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Simulation of Underground Cable Fault Detector Using Arduino

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Abstract: The project is designed to identify problem areas in the underground link line from the base station to correct areas within kilometers using the Arduino control unit. In urban zones, electrical links run underground rather than online. When there is an error in the underground link, it is difficult to distinguish the exact damage area for the link repair procedure. The proposed framework finds the exact fault area. This framework uses Arduino control units and power supply upgrades. Here a network of detectors made with a mixture of resistors is connected to an Arduino controller unit to help the internal ADC tool provide more information to the microcontroller that speaks to the link length in kilometers. Error making made with switch arrangement. Transfer is prevented by the driver from moving. 16x2 LCD design associated with microcontroller to display data. If the temporary voltage drop across the various resistors changes as required, which is then backed up to the ADC to make more accurate information to the modified Arduino controller unit which further indicates a careful defect area from the kilometer base station. The future of the task can be solved by using capacitors in the AC circuit to measure impedances that can even find open circuit cables. When there is an error in the link, the signal will alert the alarm and the farm worker can take immediate action against it.

Keywords: Arduino, fault detector, underground cable

1.0 INTRODUCTION

In today modern life, power lines are common things as it plays a big role as a transmission of the electrical energy throughout the world. But there is a problem, as it is difficult to locate immediately and the exact location of the fault that occurs underground. Underground cable is an alternative besides using overhead cables which has several advantages over overhead cables. In urban territory underground cables is the main practical installation than overhead cables. But just like overhead cables it is more difficult to locate the fault efficiently. So, this project proposes microcontroller, resistance, relay drivers and LCD to solve the problem. This will reduce the time and adequately the works to locate fault in the underground cable system.

The main objective for this project is to create an Underground fault identifier that manages to find the precise fault area. All conductors have resistance. And that resistance is the principal of this project. The resistance will increase when the length of the cable is longer. If there is a change in the value of the resistance, it can be concluded that there is fault and by using the Arduino technology it can be precisely located.

2.0 LITERATURE REVIEW

2.1 Techniques of Searching Fault Location

The faults happening within the cables can be rank into several primary classification which is short circuit. This happen when a current travel at an unintended path with low impedance, earth fault, unintended resistance and ground circuit has been interrupted. Certain advance technique is invulnerable for per capita sort of trip. Several strategies that works for the most part utilized in identifying fault area are portrayed as takes after ("Underground Cable Fault Distance Locator", 2015). [1]

- A-frame
- Thumper
- Time Domain Reflect meter (TDR).

2.2 Frame Method

In this circumstance, when the resistance is at fault, the method of thumper can be perform. This method could be the answer when the fault in the area occurs but there is a risk as it can harm the insulation of the cable when connected for a long period of time ("Cable Fault Monitoring and Indication: A Review", 2013). If there is no earth connection, A-Frame will lost its function to detect fault. So the answer is by using Time Domain Reflectometer (TDR).

Pulsed direct current (DC) are then fused within a damage cable and ground to find the ground fault. The pulse then streams along the rod and bounce back through soil at the damage area which is the ground that has been stake. The pulsed will then stream uninterrupted in ground which deliver a bit of voltage. Voltmeter is then used to measure value of the voltage of the line in the ground as shown in Figure 1. [2]

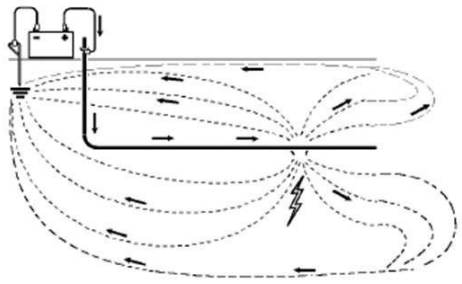

Figure 1: Example of the usage of Voltmeter

Analyzing the output of the measured voltage in the line, the method of A- Frame could be used to detect the precise location of the damage area but it is not efficient as the engineer need to trail along the line to where the ground fault occur ("The Application of Digital Relay in Fault Location Identification for Cable In Steel-pipe", n.d.). This method may confront an issue in case the return DC finds a few simpler ways to the transmitter rather than returning through the surface of earth. In some way that the ground is not solid, which gives high opposition and subsequently, less contemporary streams inside the ground. If that happens, the voltmeter comes up short and tends to be complex.

2.3 Thumper Method

This method is essentially to surge generator with a high electrical energy that is then to utilized the high electrical energy to the damage location of the line to produce a significance current coming about which then a boisterous clamor can be listen over the damage area. By using this strategy, an exceptionally immense current will pound, then a value of around 25 kV voltages occur to form clamor uproarious under the surface sufficient that can be listened from the surface. This method is just like the previous method, as this method also needs the engineer to trail along line and the engineer will need to detect or hear the sound of the clamor that occur. But the sound could be difficult to hear as there are several factors such as the condition of the surface, noise pollution and much more (Viroja, Chirag, Ridhesh, Nikhil & Dave, 2017).

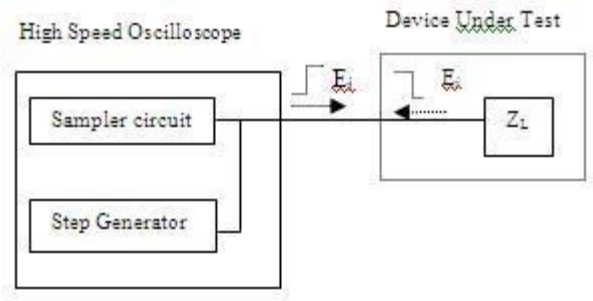

Figure 2

Within this method, it uses a bit of energy signal that will travel along the line in order for the culminate line to bounce back with a data by using a specific impedance. This data will be proportional with the impedance that occur because of the damaged line ("Research on Fault Location of Power Cable with Wavelet Analysis", 2011). A parcel of signal will bounce back to the starting point because of the variety of the impedance. The signal that has been bounce back will then affect the first signal. This mean that the damage line has an increase, but the will not be affected if there is no changes in impedance. This method will then show the data on the screen in time units for an engineer to decipher location of the damage that occur to the line. [2]

2.4 Using Arduino as Detector for Underground Cable Fault

The objective is to decide the separate of underground cable fault from the base station in kilometers. When the faults happen in an underground cable, to illuminate this issue is exceptionally time devouring, and costly. So, it will be known approximately the fault at base Station by utilizing the embedded controller and discover the distance in kilometres.[3][4][5]

The program transferred in the Arduino UNO kit is to identify damage from underground cables. When there is damage to the underground cable, the project can find out the damage through the Arduino system. The LCD display shows errors in Kilometers. Cables come in many types. Each cable has different durability depending on the fabric used. The resistance value depends on the length of the cable. Here competition is the driving force of the project. In the event of a deviation in the resistance, the voltage value will change until a certain point is called 'fault'. [6]

3.0 METHODOLOGY

3.1 Block Diagram

In Figure 3, the block diagram is shown where the component will be used to link up the procedure, method and so on. Block diagram consist of different forms and lines, to show the relationship between and dependence on the integral of a scheme, operation or methodology. This can also demonstrate how the process operates, its data inputs and data outputs at different platforms, and ways it is flowing through power, data and/or materials.

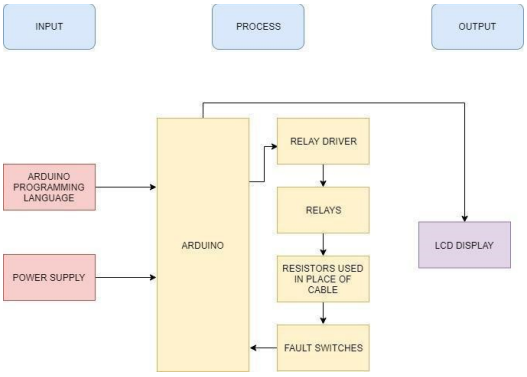

Figure 3

The first input is the program encoding in the Arduino programming language and the power supply to the Arduino. The Arduino will process the encoding. The relay is a switch, it opens and closes the circuit mechanically [7]. To open and close contacts on other circuits, relays are used. When damage is triggered on the cable, the relay terminal will immediately open and the fault channel will be disconnected automatically.

The other lines will operate as usual. The relay connector will switch from closed behavior to open behavior. After that the fault can be detected and disconnected. Resistors are used to represent the length of the cable in kilometre and the creation of an error will be made by one of the switches per kilometre to check the accuracy of the result. An LCD connected to a microcontroller will shows errors that occur at a certain distance from a particular phase.

3.2 Flow Chart

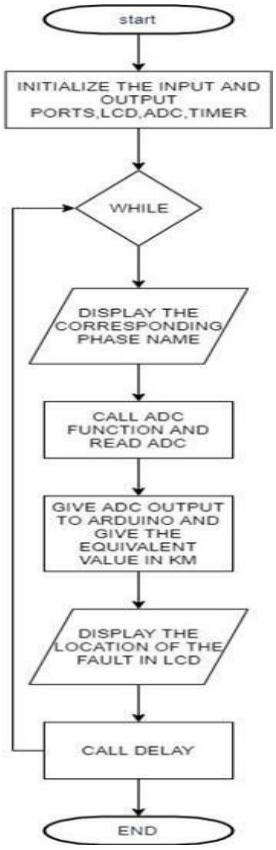

Figure 4

In each study, the system process must be more structured in a particular way. Based on Figure 4, flowchart of Underground Cable Detector Using Arduino was included to monitor the project's workflow.

In the figure above it shows the project sequence. By using the simple theory of OHMs law where the feeder through a series resistor is applied by a low DC voltage. In case if there is a short circuit the current will be dependent on the length of the fault of the cable. The drop of the series resistor voltage will react accordingly which are then cater to an ADC to produce an exact digital data which then the programmed microcontroller would show the same in kilometers. The switches that has been arranged at every possible distance will inspect the precision by using a setup of a set of resistors that will be entitled as the length in KMs.

4.0 RESULTS AND DISCUSSION

The finished project are shown in Figure 5 to Figure 8. The output and voltage of the ADC through a series resistor will indicate the value when the damage effect occurs. When the switch conditions are applied in the system, Table 1 is the record of the output and voltage of the ADC through a series resistor.

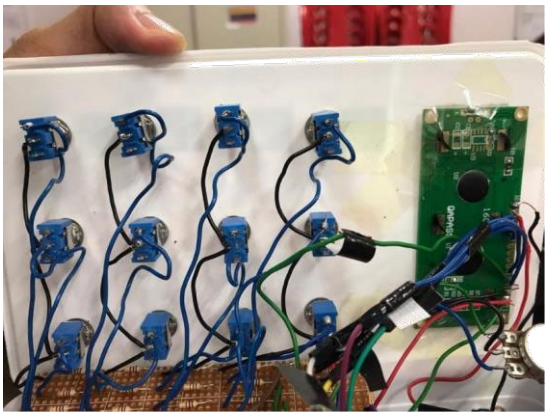

Figure 5: Resistor that has been constructed

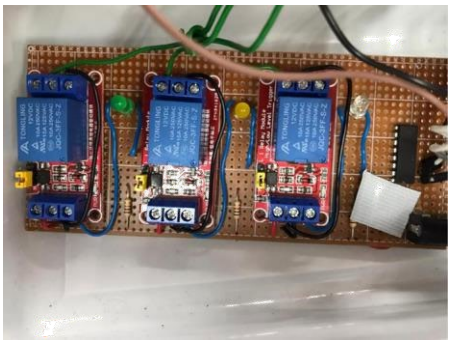

Figure 6: Relay and Relay Driver circuit that has been constructed

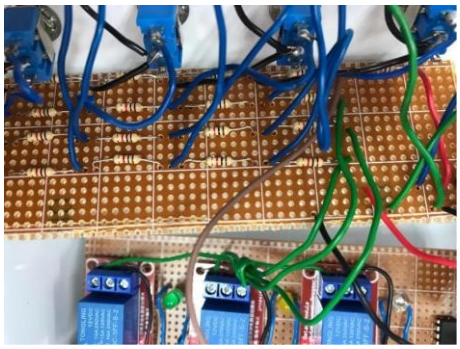

Figure 7: Switches and LCD that has been constructed

Figure 8: Project that has been fully constructed

Table 1: Results

No	Switch is connected	Voltage flow (V)	Display at LCD (KM)	ADC outcomes
1	Switch 1	3.3	2 KM of green cable	675.18
2	Switch 6	3.9	4 KM of yellow cable	797.94
3	Switch 11	4.2	6 KM of red cable	859.32
4	Switch 4, Switch 8 and Switch12	4.4	8 KM of green, yellow and red cable	900.24

As expected, the results shown correspond well to the location where fault occurs. It has to be said here that this is not a full test on an underground cable network which is more complicated. Although the resistance per kilometer of a cable should be uniform, there are factors that can

change its parameter such as the join between cables. The purpose of this project to show the principle whereby a fault can be located base on the impedance of the cable.

5.0 CONCLUSION

In conclusion, it is shown that this project which is the development of underground cable fault detector using Arduino will help to unravel many common issues confronted by worker that need to detect underground cable fault. Other than that, the aim of this project is to make it easier to detect underground cable fault location.

By doing this study, underground cable fault detector using Arduino has been built and tried. To recognize the issues leading to the project development, various publications has been examined before the development of the project. Numerous procedures are required to make the project into a reality. To refine the project, past research was also inspected on developed underground cable fault detector.

Other than that, block diagrams were built to supply the project workflows and forms. The flowchart was moreover organized in realistic representation to pick up a more prominent understanding of the project. Before the real circuit was built, the diagram was drawn up to simulate the circuit and to test. In order to guarantee that the project accomplished the required outcomes, the code was also coded and checked on. Besides, certain components were inspected to meet the study's targets and goals. Finally, the outcomes of the improvement of program and equipment were displayed.

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