, which allows the substation to remotely monitor and check for problems.

KEYWORDS: Arduino, Underground Cable Faults.

I. INTRODUCTION

The objective of this research is to identify the kind of fault and determine the distance in kilometers between an underground cable fault and a base station. We utilize overhead wires in most situations because they allow us to readily locate defects, however we cannot use overhead lines in urban cities. As a result, we've been moving to underground cables in recent years, but problems in underground cables faults are difficult to detect. An Arduino microcontroller, a relay, an LED, and an LCD are used in this project. This idea saves time and money by drastically reducing the amount of time necessary. The circuit is designed in such a way that it is simple to operate and execute in realtime.

II. RELATED WORK

To identify problems in underground cables, programmers were uploaded to an Arduino NANO kit. When a failure arises in underground cables, users may use the Arduino controller kit to locate the problem. The defects and the distance in kilometer's are shown on LCDs. Manually generated flaws are used in this project. Each cable has a varied resistance, which is determined by the cable's composition. The resistance is proportional to the length of the cable. Resistance has a significant impact on the outcome in this situation. If the resistance differs in any way, that point is referred to be a FAULT. We're figuring out where the flaws are.

TYPES OF FAULTS

There are different types of faults. The faults we are dealing with are

- Short Circuit Fault
- Open Circuit Fault
- Earth Fault

Short Circuit Fault

When there is an insulation failure between phase conductor(s) and earth, or both, a short circuit fault develops. A short circuit pathway is formed as a result of insulation failure.

Open Circuit Fault

When a circuit is disrupted by a failure, an opencircuit fault develops. An open circuit fault occurs when the circuit is not closed.

Earth Fault

An earth fault occurs when an electrified conductor makes an unintentional contact with the earth or equipment frame. The fault current's return path is through the grounding system, as well as any persons or equipment that forms a part of it.

III. PROPOSED SYSTEM

The underground fault detection system is responsible for pinpointing the exact location of the problem from the base station. Cables have a certain amount of resistance. Such resistance is the core of this project. The resistance of a cable varies depending on its length. As the length of the cable gets longer, the resistance value raises as well. Any variation in the resistance value is referred to as a flaw spot, which may be discovered using an Arduino dumped with the required software. The display unit displays the value of that fault point, which denotes the standard of distance

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(kilometers) from the base station.

IV. BLOCK DIAGRAM

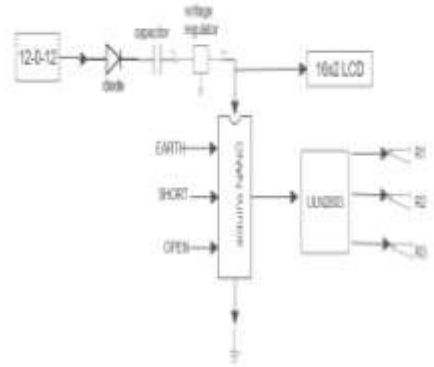


Figure 1 Block Diagram

BLOCK DIAGRAM DESCRIPTION:

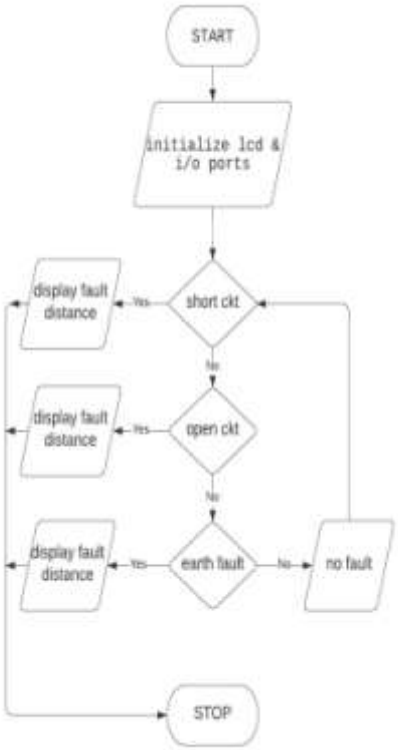
The software was built such that if there is a defect in the cable, it will instantly open the relay terminal and disconnect just the faulty line. The remainder of the lines function normally. The embedded system Arduino is a more sophisticated form of the embedded system. There are many other versions of Arduino, however we choose Arduino NANO. It quickly adapts to various serial-port devices. A relay is an electrical device that serves as a switch. If a fault develops in the line, the relay will disconnect the line. The relay's connection switches from normally closed to normally open conduct. When a cable fault occurs, the display device shows the precise problem and its position. The LED is also utilized as a signaling device **ARDUINO SOFTWARE**

The Arduino IDE software aids in interfacing the software program with the Arduino board for the effective functioning of the design. The programs typed in the software are called sketches and are saved with the extension .ino. The IDE tool helps in working with the libraries required for the design only. In this project, we mainly use the I2C library (LiquidCrystal_I2C). The software helps in debugging the code. The code here is written in embedded C language. The programs required are open source.

FLOWCHART

The below flow chart has the following step:

1. Initialize the LCD and input-output ports.
2. Check for the faults in the lines.
3. If the short circuit fault occurs, the fault and the distance will be displayed. Else it checks for the next fault.
4. If the earth fault occurs the fault and the distance will be displayed. Else it checks for the next fault. **5.** If the open circuit fault occurs the fault and the distance will be displayed.
6. Else no fault is displayed and the loop continues.



V. HARDWARE UNITS

A general-purpose chassis mounting mains transformer, the 12-0-12 5Amp Center-Tapped Step-down Transformer. The transformer's primary winding is 230V, and the secondary winding is center-tapped. The transformer works as a step-down transformer, converting 230V AC to 12V AC. The transformer produces 12V, 12V, and 0V outputs.

Figure 2 step-down transformer

LCD DISPLAY

A Liquid Crystal Display (LCD) is an Alphabetic Display, which means it can display Alphabets, Numbers, and Special Symbols. Unlike

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a sevensegment display, which can only display numbers and some of the alphabets, LCD is a user-friendly display device that can be used to display a variety of messages. It reduces the amount of connections between the LCD and the Arduino by using the I2C protocol. The only drawback of LCD over sevensegment displays is that seven-segment displays are more durable and can be seen from a greater distance than LCD. We utilized 16 x 2 alphanumeric displays in this demonstration.

Figure 3 LCD

RELAY

Relays are electromechanical or electronic switches that open and close circuits. By opening and closing contacts, relays controlan electrical circuit. When a relay contact is Normally Closed (NC), the contact is closed even if the relay is not turned on. Protective relays can prevent equipment damage including overcurrent, undercurrent, overloads and reverse currents by using its switching capabilities. Relays are widely used to switch starting coils, heating elements, pilot lights and audible alarms. In this particular project, relays are used as an indicator accompanied by an LED. When a problem is identified, the relays are turned off according to the program's instructions.

Figure 4 relay

MICROCONTROLLER ULN 2803

The ULN2803A is a Darlington transistor array with a high voltage and current. Eight NPN Darlington pairs with high-voltage outputs and common-cathode clamp diodes for switching inductive loads make up the device. The collector-emitter voltage is approximately 50 V, while the input voltage is around 30 V. More current is desired for driving a motor with the help of a relay, so a ULN2803 is used for increasing the current as per the requirement of the relay.

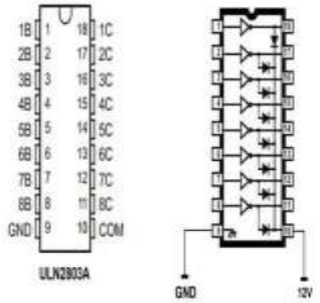

Figure 5 ULN 2803

DIODE 1N4007

The 1N4007 is a rectifier diode that is used to convert alternating current to direct current in circuits. 1N-4007 has a variety of real-world applications, including freewheeling diodes, general-purpose rectification of power supplies, inverters, and converters, among others.

Figure 6 Diode 1N4007

VOLTAGE REGULATOR 7805

The LM7805 is a voltage regulator that has an output voltage of +5 volts. Some regulators in the market are a three-pin IC; the input pin accepts the incoming DC voltage, the ground pin for establishing the ground for the regulator, and in the output pin, it supplies positive 5V. Voltage regulator generates a fixed output voltage irrespective of the input voltage and load condition. It compares the output voltage with a reference voltage and adjusts to maintain a constant output voltage It compares the output voltage to a reference value and makes adjustments to keep the output voltage consistent.

Figure 7 Voltage regulator 7805

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VI. RESULT AND DISCUSSION

For essential portions and, in some circumstances, the whole length of overhead high voltage power lines, underground cables provide a cost-effective and acceptable alternative. The environmental effect of underground cables can be reduced by using appropriate technologies in inconvenient locations. With the implementation of this project cable fault and the distance can be found out remotely a seen in the figure below.

Figure 8 Cable faults

VII. CONCLUSION

Using an Arduino microcontroller, this project aims to identify the precise position of a cable failure in subterranean cables from a substation in kilometers. The Arduino microcontroller relies on wire resistance to function. Relay aids in the separation of the defective and good lines.

VIII. FUTURESCOPE

The connection to the web page is established via an Ethernet shield. We can make it wireless by using a Wi-Fi module instead of an Ethernet switch. We can create a better user interface with the aid of an SD card. In the future, effort will be concentrated to increase the maximum distance for fault detection to 3km or more, and a graphical display monitor to improve on its information of the underground cable fault could replace the LCD display

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