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Industrial Underground Power Cable Fault Identification Using Arduino Controller

Prabakaran K[1], Arjun Balage R[2], Joseph Kevin Singh P[3], Muthupattan M[4]

[1]*Assistant Professor, Department of Electronics and Instrumentation Engineering, Erode Sengunthar Engineering College, Tamilnadu, India*
[2,3,4] *UG student, Department of Electronics and Instrumentation Engineering, Erode Sengunthar Engineering College, Tamilnadu, India*

Abstract - *The paper is intended to detect the location of fault in underground cable lines from the base station to exact location in kilometers using an Arduino micro controller kit. In the urban areas, the power cable runs in undergrounds instead of overhead lines. Whenever the fault occurs in underground cable it is difficult to detect the exact location of the fault for process of repairing that particular cable. The proposed technology uses Arduino controller to identify the fault and it is indicated in LCD display in kilometers. Main advantages of this system is low cost, less complexity, long distance applications.*

Key Words: Power Cable, Fault detection, Controller, Lactation, Display.

1. INTRODUCTION

Transmission lines are needed to carry the electrical power. Generally we used to overhead lines. We can easily identify the faults but in rushed places or familiar cities we couldn't use overhead lines. So, we are moving to underground cables. Underground transmission lines have lower visibility and less affected by weather, therefore they are more popular in urban areas. Underground cables used largely in urban area instead of overhead lines. We can't easily identify the faults in the underground cables. This paper deals with microcontroller, buzzer and LCD. This proposes greatly reduces the time and operates effectively. Programs uploaded in Arduino UNO kit to detect faults from the underground cables. When a fault occurs in the underground cables, we can find out faults through Arduino controller kit. LCD display which displays the faults in Kilometres. In this paper we created faults manually. Cable has many types. Every cable has different resistance which depends upon the material used. The value of the resistance is depends upon the length of the cable. In here resistance is the leading role of the paper. If any deviations occur in the resistance, the value of the voltage will be changed that particular point is called fault. We can find out those faults. The faults in cable during the transmission of power are as follows.

1.1 Types of Faults

Faults have many types. Frequently occurs the faults are given below

- Short circuit fault
- Open loop fault
- Ground of cable fault

1.1.1 Short circuit fault

This fault in cable occurs when the insulation between the two cables or multi core cables gets damaged. In such case the current will not pass through the main core which is connected to the load but will flow through one cable to another.

1.1.2 Open loop fault

This fault occurs when the conductor pulled out of its joint. In such case the current will not flow through the cable.

1.1.3 Ground of cable fault

This fault occurs when the insulation of coil gets damaged. The current start flowing from cable core to the earth or sheath.

1.2 Existing Technology

In ground cable fault detection latest existing system is METRO TECH 9800XT model. The Model 9800XT is a series of state-of-the-art utility line locators precisely designed with many powerful features to provide you with optimum information about your locate situation.

1.2.1 Transmitter

Ground cable is connected to transmitter with the help of ground rod. Due to varying the frequency knob and power knob. There are 3 variant frequency is used in the transmitter.

- "AUTO" - Automatic frequency
- 82kHz – Radio frequency
- 9.8kHz – Audio frequency
- 982Hz – Low audio (9890XT only)

The amount of transmitter signal output for each power setting changes according to which frequency we are using.

1.2.2 Receiver

Receiver tracing a conductor, always be alert to surrounding conditions which could interfere with the

accuracy of your locate. Adjacent conductors pull the signal away from your target conductor and can mislead you in both position and depth of your conductor.

Model Receiving frequency
9860XT Active - 9.82 kHz, 82 kHz
Passive - 50/60Hz, 14-22 kHz
9890XT Active - 982Hz, 9.82 kHz, 82 kHz
Passive - 50/60Hz, 14-22 kHz

Receiver detected frequency until the fault location reaches. When receiver reaches fault location signal strength and current will be decrease and drops at target depth. So we would locate the exact location of fault area.

2. FAULT DETECTION USING CONTROLLER

The paper is intended to detect the location of fault in underground cable lines from the base station to exact location in kilometers using an Arduino micro controller kit. In the urban areas, the power cable runs in undergrounds instead of overhead lines. Whenever the fault occurs in underground cable it is difficult to detect the exact location of the fault for process of repairing that particular cable. The proposed system finds the exact location of the fault. This system uses an Arduino micro controller kit and a rectified power supply. Here the current sensing circuits made with a combination of resistors are interfaced to Arduino micro controller kit to help of the internal ADC device for providing digital data to the microcontroller representing the cable length in kilometers. The fault creation is made by the set of switches. The relays are controlled by the relay driver. A 16x2 LCD display connected to the microcontroller to display the information.

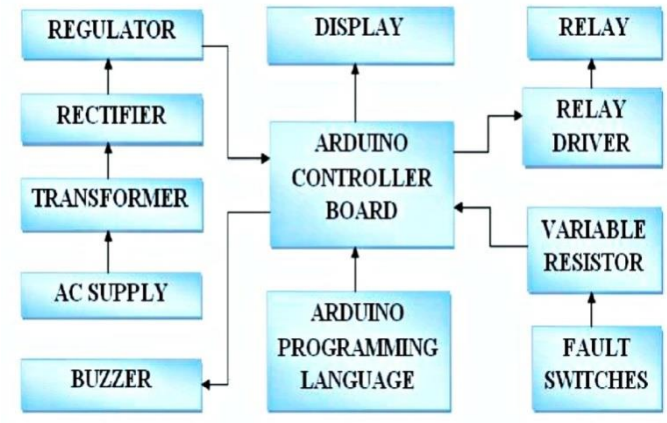

Fig -1: Block diagram of the Fault Location System.

In case of short circuit the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data to a programmed Arduino micro controller kit that further displays exact fault location from base station in kilometers. The paper future can be implemented by using capacitor in an AC circuit to measure the impedance which can even locate the open circuited cable. Whenever a fault occurs in a cable the buzzer produce the alarm to alert and to take an immediate action by field workers as shown in Figure 1.

2. WORKING OF CONTROLLER

This fault identification system deals with finding the exact location of fault from the base station. Cables have some resistance. We are mainly focusing the resistance of the cable. Resistance can vary with the length of the cable. This system is based on the ohm's law. If the length of the cable increases, the resistance also increases. If there is any deviation in the resistance, this point is called as fault point in the cable, thus the fault is identified by using the Arduino. The fault point is represented in kilometers from the base station, which is displayed in the LCD display interfaced with the Arduino. In our paper we can detect the fault in 3 phases. In each phase of the system large wire required 3km, 4km, 5km. so this can't fit in this system.so used for this its internal resistance of cable. Because, as the length of the copper wire increase the resistance in the cable also increases.so we connect 1kΩ resistance for each 1 km distance 1km indicate 1km distance .In this paper we connect 4 resistance of 1km in series so we cover 4km distance in each phase.

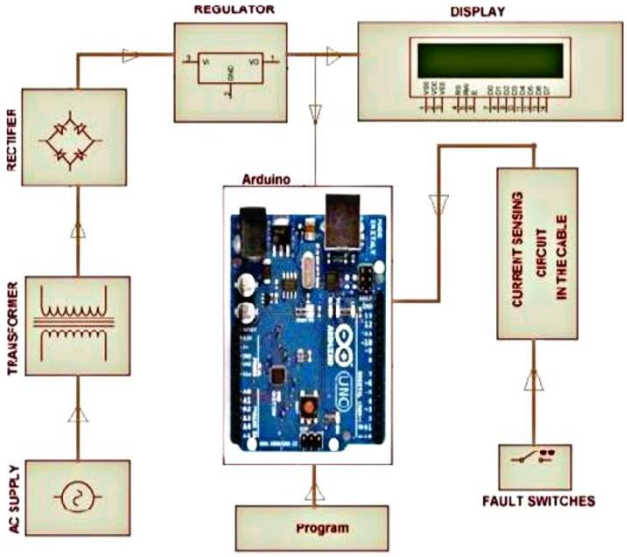

Fig -2: Connection diagram of Hardware

In this paper just connect switch to disconnect the wire in each km segment .with the three phage cable one reference cable are also present to compare with it .The Arduino board required the reference resistance of cable with the fault cable resistance .consider, a single cable in which 4 resistance are connected with 4 switches and when fault occur the system at 2 km distance. The 2 kΩ resistance are given to the Arduino .The Arduino compare it with reference resistance .The Arduino is program such that it contain the ohm lows V=IR as the resistance value decreases the voltage in the cable increases and it calculate the fault location. The Arduino has only 1input port. So for 3 phages three relay are connected which gives data to the Arduino one by one as shown in Figure 2.

3. SIMULATION OF FAULT LOCATION.

In this paper the simulation is done by using "PROTEUS 8.1 SP1 BUILD 17358 WITH ADVANCED SIMULATION" software. The below figure represents the simulation in PROTEUS software. The input used here is 5v dc source. As shown in Figure 3 a series of resistors are connected with the transmission power cable. In this fault location system we mainly deal with resistance as we are calculating only that parameter by measuring voltage and current of the system. Hence the simulation would be able to demonstrate the operation of the paper and by using switches we are able to show the distance of the occurrence of the fault.

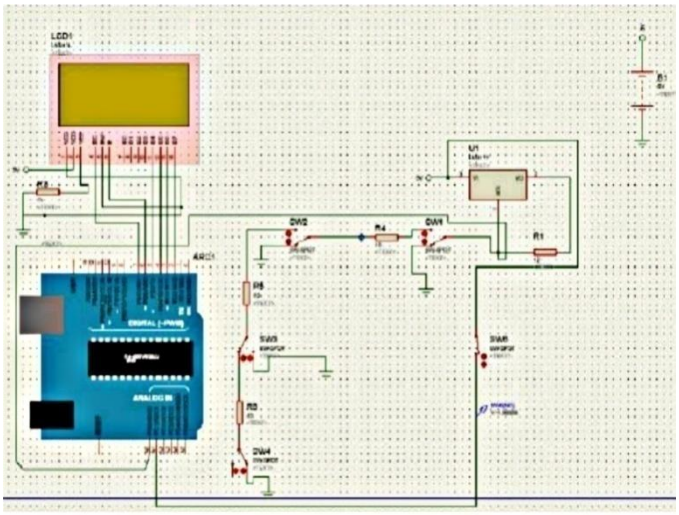

Fig -3: Connection Diagram in Proteus

This can be achieved as we already know that resistance is proportional to length. The simulation also uses liquid crystal display, spdt switches, LM317T voltage regulator for this paper. In proteus the operation of the components is similar to the operation of components in real life. Hence proteus was preferred for simulation.

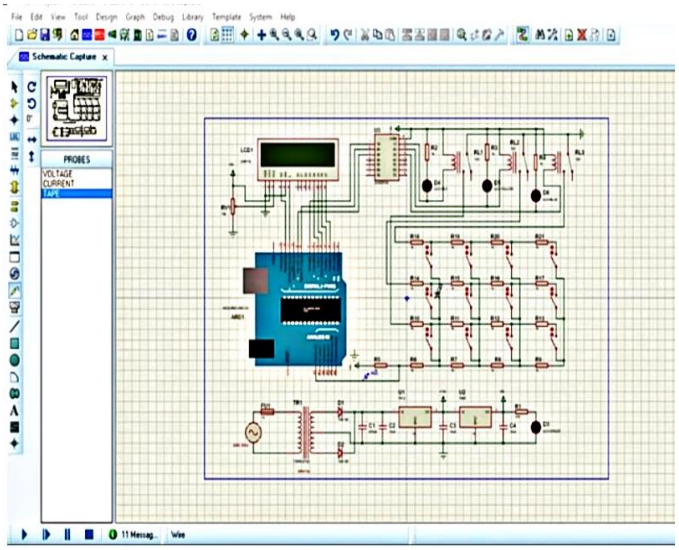

Fig -4: Simulation diagram in proteus

4. HARDWARE COMPONENTS OF FAULT LOCATION.

The following hardware components are used to design the hardware.

Table -1: List of Hardware Components

S.No.	List of hardware components
1	Transformer (230 – 12 V Ac)
2	Voltage Regulator (LM 7805)
3	Rectifier
4	Filter
5	Arduino (Atmega 328)
6	Liquid Crystal Display
7	1N4007
8	Resistor
9	Capacitor
10	Voltage Regulator (LM 317t)

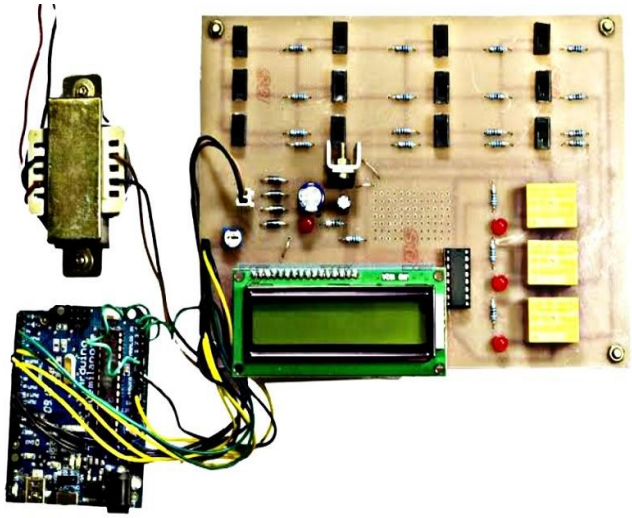

Fig -5: Working of Hardware Kit

4. RESULTS OF FAULT LOCATION.

Here, we can observe the results for different faults according to the change in the resistance.

Table -2: Results of fault location using controller

Switch Position	LCD Display	Line Resistance (switch is closed)	Fault location
No Load	NO FAULT	---	---
Switch 1Closed	Open Circuit Fault	1 ohm	1.02 Km
Switch 2 Closed	Short Circuit Fault	2 ohm	2.28 Km
Switch 6 Closed	Line to Line Fault	2.01ohm 2	0.52 Km

From the above results we can see that the proposed work is capable of working as demonstrated. It's a difficult task to identify the faults in underground transmission lines. By using Arduino controller we can find out exact fault location. Once faults occur in the cable, the display unit displays the exact fault location that displays which phase is affected in the cable.

4. CONCLUSION

Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the proposed work been successfully implemented. The main advantage of using this paper is, it is less costly and unlike distance relays it does not require any other extra equipment or communication with other devices.

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