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Analyzing the Working of Underground Cable Fault Distance Locator Using Proteus Software

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Abstract : **India is among the fastest growing countries in the world and civilization is also increasing day by day. In order to provide power to such a large population and reducing the chaos of overhead transmission lines, underground cables are the current need of the situation. Several advantages of using these cables are like low transmission losses, low regular maintenance cost and less exposure to the severe weather conditions. But there is a chance of fault and it is hard to locate it in less time. The aim of this paper is to detect the fault and to determine the exact distance of the underground cable fault from a substation in kilometers.**

Key Words : Underground cable, fault location,Arduino, Ohm's law

I. INTRODUCTION

Till last decades cables were made to lay overhead and currently it is laid to underground cable which is superior to earlier method. Because the underground cables are not affected by any adverse weather conditions such as storm, snow, heavy rainfall as well as pollution. But when any fault occur in cable, thenit is difficult to locate the fault. So we will move to find the exact location of fault. This project uses the standard concept of ohm's law i.e. when a low D.C voltage is applied at the feeder end through a series resistor (cable lines), then current would vary depending upon the location of the fault in the cable. In case there is a short circuit (line to ground), the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data which the programmed arduino family would display in kilometers.

1.1 TYPES OF FAULTS

A fault in a cable can be classified into two types such as

A). Open Circuit Fault: This type of fault occurs when the flow of current through an underground cable becomes zero. It can be occurred by disruption in conducting paths. Such type of fault occurs when one or more phase conductors break.

B). Short Circuit Fault: This type of fault occurs when two or more conductors of the same cable comes in contact with each other i.e. possible only because of the breakdown of the individual insulation of the cables. So it is impossible to detect visually without taking the cables apart.

Short circuit faults can be further classified into two types-

a). Symmetrical fault: Three-phase fault is called as symmetrical fault. In this fault all the three phases are short circuited.

b). Unsymmetrical fault: This fault effects one or two phases of a three phase system causing the magnitude of the current is not equal and not displaced by 120 degrees.

II. PROPOSED TECHNIQUE

EXISTING SYSTEM: In a-frame method, a pulsed DC is injected into the faculty cable and earth terminal to locate the ground fault. The DC pulse will flow through the conductor and return via earth from earth fault location back to the ground stake. The

flow of pulsed DC through the ground will produce a small DC voltage. A sensitive voltmeter is used to measure the magnitude and direction of DC voltage in segment of the earth along the cable route. Analyzing the results of measuring voltage along the route, the location of the fault in the cable can be pinpointed. A frame is an accurate method but it is not the fastest one. This method may face a problemif the return DC finds some easier path back to the earth stake of transmitter instead of returning through the ground. If the ground is sandy, paved which provides high resistance and consequently, less current flows through the ground. In that case, the voltmeter fails to measure the voltage and fault detection becomes complicated.

PROPOSED SYSTEM: A transmission line is a specialized cable design to carry alternating current of radio frequency. This is, current with a frequency high enough that their wave nature must be taken into account. This project work on the principal of electric capacitance sensor which will be placed near the line to be detected and whenever there will be discontinuity that is if voltage will not be present in the wire it will automatically blink the LED and indicate fault occurs in the LCD display.

III. BLOCK DIAGRAM

This project uses simple ohm's law which is used to locate the short circuit faults, where a DC voltage is applied at the feeder end through a series resistor, depending upon the length of the fault of the cable current varies. The voltage drop across the resistor changes accordingly and this voltage drop is used in detection of the fault location in the underground cables. The below figure is the block diagram of the underground cable fault distance surveyor. In this project, power supply consists of a step-down transformer, which steps down the voltage and is converted into DC by using a bridge rectifier. It is assembled with a group of resistors representing cable length's in kilometers.

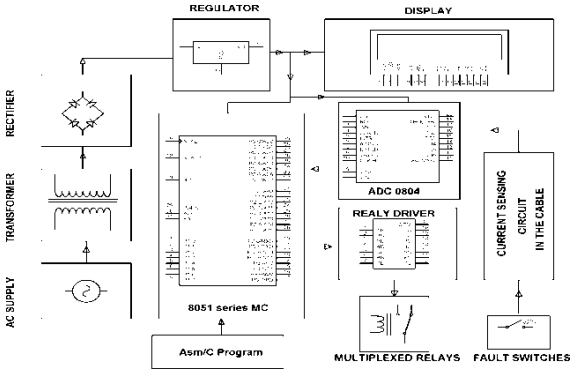

Fig.1 Block diagram of the model

The voltage drop across the feeder resistor is given to an ADC which supplies a digital information which the programmed arduino would show an equivalent on LCD in kilometers. The hardware of this project is shown below.

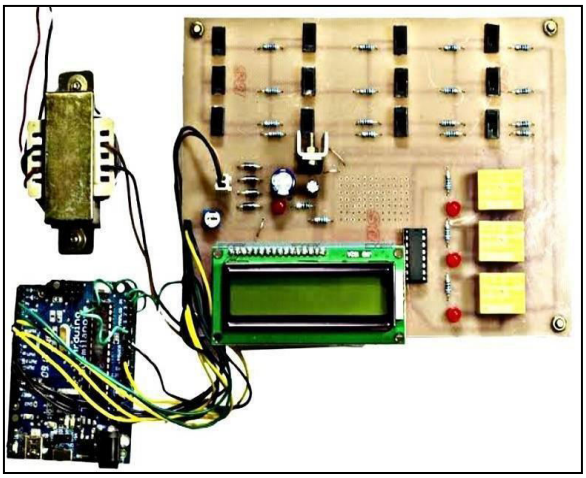

Fig.2 Hardware diagram of the project

The whole cable part is denoted by a set of resistors along with the switches all at distinct locations. The current sensing part of the cable that is represented as set of resistors and switches as shown in the hardware image are used as fault creators that helps in indication of the fault at each location. Hence, this part senses the change in the current by sensing the voltage drop.

Next is the controlling part which consist of ADC that receives input i.e. voltage drop from the current sensing circuit and converts this voltage into digital signal then feeds the arduino with the signal. This arduino (UNO) also plays a crucial role as a

controlling unit and makes the necessary calculations regarding the distance of the fault. This arduino also drives a relay driver which controls the switching mechanism of the set of relays for proper connection of the cable at each phase.

The display part consists of a LCD display that is interfaced to the arduino which shows the status of the cable of each phase and the distance of the cable at the particular phase, if there is any fault.

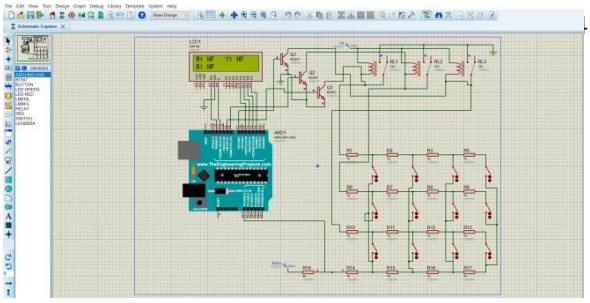

Fig.3 Representation of no fault condition using simulation

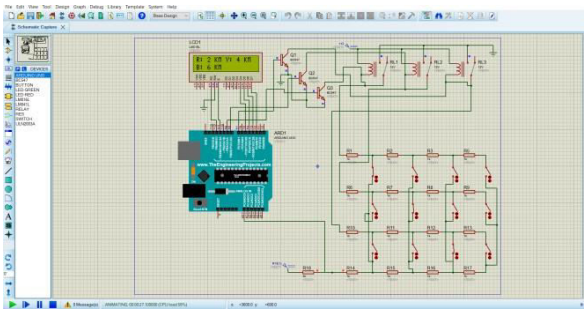

Fig.4 Representation of faulty condition in all three phases using simulation

From the above simulation diagram, we can see that switches of all the three phases are switched ON at different locations causing the fault. The fault location of all the three phases are shown on the LCD display i.e. in R phase: 2km, Y phase: 4km, B phase: 6km.

IV. ALGORITHM AND FLOW CHART

4.1 ALGORITHM

Step1. Initialization of ports, declare timer, ADC, LCD functions.

Step2. Turn ON relay 1 by making pin 0.0high after beginning of an infinite loop.

Step3. Display "R:" at the starting of first line in LCD.

Step4. Depending upon ADC output, call ADC function which displays the fault position.

Step5. Call the delay.

Step6. Repeat steps 3 to 5 for other two phases.

4.2 FLOWCHART

The flowchart of the underground fault detection initializes the input and the output ports, declare timer, ADC and LCD. When there is a situation of fault in the underground cable the system starts to find out in which phase fault has occurred. If the fault is present in R phase then the corresponding relay will be activated and display the phase name on the LCD. This data will be converted into analog to digital with the help of ADC which is in-built in arduino, while the arduino calculates the data in km equivalent to the digital data to the LCD, then LCD displays the location of the fault. If there is no fault inR phase then the system will search the fault in other phases in a similar manner.

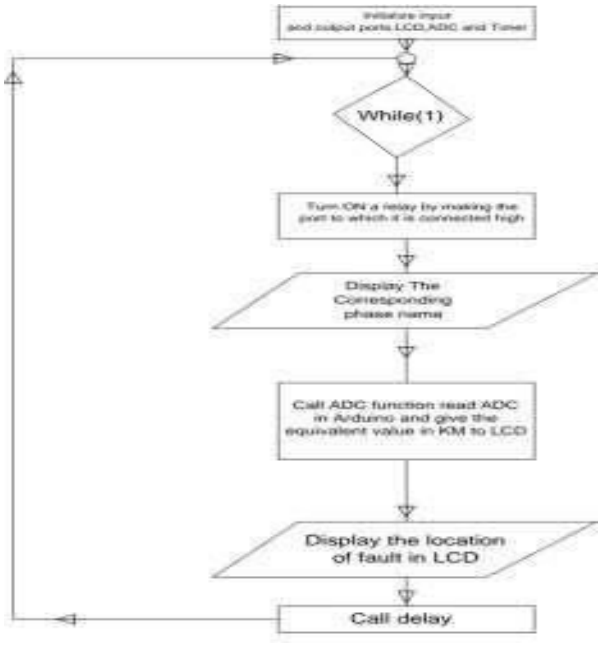

Fig.5 Flow Chart

IV. FUTURE SCOPE

This project includes, higher public acceptance, perceived benefits of protection against electromagnetic field radiation (which is still present in underground lines), lower maintenance and fewer interruption. Failure rates of overhead lines and underground cables vary widely, but typically underground cable outage rates are about half of their equivalent overhead line types. Primary benefits of using underground cables can be cited into four areas: Potentially-Reduced Maintenance and Operating Costs, Lower storm restoration cost, Improved reliability, less damage during severe weather.

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