Internet of Things (IOT) Based Underground Cable Fault Detector using ATmega Microcontroller

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Abstract: **A fault is an unexpected change of the system functionality, which causes deviation of a plant behavior from that which is specified it .The problem of detect the location of fault in transmission line has become complex and expensive which depended on The current mechanism used to detect the fault in power transmission lines approximated by the calculation of the impedance obtained from voltage and current data. The works of this is to find solution of how detected and located of fault in the transmission line Diagnosing fault source is difficult and entire cable should be taken out from the ground to check and fix faults. The project work is intended to detect the location of fault in underground cable lines from the base station in km using a micro-controller 8051. To locate a fault in the cable, the cable must be tested for faults. This prototype uses the simple concept of Ohms law. The current would vary depending upon the length of fault of the cable. In the urban areas, the electrical cables run in underground instead of overhead lines. Whenever the fault occurs in underground cable it is difficult to detect the exact location of the fault for process of repairing that particular cable. The proposed system finds the exact location of the fault. The prototype is modeled with a set of resistors representing cable length in km and fault creation is made by a set of switches at every known distance to cross check the accuracy of the same. In case of fault, the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data to a programmed 8051 IC that further displays fault location in distance. The fault occurring distance, phase, and time is displayed on a 16X2 LCD interfaced with the micro-controller. IOT is used to display the information over Internet using the Wi-Fi module ESP8266.A web page is created using HTML coding and the information about occurrence of fault is displayed in a web page. At the end of research we have acquired results that it can be determined where the error with high accuracy.**

Index Terms: **Underground Cable, Fault Location, Location Methods, Micro-controller, web page, IOT.**

I. INTRODUCTION

In an electric power system, a fault is detected by any abnormal electric current follow. For example, a short circuit is a fault in which current bypasses the normal load. An open-circuit fault occurs if a circuit is interrupted by some failure. In three-phase systems, a fault may involve one or more phases and ground, or may occur only between phases. In a "ground fault" or "earth fault", charge flows into the earth. The prospective short circuit current of a fault can be calculated for power systems. In power systems, protective devices detect fault conditions and operate circuit breakers and other devices to limit the loss of service due to a failure. In a poly phase system, a fault may affect all phases equally which is also called symmetrical fault. If only some phases are affected, the resulting asymmetrical fault becomes more complicated to analyze because the simplifying assumption of equal current magnitude in all phases is no longer applicable. The analysis of this type of fault is often simplified by using methods such as symmetrical components.

A symmetric or balanced fault affects each of the three phases equally. In transmission line faults, roughly 5% are symmetric this is in contrast to an asymmetrical fault, where the three phases are not affected equally. An asymmetric or unbalanced fault does not affect each of the three phases equally Power transmission and distribution lines are the vital links that achieve the essential continuity of service of electrical power to the end users. Transmission lines connect the generating stations and load centers. Faults are caused either by insulation failures and conducting path failures. Most of the faults on transmission and distribution lines are caused by over voltage due to lighting and switching surges or by external conducting objects falling on over head lines. Birds, tree branches may also cause faults on over head lines. Other causes of faults on over head lines are direct lightning strokes, aircraft, snakes, ice and snow loading, storms, earthquakes, creepers etc. In the case of cables, transformers, generators the causes may be failure of solid insulation due to aging, heat, moisture or over voltage, accidental contact with earth.

II. TYPES OF FAULTS IN CABLE

1.1.1. Open Circuit Fault:

When there is a break in the conductor of the cable, it is called open circuit fault of the cable. The open circuit fault can be checked by meager. For this purpose, the three conductors of the 3-core cable at the far end are shorted and earthed. Then resistance between each conductor and earth is measured by a meager. The meager will indicate zero resistance in the circuit of the conductor that is not broken. However, if the conductor is broken, the meager will indicate infinite resistance in its circuit.

1.1.2. Short Circuit Fault:
When two conductors of a multi-core cable come in electrical contact with each other due to insulation failure, it is called short-circuit fault. The two terminals of the meager are connected to any two conductors. If the meager gives zero reading, it indicates short-circuit fault between these two conductors. The same step can be repeated for other conductors taking two at a time.

1.1.3. Earth Fault:
When the conductor of the cable comes in contact with earth, it is called earth fault or ground fault. To identify this fault, one terminal of the meager is connected to the conductor and the other terminal connected to earth. If meager indicates zero reading, it means the conductor is earthed. The same procedure is repeated for other conductors of the cable. This project is used to detect the location of fault in digital way. Locating the faulty pointing an underground cable helps to facilitate quicker repair, improve the system reliability and reduced outage period. The article has been organized as follows. Section 2 discuss about different methods used to detect the location of fault in underground cables. Section 3 describes the basic principle of the proposed fault locating method.

III. LITERATURE SURVEY

[1] Tanmay Kedia, Vinita Sahare, Kanchan Kumar Bauri, Rajendra Kumar Sahu, Sanjeev Kumar, Abhijeet Lal "Underground Cable Fault Distance Detector using ATmega328 microcontroller" ISSN (Print) : 2320 – 3765 ISSN (Online): 2278 – 8875 Vol. 6, Issue 10, October 2017.
Frequent fault in underground cables due to the breakdown of paper plastic insulation due to chemical reaction or poor workmanship during installation and the difficulties in locating the approximate fault area have been a serious problem. Most Underground Faults are located by unearthing the entire length of cable to enable visual inspection to be carried out. In case where visual inspection is not helpful then the entire length of cable is replaced. This manual method is not only expensive but also results in heavy loss of revenue to the power distribution company.

[2] Nikhil Kumar Sain, Rajesh Kajla, Mr.Vikas Kumar —Underground Cable Fault Distance Conveyed Over GSM, E-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 11, Issue 2 Ver. III (Mar. – Apr. 2016), PP 06-10.
This paper proposes fault location model for underground power cable using microcontroller. The aim of this project is to determine the distance of underground cable fault from base station in kilometers. This project uses the simple concept of ohm's law. When any fault like short circuit occurs, voltage drop will vary depending on the length of fault in cable, since the current varies. A set of resistors are therefore used to represent the cable and a dc voltage is fed at one end and the fault is detected by detecting the change in voltage using analog to voltage converter and a microcontroller is used to make the necessary calculations so that the fault distance is displayed on the LCD display.

[3] R. K. Raghul Mansingh, R. Rajesh, S. Ramasubramani, G. Ramkumar, Underground Cable Fault Detection using Raspberry Pi and Arduino, International Journal of Emerging Technologies in Engineering Research (IJETER), Volume 5, Issue 4, April (2017).
The aim of this project is to determine the underground cable fault. This project uses the simple concept of CT Theory. When any fault like short circuit occurs, voltage drop will vary depending on the length of fault in cable; since the current varies CT is used to calculate the varying. The signal conditioner manipulates the change in voltage and a microcontroller is used to make the necessary calculations so that the fault distance is displayed by IOT devices.

IV. CIRCUIT DIAGRAM

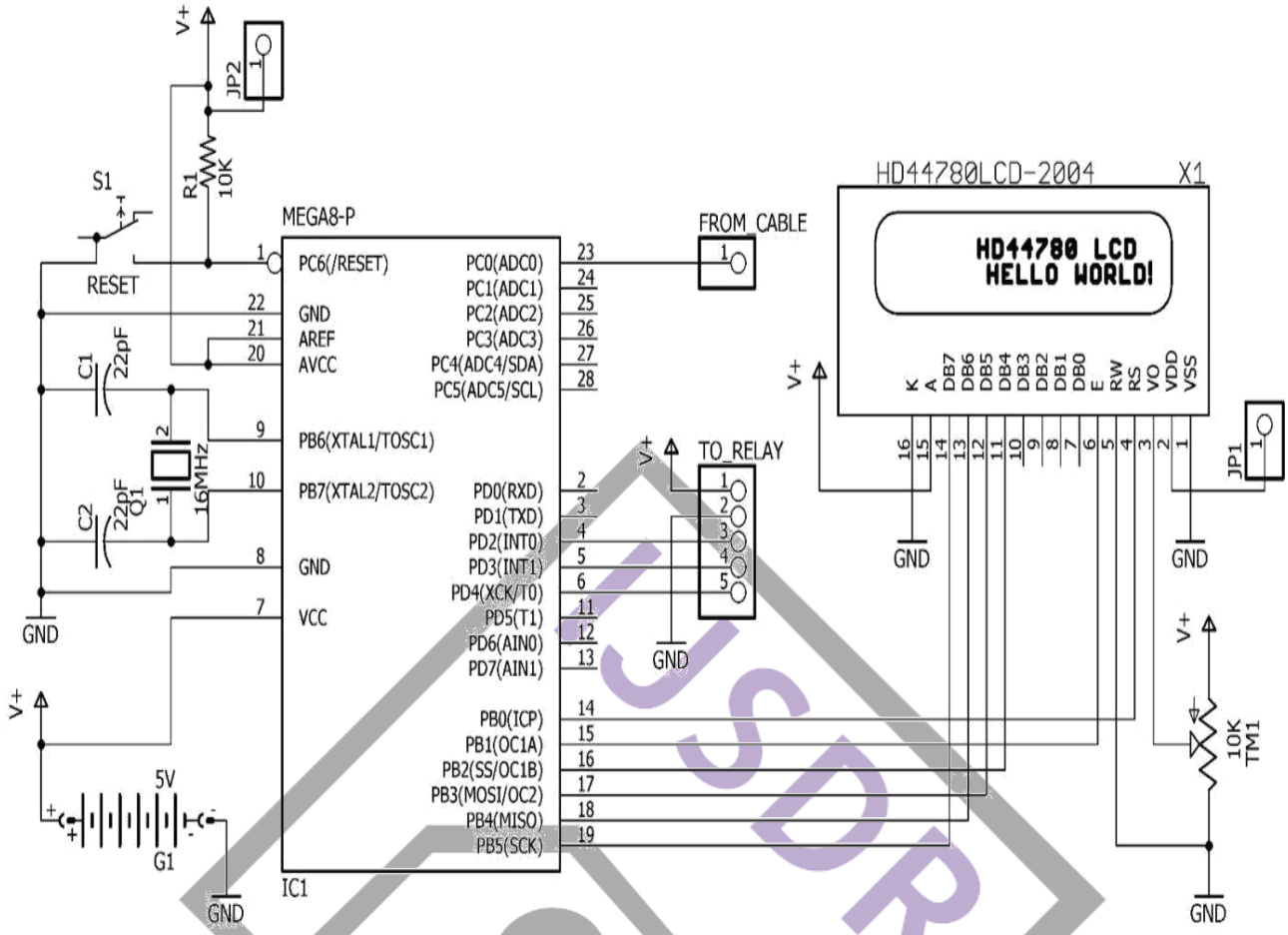

Fig. 1 Circuit Diagram

The objective of this project is to determine the distance of underground cable fault from the base station in kilometers. An underground cable system is quite common in many urban areas wherein it becomes very difficult to repair in case of any faults because finding the exact location of the fault in such cable system is quite difficult. With the proposed system, finding the exact location of the fault is possible.

This project uses a standard concept of Ohms law, i.e., when a low DC voltage is applied at the feeder end through series resistor (assuming them as cable lines), then the current would vary depending upon the location of the fault in the cable. In case of a short circuit (line to ground), the voltage across the series resistors changes which is then fed to an ADC, to develop a precise digital data that gets displayed on the LCD.

V. BLOCK DIAGRAM & PROPOSED METHODOLOGY

The proposed system is an IOT enabled underground cable fault detection system. The basic principle behind the system is Ohms law. When fault occurs in the cable, the voltage varies which is used to calculate the fault distance. The system consists of Wi-Fi module, Micro-controller, and Real-Time Clock. The block diagram of the fault detection system is shown in the Fig 2.

The power supply is provided using step-down transformer, rectifier, and regulator. The current sensing circuit of the cable provides the magnitude of voltage drop across the resistors to the micro-controller and based on the voltage the fault distance is located.

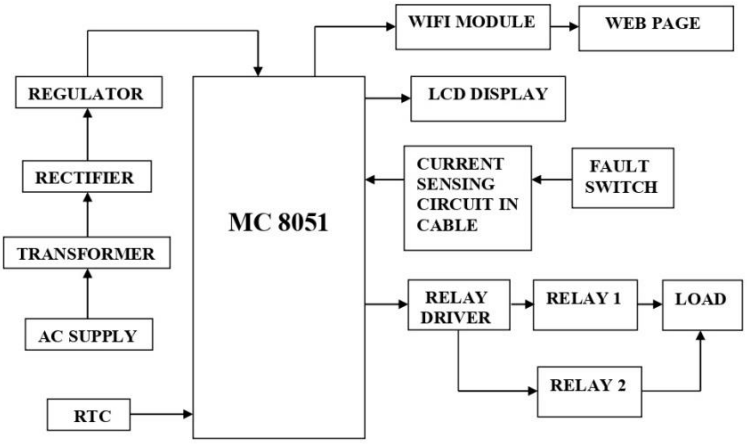

Fig. 2 Block Diagram of Fault Detection system

VI. FLOWCHART

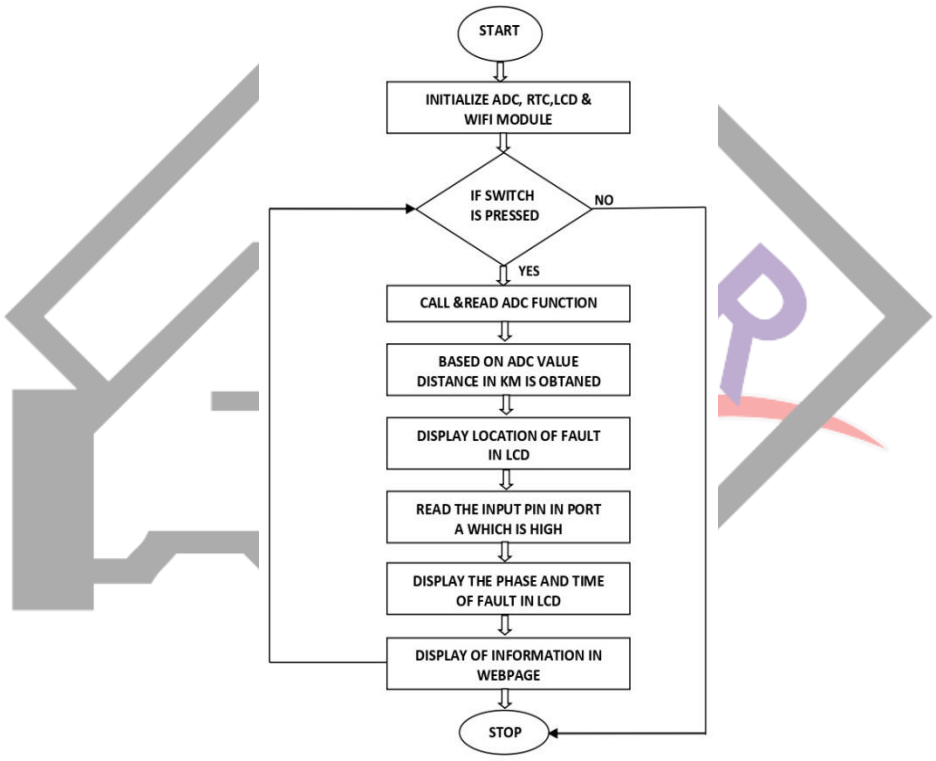

Fig. 3 Flow Chart

Algorithm for flow chart:

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.

Step7: And Send data to think speak website.

VII. HARDWARE AND SOFTWARE USED

Hardware used:

- IOT
- 8051 series Microcontroller, LCD, Crystal, ADC, Relays, Relay Driver.
- Esp8266 (IOT) Wi-Fi module.
- IC, Transformer, Diodes, Voltage
- Regulator, Resistors, Capacitors, LEDs
- Slide switches.

Software Used:

- Keil Software
- Embedded C
- Compilers for C (ANSI C)

VIII. ADVANTAGES AND APPLICATION

Advantages:

- Provides precise accuracy in determining the location of fault.
- Consumes low power in nano watts.
- Compact size, Easy to handle.
- Less maintenance cost.
- It has higher efficiency.
- Lower tree trimming cost.

Applications:

- It is basically use for underground wire fault detection.
- It is used to find wire breakage within the cables.

IX. RESULT AND CONCLUSION

This is proposed model of underground cable fault distance locater using micro-controller. It is classified in four parts –DC power supply part, cable part, controlling part, display part. DC power supply part consist of ac supply of 230v is step-down using transformer, bridge - rectifier converts ac signal to dc & regulator is used to produce constant dc voltage. The cable part is denoted by set of resistors along with switches. Current sensing part of cable represented as set of resistors &switches are used as fault creators to indicate the fault at each location. This part senses the change in current by sensing the voltage drop. Next is controlling part which consists of analog to digital converter which receives input from the current sensing circuit, converts this voltage into digital signal and feeds the micro controller with the signal. The micro-controller also forms part of the controlling unit and makes necessary calculations regarding the distance of the fault. The micro-controller also drives a relay driver which in turn controls the switching of a set of relays for proper connection of the cable at each phase.

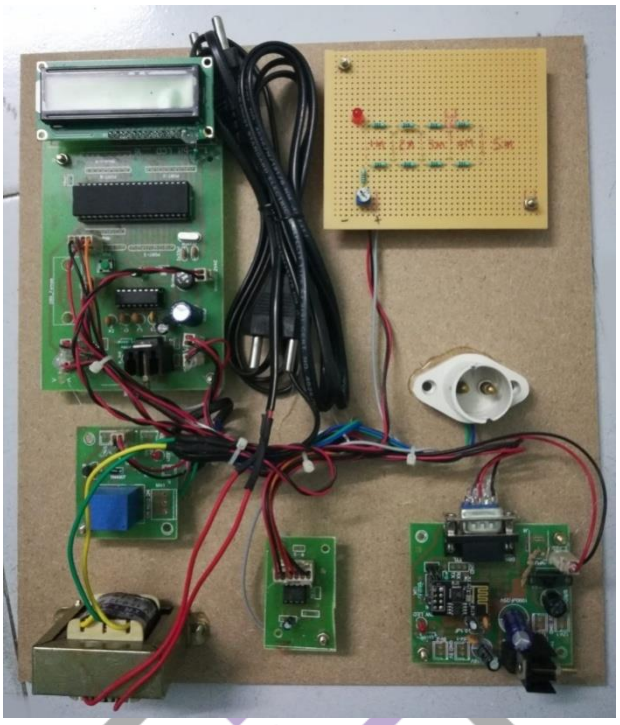

Fig 5.6 Hardware Circuit of Proposed System

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