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CABLE FAULT DISTANCE LOCATOR

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ABSTRACT

In this paper, a way for sleuthing cable fault distance locator is done by using microcontroller. The target of this project is to work out the gap of cable fault through base station in kilometers. It uses the straight forward conception of digital Murray loop, voltage changes can vary counting on the length of fault in cable, since the current varies. A group of resistors are used to represent the length of cable in kilometers and a DC voltage is fed at one end and the fault is detected the change in voltage using analog to voltage converter. The fault occurring at what distance is shown on LCD which is interfaced with the microcontroller that is used to make the necessary calculations.

KEYWORDS: *Cables, Faults Location, Fault Detection, Location Method, Microcontroller.*

I. INTRODUCTION

For most of the worldwide operated low voltage and medium voltage distribution lines cables have been used from many decades. To reduce the sensitivity of distribution networks to environmental influences high voltage cables are used more and more. Cables have been widely used in power distribution networks due to the advantages of connection, involving more security than overhead lines in bad weather, less liable to damage by storms or lightning. It is less expensive for shorter distance, eco-friendly and low maintenance.

But if any fault occur in cable, then it is difficult to locate fault. So this project is used to detect the location of fault in digital way. The requirement of locating the faulty point in a cable in order is to facilitate quicker repair, improve the system reliability and reduced outage period.

II. FAULT IN CABLE

Fault in cable is defined as a physical condition that causes a device, a component or an element to perform in a required manner. It will occur because of any defect, weakness or non-homogeneity or by breaking of conductor and failure of insulation. Power cable fault location techniques are used in power system for accurate pin pointing of the fault positions. The benefits of accurate location of fault are:

- Fast repair to revive back power to system.
- Improve the system availability and performance.
- Reduce operating expense and save the time needed by the crew searching in bad weather, noisy area and tough terrains.

III. TYPES OF FAULT IN A CABLE

A fault may be a bolted connection or may have some electric resistance within the fault Association. The fault can be basically mainly in two categories:

1. Open Circuit:
Open circuit fault happens, when there is a break in the conducting path of a cable. These kind of faults are better comparatively short circuit faults because when these fault occur current flows through cable becomes zero. The open-circuit fault can be detected by megger by measuring resistance between each conductors and earth.
2. Short Circuit:
An abnormal connection of comparatively low electric resistance, whether created accidently or intentionally, between two points of various potential. When two conductors of multi core cable come in electrical contact with one another because of insulation failure, it is thus referred to as short-circuit fault.

IV. LITERATURE SOURCES

Finding the location of a cable fault doesn't have to be like finding a needle in a haystack. The common methods of locating faults are

1. Sectionalizing: This procedure risks reducing cable reliability, because it depends on physically cutting and splicing the cable. Dividing the cable into successively smaller sections and measuring both ways with an ohmmeter or high-voltage insulation resistance (IR) tester enable to narrow down search for a fault. This laborious procedure normally involves repeated cable excavation.

2. Time domain reflectometry (TDR): The TDR sends a low-energy signal through the cable, causing no insulation degradation. A theoretically perfect cable returns that signal in a known profile. Impedance variations in a "real-world" cable alter both the time and profile, which the TDR screen or printout graphically represents. One weakness of TDR is that it does not pinpoint faults.

3. Murray loop test: It is a bridge circuit used for locating faults in underground or underwater cables. It uses the principle used in potentiometer experiment. One end of the faulted cable is connected through a pair of resistors to the voltage source. Also a null detector is connected. The other end of the cable is shorted. The bridge is brought to balance by changing the value of R_B.

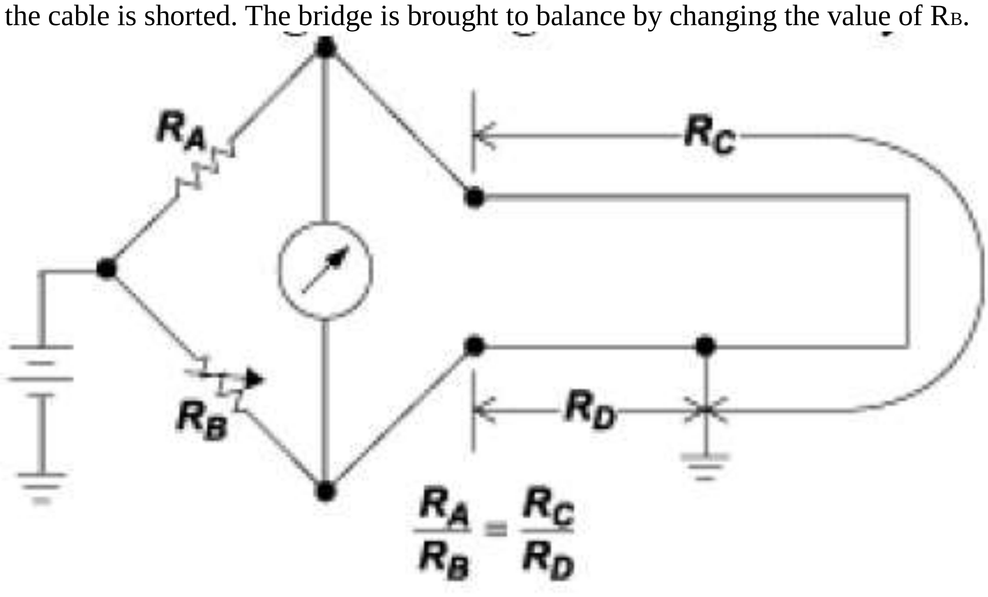

Figure 1: Murray loop test.

In above figure, RC is proportional to (l+ (l-x)) and RD is proportional to l. Therefore,

$$\boldsymbol{RA/RB = r = RC/RD} = (\boldsymbol{2l - x})/\boldsymbol{x} \quad (1)$$

And hence $\boldsymbol{x = 2l/(r-1)}$ (2)

Where l is the length on each segment of wire, r is the ratio R_A/R_B and x is the length of faulty segment.

The main disadvantage of this method assumes that only a single fault exists, a low resistance when compared with cable resistance and cable conductors have uniform resistance per unit length.

4. Varley loop test: If the fault resistance is high, the sensitivity in Murray bridge is reduced and Varley loop may be more suitable but only a single fault exists. Except that here the ratio arms are fixed and a variable resistance is connected to the test end of the faulty cable.

The drawbacks of the above methods can be overcome to certain extent by this method in which the concept of OHM's law is applied.

V. BLOCK DIAGRAM

In this project simple Ohm's law is used to locate the short circuit fault, where a DC voltage is applied at the feeder end through a series resistor, depending upon the length of fault of the cable current varies. The voltage drop across the series resistor changes accordingly and this voltage drop is used in detection of fault location in the cables. The below figure is a block diagram of cable fault distance surveyor. In this project power supply consists of a step down transformer (230/12V), which step down the voltage to 12V AC and it is converted into DC by using a by ridge rectifier. It is assembled with a group of resistors representing cable lengths in kilometers.
The voltage drop across the feeder resistor is given to an ADC which supplies digital information which the programmed microcontroller would show an equivalent on LCD in kilometers.

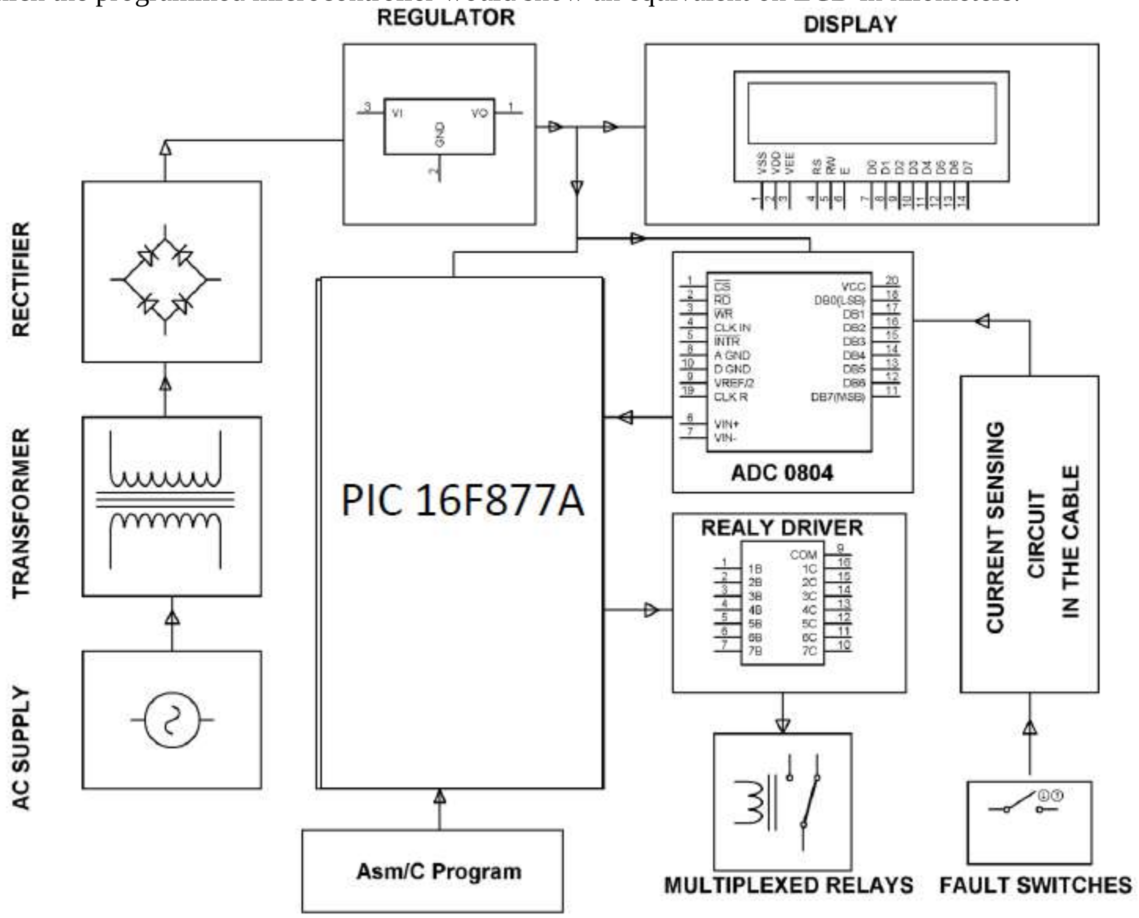

Figure 2 : Block Diagram.

VI. ALGORITHM

Algorithm:
Step1: Initialize the ports, declare timer, ADC, LCD functions.
Step2: Begin an infinite loop; turn on relay 1 by making pin 0.0 high.
Step3: Display "R:" at the starting of first line in LCD.
Step4: Call ADC Function, depending upon ADC output, displays the fault position.
Step5: Call delay.
Step6: Repeat steps 3 to 5 for other two phases.

VII. CIRCUIT DIAGRAM

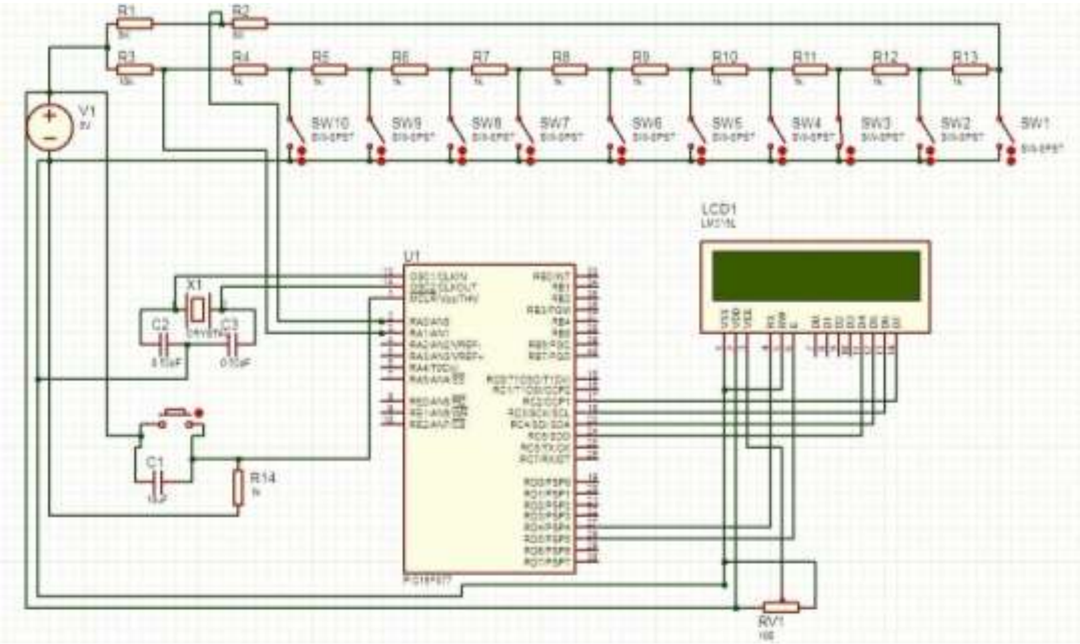

Figure.3. Circuit Diagram

In above circuit diagram, we use murray loop concept to determine the fault location. This circuit is design & perform on the Proteus, PCB design &simulation software(version 8.5). Voltage is the function of resistance of the cable (ohm/km) and resistance of the cable is function of length at resistivity & uniform area is constant (:.R α L, at ρ &A is constant). So that the voltage varies when fault location varies. In this simulation, the set of 10 resistor connected in series representing cables i.e R_4,R_5, R_6,R_7,R_8, R_9,R_{10},R_{11},R_{12},R_{13} and 10 switches representing faults are simulated using Proteus Software

VIII. OPERATIONAL EXPLANATION

1. Connections: The output of the power supply which is 5V is given to the 11^{th}& 32^{th} pin of microcontroller and GND is connected to its 12^{th}& 31^{th}pin. Port 2 to 3 of microcontroller (Analog to digital converter) is given voltage at different points (A&B). Port 17,18,23,24,27,28^{th} is giving to 16x2 LCD display. Port 26,27 is giving to GSM. Port 13^{th} & 14^{th}giving to crystal oscillator which provides clock frequency to the microcontroller. Port 1 of microcontroller is rest pin is provided by reset circuit.

2. Operating procedure:: The project uses ten sets of resistances in series representing cables as shown in the circuit diagram. Each series resistors represents the resistance of the cable for a specific distance thus 4 such resistances in series represent 1-4km's. Switches are used to common point of their contacts are grounded while the NO points are connected to the input of the resistor of single phase cable. When fault on the first resistor then it indicate fault at one kilometer from device installed and at 5^{th}resistor it indicates fault at 5 kilometer.

While any of the 10 switches (representing as fault switches) are operated they impose conditions like short circuit fault, open circuit fault and ground fault as per the switch operation. The program while executed continuously scans by operating the microcontroller in sequence of 1sec interval. Thus any point while driven to GND through the common contact point develops a current flow through resistors & the cable by the fault switch depending on the created fault. Thus the voltage difference at the analog to digital (inbuilt in microcontroller) pin varies depending on the current flow which is inversely proportional to the resistance value representing the length of cable in kilometers. This varying voltage is fed to the ADC to develop an 8 bit data to the microcontroller. Program while executed displays an output in the LCD display upon the distance of the fault occurring in km. In a fault situation it display's R=3km if the 3km's switch is made ON. Accordingly all other faults are indicated.

IX. RESULT

Table 1: Variation of voltages according to fault location

VOLTAGE (A_O-A_1)	OUTPUT(FAULT LOCATION)
0 V	NO FAULT
1.62 V	1km
1.42 V	2km
1.22 V	3km
1.05 V	4km
0.87 V	5km
0.71 V	6km
0.53 V	7km
0.36 V	8km
0.19 V	9km
0.01 V	10km

X. CONCLUSION

In this paper we detect the location of open circuit and short circuit fault in the cable from the base station in km with the help of PIC 16F877A. In this method the short circuit fault at a particular distance in the underground cable can be located using simple concepts of Murray loop enables to rectify fault efficiently. Further this project can be enhanced by using capacitor in an AC circuit to measure the impedance which can even locate the open circuited cable, unlike the short circuited fault only using resistors in DC circuit as followed in the above proposed project. The fault occurring at a particular distance and the respective phase is displayed on a LCD interfaced to the microcontroller.

XI. FUTURE SCOPE

In this project, the fault occurring at what distance is shown on LCD which is interfaced with the microcontroller. Further connect to the GPS technology which provide more accurate fault location with its longitude and latitude co-ordinates.

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