GSM Based Underground Cable Fault Distance Locator

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Abstract— The objective of this research paper is to determine the distance of underground 3 phase power cable fault from base station in kilometers by using PIC microcontroller & GSM. This project uses the simple concept of ohm's law & Voltage divider rule. When short circuit occurs in a 3 phase power cable, voltage changes based on the length of fault happened in a cable, since the current varies. Here, 1 KΩ resistors are used to represent the cable for R, Y and B [1]. The fault is detected by detecting the change in voltage using an ADC and a PIC microcontroller. These ADC & PIC Microcontroller are used to make the required calculations for fault detection and once the calculation done, the fault distance will be display on the LCD screen. SIM 800 - GSM module is used to send the information via AT Commands.

Key words: Underground Power Cable; Fault Detection; ADC; SIM800 GSM Modem; LCD; PIC Microcontroller; PIC18F4550

I. INTRODUCTION

Transmission line by underground method finds its use and application over a large area. Underground cable is widely preferred to ensure safety [2]. Underground cable installations are costly as compared to overhead cable but at the same time, it is more reliable and also the life of underground cable is more as compared to overhead lines. This underground cables are unaffected by adverse conditions (Storm, Rainfall) and the chances for fault in underground cables are less than that of overhead cables [1]. When the fault happens at undergrounds power cables, to detect fault becomes difficult.

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

1) Open circuit fault
2) Short circuit fault

A. Open Circuit Fault:

Open circuit fault happens when one or more phase conductor wire break. The value of current in such fault becomes zero and the load side gets isolated from the Generation side.

B. Short Circuit Fault:

When conductors of different phases get connected with each other than such fault comes under short circuit fault [1].

II. BLOCK DIAGRAM

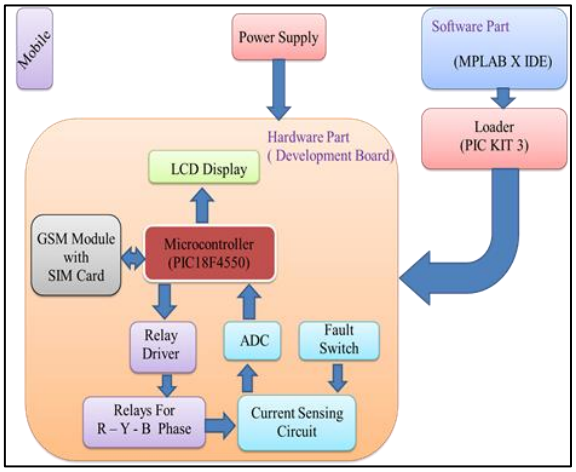

Fig. 2.1: Block Diagram of Complete Project

A. Explanation of Block Diagram:

An embedded system is typically a design that uses the power of a small microcontroller, like the Microchip PIC microcontroller (MCU) or dsPIC digital signal controller (DSC) [3].

PIC Microcontroller is a heart of the project. Here, 1K ohm set of resistors are used to represent the power cable (R – Y - B). DC voltage is fed at one end and the fault is detected by detecting the change in voltage. For current sensing element – Switch is used. ULN2003a Driver IC is used to drive 3 relays. This 3 Relays are used for scanning 3 phases (R – Y – B), one by one. If any faults occur in any of the phase, it will detect during scanning that particular phase. PIC18F4550 microcontroller is used to make the necessary calculations so that the fault distance is displayed on the LCD screen. SIM 800 - GSM module is used to send the information via AT commands.

A GSM (Global System for Mobile Communications) modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone [4]. From the mobile operator perspective, a GSM modem looks just like a mobile phone which is helpful to send information about the fault to the user. Hence user will get update of occurrence of fault in kilometer from base station.

Fig. 2.2: SIM 800 GSM Modem

In a software side, MPLAB X IDE [3] is used to write program in Embedded C. This programmed is dumped on Microcontroller by PIC kit 3 loader [4].

The experimental set up of the project is shown in below figure 2.3.

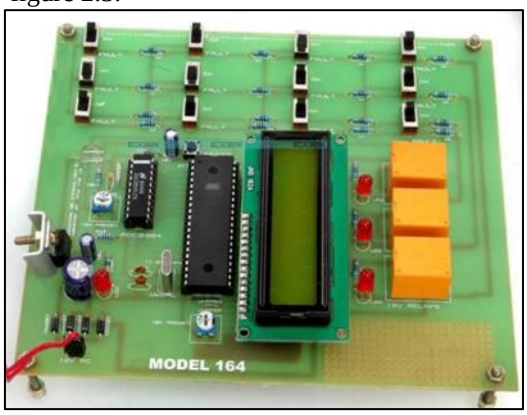

Fig. 2.3: Experimental Setup of project

III. FLOW CHART

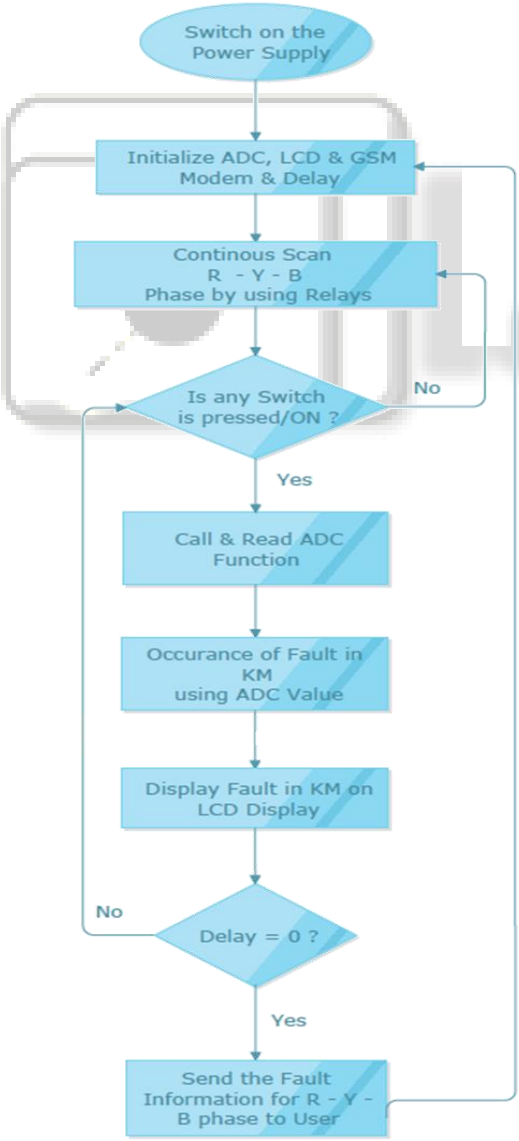

Fig. 3: Flow Chart of the Project

IV. CIRCUIT DIAGRAM & DESCRIPTION

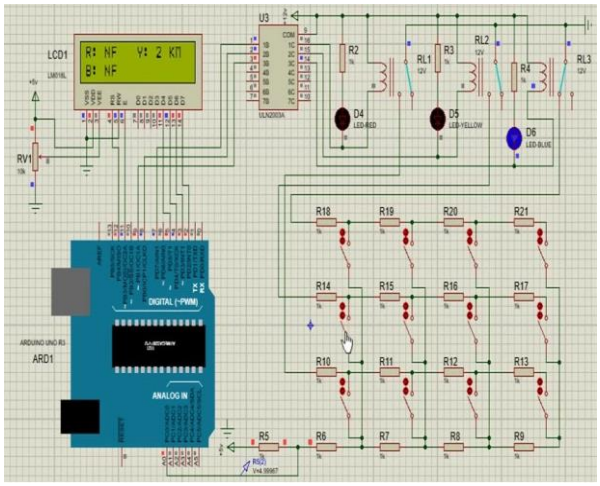

Fig. 4.1: Circuit Diagram of the Project

A. *Explanation:*

Here, 1K ohm set of resistors are used to represent the power cable (R – Y - B). DC voltage is fed at one end. When there is no fault in any phases, LCD will display as NF (No fault) because at that time, no voltage across any register of the cable. During NF – Fault switch will be open so no current will flow. Here, according to 4 different voltages of R – Y – B phases, we have decided as 1 km, 2 km 3 km and 5 km. Particular ranges are clearly defined in the programming so once its detect that range via ADC, it will be display that particular range in kilometer by using PIC Microcontroller. Finally same information sends to user via AT command by using GSM SIM 800.

B. *Calculations:*

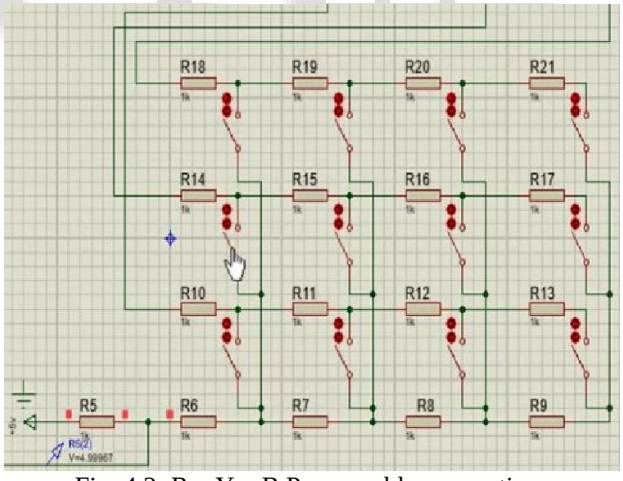

Fig. 4.2: R – Y – B Power cable connections

- 5V DC is given to register R5
- Register R18 – R14 – R10 is connected to R, Y and B phase Relay respectively
- Voltage across any Power Cable Register = 0V because Fault switch = OFF
- Now to find voltage across any register, when Fault switch = ON;

For Example: 2 km Fault switch of B phase = ON = Connected

We have to apply Voltage Divider Rule;

$$V15 = \left(\frac{R15}{R15 + R14 + R5 + R6 + R7}\right)Vs$$

$$V15 = \left(\frac{1K}{1K + 1K + 1K + 1K + 1K}\right)5$$

$$V15 = 1 \text{ Volt}$$

Where Supply Voltage = Vs = 5

Similarly we can find the voltage across any register. Voltage will keep on decreases when the kilometer increases.

V. Application

Its main application is to detect the fault of underground cable which is very hard to detect as it is not possible to see such faults which are quite possible in the case of overhead transmission line. So for such cases this project is very helpful as the distance at which the fault has occurred can be calculated and then further action regarding the fault can be taken to overcome them.

VI. Conclusion

The short circuit fault at a particular distance (1 Km, 2 Km, 3 Km and 4 Km) in the underground power cable is located to rectify the fault efficiently using (Fault switch and) simple concepts of Ohm's law and voltage divider rule. The fault displays on the LCD screen and send the message to User. The advantages of accurate location of fault are fast repair to revive back the power system; it improves the system performance and reduces the operating expense and the time to locate the faults in the field [6].

References

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