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Underground Cable Fault Detection Using Arduino

Prof. S.K. Pawar[1], Prof. A.S. Nigade[2], Riya Singh[3], S.Akshay Subramanian[4], Shivam Bhardwaj[5]

[1]*Professor, Department of Electronics Engineering, BVUCOEP, Maharashtra, India*
[2]*Professor, Department of Electronics Engineering, BVUCOEP, Maharashtra, India*
[3]*Student, Department of Electronics Engineering, BVUCOEP, Maharashtra, India*
[4]*Student, Department of Electronics Engineering, BVUCOEP, Maharashtra, India*
[5]*Student, Department of Electronics Engineering, BVUCOEP, Maharashtra, India*

Abstract – The main objective of the project is to find out the exact location of the fault in underground cable lines from the base station to that location in kilometers with the help of an Arduino microcontroller kit. In the civilized and developed areas, the electrical cables are installed underground instead of overhead cable lines. When so ever the fault happens in underground cable lines it is quite difficult to find out the exact location of the fault for the procedure of rehabilitating that particular cable line. The proposed system detects the exact and accurate location of the fault. This whole system uses an Arduino microcontroller kit and a power supply which is rectified. Here in this system, the current sensing circuit is built with a combination of resistors that are interfaced with the Arduino microcontroller kit to help the internal ADC device for giving digital data to the Arduino microcontroller representing the string length in kilometers. The fault in the system is introduced with the help of a set of switches. Relay switches are controlled by relay driver. A 16x2 LCD display is connected to an Arduino microcontroller to display the information about the fault. In case of short circuit the voltage across series resistors changes accordingly there will be a voltage drop, which is then fed to an ADC to made precise digital data to a programmed Arduino microcontroller kit, Arduino sense that voltage drop and then further displays the exact fault location from the base station in kilometers.

Key Words: Arduino Microcontroller, IoT, Cable Fault, LCD, Resistor, Resistance.

1.INTRODUCTION

The purpose behind this project is to find out the interval space of underground cable fault from the base station in kilometers by using the development board i.e, Arduino board. Usually, overhead lines are preferred as fault detection becomes quite easier. but in expeditious, developed and crowded places, overhead lines are not the better choice. So, we incipient the use of underground cables. In civilized area, underground cables are preferable over overhead lines. Nevertheless, Fault detection is not simple in underground string. This project copes with Arduino microcontroller, buzzer & 16x2 LCD. So, the proposal is effectively lessening the time and working efficiently. In civilized or developed areas, the underground line process is usually practiced. Majorly, these faults introduced as a result of its construction phase & several other causes. That moment, When we are unaware of its precise spot, it becomes rigorous to eject the cable out. There are three major types of faults in Underground cables: Open Circuit Faults, Short Circuit Fault & Earth Fault.

1.1 Types of Fault:

Open Circuit Faults*:*

The very common issue with underground cables is open circuit fault. It occurs when there is cut in the conductor material of the line. One of the easiest ways to find out if there is any open circuit fault in the cable using a fault locating device termed as megger. If you abbreviate the three conductors at the distant end of cable and then connect them all to the ground. Afterwards, you use megger to get and read the resistance between all conductors and the earth. If the resistance value is zero, then there is no fault. Nevertheless, if the megger shows that there is infinite resistance, the cable is faulty and need replacement.

Short Circuit Fault*:*

This is also the most common issue with underground cables. It occurs when two conductors of a multicore wire keep come in touch with one another. The megger can be used to detect this fault as well. Two conductors are connected to terminals of the megger. If the megger shows no reading between the conductors, there is a fault.

Earth Fault*:*

This is the third most common fault with underground lines. It occurs when the conductors come in touch with the ground. The current flowing in the conductors is grounded. The fault detector(megger) terminals are connected to the conductor and to the ground to detect this fault. If the megger reflects a zero reading, this means earth fault is present.

1.2 Types of wire:

There are different type of cables which are install underground:

- Low-tension (LT) cables - upto1000 V.
- High-tension (HT) cables -upto11,000 V
- Super-tension (ST) cables - from 22 kV to 33 kV
- Extra high-tension (EHT) cables - from 33 kV to 66 kV
- Extra super voltage cables - beyond 132 kV.

The cables must be installed 24 inches deep under the surface.

2. HARDWARE AND SOFTWARE REQUIREMENTS:

Hardware:

- Resistor:

A resistor a type of passive component. The use of resistor is to limit or to regulate the electric current flow within a circuit. In this project we have replaced the underground cable with resistor. Used to measure the change in resistance whenever there is a short circuit fault.

- Transformer:

Transformer is an electric device used to transmit electric energy. The transmitted electric energy is AC (alternating) current. The most important work of transformer is to covert a specific value to some other value. In our project we used voltage transformer. A voltage transformer is used in our project to convert the a.c. voltage to 12V a.c.

- Rectifier:

Rectifier is an electric device use to convert the A.C. into D.C. (direct current). In this project we have used a bridge rectifier because of its very good performance at stability. The rectifier takes the output of the transformer which is 12V a.c. and convert it into 12V d.c.

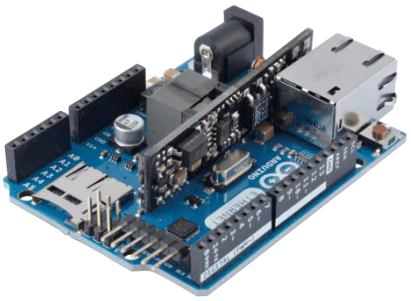
- Relay Driver:

Relay driver is a switch which is used to switch a high current ON and OFF. In the project it is used to disconnect the fault line with the health line in the circuit.

- Arduino:

Arduino is an open source hardware and software platform. It is a 14 pin device which have digital output pins and analog input pins. It uses microcontroller atmega328. It has a USB port to upload program. A reset button to restart program. It takes 5V power supply. The output of the Arduino is connected to the LCD. Fault is an analog phenomenon but Arduino reads digital input so it has a inbuilt A/D convertor to convert the analog input to digital for its convenience.

Arduino is used to detect the exact location from base station in kilometers using the microcontroller. The microcontroller action is dependent on the cable resistance.



- LCD:

Liquid Crystal Display is a flat display device. We have used 16*2 LCD display. A 16*2 converts a display 16 characters per line in 2 such lines. On the LCD we get the output in digital form. For example, if there is a fault at 2km in red line then the LCD will show R=2KM, B=NF (no fault) AND Y=NF.

Software:

- Arduino IDE:

Arduino IDE is open-source platform which make it convenient to write the code and upload it to the Arduino USB port. Arduino IDE is featured with rich library. It is fast and powerful. It supports the language C and C++ with special riles of code structuring.

- Wifi-module:

  The wifi module(ESP8266) is a system on chip module. The main function of this is to connect any microcontroller to the wifi network. It is widely used for IoT applications

3. WORKING:

The proposed system uses the Arduino Uno microcontroller which requires a DC of 5v.

To provide the required power supply we will be using a bridge transformer along with rectifier circuit to a stepped down voltage DC supply. In order to ensure constant power supply devoid of any fluctuations we will be using a voltage regulator.

Considering practicality and feasibility, we will be using a set of resistor to represent cables with each resistor in a series combination representing internal cable resistance of cable up to 1km.

To demonstrate the working of proposed system, introducing faults is necessary, this is accomplished by placing fault switches between each resistor in series connection. There will be a set of resistors in series connection each representing cables namely R, B and Y.

The combination of resistors and fault switches are interfaced to the microcontroller. When a fault is introduced in the circuit with the help of fault switches. The proposed system uses the concept of Ohm s law for finding fault distance, as we know that the resistance of a cable increases with length.

Whenever a fault is introduced between resistors, a voltage drop across the resistor is observed, this difference in voltage levels is observed by the Arduino microcontroller. The analog signal acquired from the circuit is first converted into digital signal by the in-built ADC, which is present in Arduino Uno, and then only it is fed to the microcontroller.

All the instructions and programs related to the calculation of fault distance and displaying of the results will be preloaded into the microcontroller with the help of Arduino IDE.

The relay drivers are interfaced with the microcontroller. The sole purpose of relay driver is to disconnect the faulty cable line from the rest of the connection. This is done after the relay driver receives a signal from the microcontroller.

Whenever the microcontroller observes a fault, the location of fault distance is displayed on the LCD and the corresponding LED representing the cable which has a fault is turned OFF and the cable is disconnected with the help of relay driver.

The proposed system will also be connected to Internet using ESP8266 Wi-Fi module. The wi-fi module is interfaced to the microcontroller. There are many online platforms in internet which is used in implementing IoT Projects.

With the help of Wi-fi module the Arduino microcontroller will be connected to Internet. Also the results will be displayed on a webpage which can be accessed by other devices. This also provides live monitoring of our proposed system.

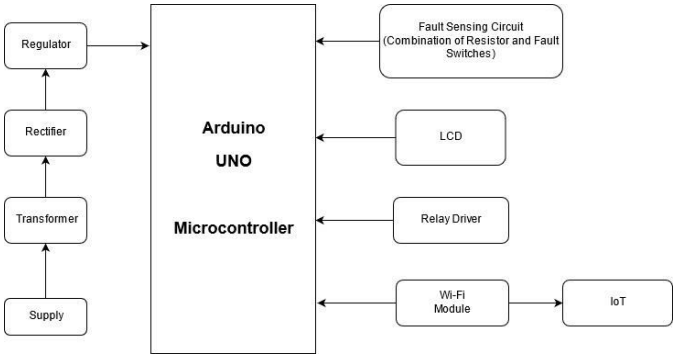


Fig: Block diagram of the system.

4. APPLICATION AND ADVANTAGES:

4.1. Application:

- Used in communication system. E.g.: Jio Fiber.
- Less fault occurs then overhead Cables.
- Applicable to all types of Cables.

4.2. Advantages:

- Applicable to all type of cables.
- Cost effective and Low maintenance.
- Help in reducing human effort.

5. CONCLUSIONS

The proposed system aims to determine the location of fault present in an underground cable system. Finding accurate fault distance with the help of Arduino improves makes the process of fault detection more efficient.

Also the proposed system working conditions will be made available on Internet for quick response with the help of an IoT platform and wifi module ESP8266. This project in future. can further be improved by detecting open circuit faults with the help of capacitors and using the capacitance to find the fault distance. This project intends to save time and also reduce manpower usually required to find fault in underground cable.

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