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Cable Reproach Diagnosis System

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Abstract: Nowadays, underground cables are used rather than overhead lines in urban areas. Locating the faults in the cables under the ground is a tedious task and there's a prospect of damaging the insulation while digging the cable. The aim of this research paper is to ascertain the distance of underground 3 phase transmission line faults from the base station in kilometers. This prototype uses the lucid concept of Ohm's law. The current would alter depending upon the length of fault of the cable. The proposed system finds the precise location of the fault. It's modeled with a group of resistors representing cable in kilometers and fault creation is formed by a collection of switches at every known distance to cross-check the accuracy of the identical. The information is shipped to the user by employing a GSM and GPS module.

I.INTRODUCTION

The world is becoming digitized and so the project is proposed to find the location of the fault in a digital way such as digging, earthquake, construction work, rodents, etc.

Types of fault in a three-phase power cable can be classified as:

1. Open Circuit Fault: Open circuit faults occur when one or more phase conductor cables break. The current value in such a fault becomes zero and the load side is ostracized on the generation side. These types of faults occur due to conductor breakage, cracks or disjoints of the conductor completely.
2. Short Circuit fault: If the conductors of the different phases are connected to each other then such a fault becomes less of a short circuit fault. The short circuit fault is of two types: One fault is symmetrical and the other is asymmetrical fault. Asymmetrical faults occur due to short circuit of all three phases together while asymmetrical faults occur due to short circuit of any one or two phases together in three phases.
3. Earth fault: When a cable conductor meets the ground, it is called an earth fault.

To solve this problem, here we present a project named Cable Reproach Diagnosis System that finds the location of the fault in the cable underground. This project incorporates Arduino UNO R3, GPS, GSM, buzzer and LCD. This substantially reduces the time and works effectively. Until now, researchers have made several attempts to build and implement an electronic underground cable fault detector that will help in solving the problems as well as challenges that we come across while using the underground cables and detection of faults that occur within underground cables but unfortunately, there have been shortcomings in their solutions. All the above research has some limitations. Thus, we designed and implemented an Arduino based underground cable fault detector that's competent of running on dual power supply i.e.AC mains and a DC battery pack, and display results on an LCD module. This design also runs on computer software because it uses an Arduino UNO R3 that also needs source code.

II.LITERATURE SURVEY

A. Cable Thumping For Locating Underground Cable Faults

A cable thumper is essentially a portable high voltage surge generator. It injects a high voltage DC surge (of 25 KV) into the cable with fault. If you supply a sufficiently high voltage into the cable with fault, the open-circuit fault in the cable will break down creating a high-current arc. This high current arc makes a peculiar thumping sound at the exact location of the fault. To find the location of a fault in the cable using the thumping method, a thumper is placed to thump continuously. Further, walking along the cable path to listen to the thumping sound is done. The DC voltage applied is directly proportional to the resulting thump. This method is beneficial for relatively shorter cables. For longer extended cables, this thumping method becomes non-viable. It may take hours or perhaps days to walk along the cable path to locate the fault. Moreover, during this period, the cable is exposed to high voltage surges. Thus, while the already existing fault is found and located, the high voltage surges may weaken the insulation of the cable and make it worse.

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B. Time Domain Reflectometer (TDR) Method

The Time Domain Reflectometer (TDR) sends a short-duration low energy signal (of 50 V) at a high repetition rate into the cable. This signal reflects back from the point of alteration in impedance within the cable (fault). TDR and RADAR work on the similar principle. TDR measures the time a signal takes to reflect back from the point of alteration in impedance within the cable (fault). The reflections are trailed on a graphical display in which the amplitude is on the y-axis and the time elapsed on x-axis. The elapsed time is directly associated with the distance of the location of the fault. If the injected signal stumbles upon an open circuit (high impedance), it ends up in high amplitude upward deflection on the trace. Whereas in case of a short-circuit fault, the trail will show a high amplitude negative deflection. A shortcoming of TDR is that it cannot pinpoint the precise location of the faults. It gives an approximate distance of the location of the fault. When the TDR sends a test pulse, reflections that occur during the time of outgoing test pulse might get obscured from the user. This happens with the faults at the near end and are called as blind spots. Further, a TDR is inefficient in seeing high resistance (greater than 200 Ohms) ground fault. If there's any electrical noise in the surrounding area, interference between it and the TDR signal may take place.

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C. Surge Pulse Reflection Method

This method incorporates a current coupler, a thumper and a storage oscilloscope (analyzer). This method is employed for long cables and on faults that are toilsome to arc over, which do not show up using arc reflection method. This method has a thumper which is directly connected to the cable without a filter that can restrict both the voltage and the current applied to the fault. The thumper injects a high voltage pulse into the cable thus creating an arc at the fault, which causes a reflection of energy back to the thumper . The reflection repeats back and forth between the fault and the thumper till its energy gets expended. The surge reflections are sensed by the current coupler and further captured and displayed by the storage oscilloscope.

D. Voltage Decay Reflection Method

This method makes use of a voltage coupler, a dielectric test set and a storage oscilloscope. This method is used for transmission class cables when the generation of an arc at the fault requires a breakdown voltage greater than that a typical surge generator can provide. The reflections produced by the flashover of DC voltage at the fault are sensed by voltage coupler and these reflections are captured and displayed by a storage oscillator.

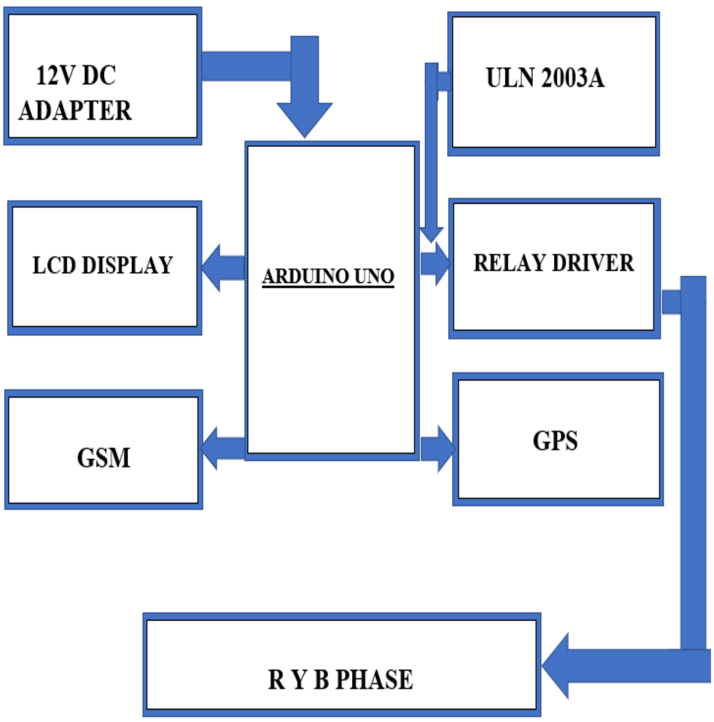
E. Sectionalizing

It involves cutting and splicing the cable physically, which can decrease the reliability of the cable. The cable needs to be divided into small parts which will enable us to find the fault. For example, a 500-ft length cable will be cut into 250-ft length sections each, and reading is measured in both ways with the help of Ohmmeter and high-voltage insulation resistance (IR) tester. It is defective if the reading on the IR tester shows low. This procedure has to be repeated unless we reach a short section which will allow rectifying the fault.

F. Arc Reflection Method

The arc reflection method makes use of a TDR with a filter along with a thumper. The surge generator i.e. thumper is employed to create an arc across the shunt fault which creates a momentary short-circuit for the TDR to show a downward deflection productively. The arc reflection filter protects the TDR from high voltage surge generated by the surge generator and routes the low-voltage signal down the cable.

III.BLOCK DIAGRAM



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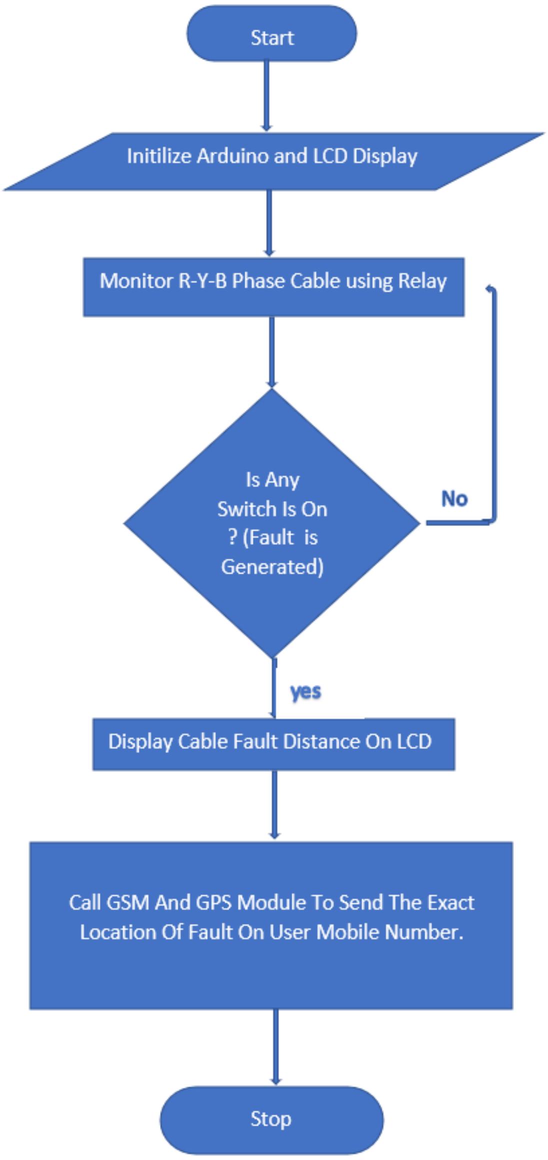
FLOWCHART



IV.PROPOSED WORK

The system proposed here locates the fault precisely. Resistance will fluctuate with respect to the cable length. If there is a short circuit (LL or 3L or LG), the current alters with respect to the length(in km) at which the fault has occurred in the cable. The cables are represented by a set of resistors with switches for short-circuiting. The series resistor voltage drop alters with respect to the fault .The project is designed with a set of resistors representing cable length in Kilometers and fault is generated by a set of switches at every known Kilometer to check the accuracy of the same. The power supply consisting of an AC supply of 230v is stepped down with the help of a 12 volt DC adapter. Whenever we press the switch, a fault is created and the arduino which already is pre programmed senses the voltage alterations and the distance at which the fault has occurred is calculated. Arduino code is done with embedded C language and Arduino software. The ATMEGA32A-PU microcontroller is also a part of the controlling unit and this Arduino microcontroller also operates a relay driver (ULN2003A) that controls switching of a set of relays for interconnection of the cable at each phase. It makes necessary computations regarding the distance of the fault. The fault occurring region is displayed by interfacing the LCD with Arduino and the fault distance is sent to the user through mobile. This is done with the help of GSM and the exact location from the GPS module is taken and displayed on the phone of the user.

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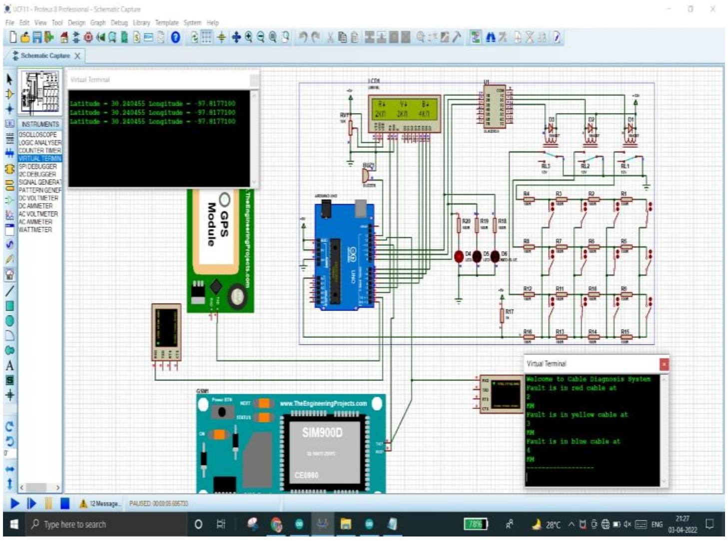
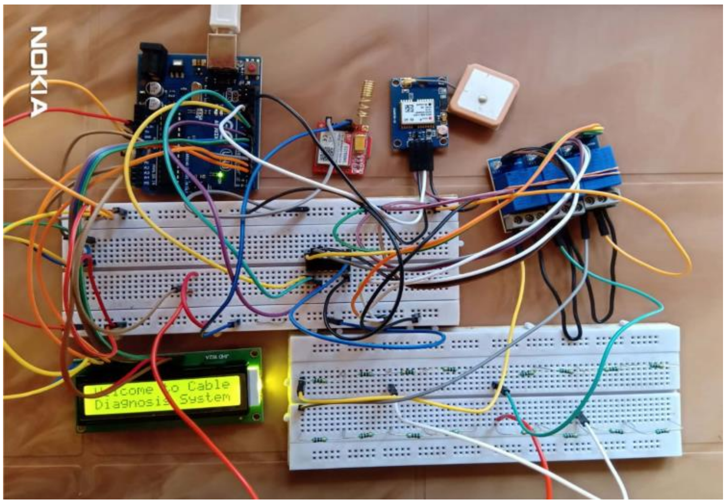
- **SIMULATION RESULTS**



- **HARDWARE IMPLEMENTATION**



V.CONCLUSION

The short circuit fault at a specific distance (1 Km, 2 Km, 3Km and 4 Km) in the underground power cable is located to rectify the fault efficiently using simple and easy concepts of Ohm’s law and voltage divider rule. The LCD screen displays the distance at which the fault has occurred, and the user receives a message conveying the fault occurrence and its location. The issue of fault-finding in an underground cable power grid has drawn a lot of attention. However, a simple and easy ohm's law-based technology quickly locates faults, which inevitably aids in fault clearing, maintaining aesthetics, reducing time and drudgery, and minimizing cost of the entire process. The advances in underground cable detector design could lead to widespread adoption of underground cable technologies in developing countries' major cities, reducing environmental disasters related to overhead transmission lines.

VI.FUTURE SCOPE

In this project we detect the location of a short circuit fault in an underground cable line. But the solution to find and locate an open
circuit fault can be designed and incorporated in this system. A device can be added to the system that detects the radiations emitted by a cable and wherever the designed tool stops to detect the radiations an open circuit is detected. The device must have good sensitivity to detect radiation from the underground cable. The open circuit fault can also be detected using a capacitor in the AC circuit that measures the change in impedance and calculates the distance of fault.

The data of the fault received can also be shared on a website using IOT for the government and Industrial sector. This website can continuously take updates from the system and display on its web pages.

VII. ACKNOWLEDGMENT

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