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Underground Cable Fault Detection Using Arduino Microcontroller

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ABSTRACT: In urban areas, electrical cables run underground instead of running over, because it does not affected by any adverse effect of weather such as heavy rainfall, snow, thunder storm. Whenever a fault occurs within the underground cable, it is difficult to detect the exact location of the fault for the repair process of particular cable. The proposed system found the point of the exact location of fault. The paper uses the standard concept of Ohm's law i.e. when a low dc voltage is applied at the end of feeder through series resister (cable lines) then the current will vary depending on the location of the fault. Short in the cable.

This system uses an Arduino microcontroller and a rectified power supply. In this case, the current detection circuit in combination with the resister is connected to the microcontroller with the aid of an ADC device to represent the length of wire in Km. Error creation is performed by a set of switches. The relays are controlled by a relay exciter IC, which is used to check cable line. A 16x2 LCD is used to display information. Also one more feature is that using GSM the message of fault detection, location of fault and distance of fault from base station inkilometers this all information is send to base station. As soon as a fault occurs in a cable the buzzer produce the alarm to alert and to take an immediate action by field workers.

Key Words — Arduino microcontroller, Ohm's law, LCD, GSM, ADC, cable fault.

I. INTRODUCTION

Even the last cables of the decades where made to put the overhead and is currently put to the underground cable that is superior to the previous method. Because the underground cable are not affected by adverse weather conditions, such as storm, snow, heavy rain as well as pollution. But when any fault occurs in the cable, then it is difficult to locate fault. When it is easy to detect and correct the faults in overhead line by mere observation, it is not possible to do so in an underground cable. As they are buried deep in the soil it is not easy to detect the abnormalities in them. Even when a fault is found to be present it is very difficult to detect the exact location of the fault. Due to which dugging of entire area has to do, for detecting and correcting the fault which in turn causes wastage of moneyand manpower. So it is necessary to know the exact location of faults in the underground cables [1]. So we will move to find the exact location of fault. Now world has been digitalized so the paper is intended to detect the location of fault in digitalform. The underground cable system is the most common practiced followed in many urban areas. While the fault occurs for some reason at that time the repair process related to that particular cable is difficult due to not knowing the exact location of fault [2].

In the event of short circuit (Line to Earth) fault, the voltage accordingly. It is then fed to an ADC to develop precise digital data that is directed to the programmed Arduino to display the same in kilometers. Hence this paper is very helpful for determining exact location of short circuit fault. How to send this message to the base station, how the system works and alerts the field workers.

II. LITERATURE SURVEY

Mr.Pavan Suresh Warade, Lakshman k, Presented Design & Implementation Of Fault Identification In Underground Cables Using IOT [4]. They designed a system using 8051 microcontroller to detect the exact location of fault and this information of fault detection is also sent to a dedicated website over internet (IOT).

Dr. G. Joga Rao, S. Sharmilla, M. Mohan Avinash, N. Dileep Kumar, S. Mohan Swamy, B. Ranjith Kumar, Presented Analysis of Underground Cable Fault Distance Locator [5]. By analysing the

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existing system and to overcome the drawbacks occurs in the existing system they studied a system of finding exact location of cable fault using 8051micocontroller.

Mohammed Basha, T.Govind, P.Gurumurthy Reddy, Presented Arduino Based Underground Transmission Cable Fault Location System [6]. In this paper they used the wide application of embedded system and using one of them i.e. Arduino they developed a system of finding exact location of underground cable fault and also gave the result.

Shaikh Shahir, Shaikh Tariq, AqdasBangi, KhizarKhot Presented Underground Cable Fault Detector Using Gsm [7]. In this paper, they used microcontroller AT89552 which is used to detect location of cable fault and here also GSM is used for conveying information to the desired location.

R.K.RaghulMansingh, R.Rajesh, S.Ramasubramani, G.Ramkumar Presented Underground Cable Fault Detection using Raspberry Pi and Arduino [8]. In this paper they studied a system of finding underground cable fault especially high impedance incipient fault using Raspberry Pi and Arduino. They uses the simple concept of CT (Current Transformer) Theory so fault can be easily detected

TYPES OF CABLE FAULTS

These are the types of Cable Faults Commonly Found in the underground Cables.

A. **Open-Circuit Fault**

Open circuit fault is a kind of fault that occurs as a result of the conductor breaking or the conductor being pulled out of its joint. In such instances, current will not flow there at all, as the conductor is broken (conveyor of electric current) [3].

B. Short-circuit or cross fault

This kind of fault occurs when the insulation between two cables or between two multi-core cables gets damaged. In such instances, through the main core the current will not flow which is connected to load but will flow directly from one cable to another or from one core or multi-core cable to the other instead. The load will be short circuited [3].

C. Ground or earth faults

This kind of faults occurs when the insulation of the cable is damaged. The current will flow through the faulty cablestarts flowing from core of the cable to earth or the sheath of the cable. Current will not flow through the load [3].

FAULT LOCATION METHODS

Fault location methods can be classified as follows:

1) Online method

To determine the fault points this method utilizes & processes the sampled voltages & current. Online method for underground cable is less than overhead lines.

2) Offline method

This method uses special instrument to test out Service of cable in the field. The offline Methods are as follows,

a) Tracer method

In this method fault point in the cable lines is detected by walking on ground. The fault point is indicated from audible signal or electromagnetic signal. It is used to point out fault location very accurately.

Example:

1) Tracing current method
2) Sheath coil method

b) Terminal method

This technique is used to detect fault location of cable from one or both ends without tracing. The general area of fault is located by the use of this method, to expedite tracing on buried cable.

Example:

1) Murray loop method
2) Impulse current method [1].

III. PROPOSED SYSTEM

Underground cable fault detector deals with finding of exact fault location from the base station itself. The proposed system finds the exact location of the fault. This paper uses the standard concept of Ohm's law i.e. As soon as a low DC voltage is applied at the feeder end through a series resister, the current would vary depending upon the location of fault in the cable. Cables have some resistance. We are mainly focusing on the resistance. Resistance can vary with respect to the length of the cable. If the length of the cable is increase, the value of the resistance will also increase. If any deviation occurs in the value of resistance, we will call that is fault point and finding that place through Arduino technology. The standard of distance (kilometer) from the base station is represented by the fault point. This value displayed by display unit LCD. Also one more feature is that using GSM the message of fault detection, location of fault and distance of fault from

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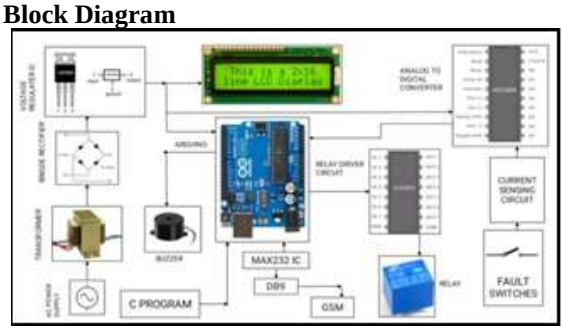
basestation in kilometers this all information is send to base station. Whenever a fault occurs in a cable the buzzer produces the alarm to alert and to take an immediate action by field workers.

Block Diagram



HARDWARE USED

1) **Arduino Microcontroller**

It is a powerful single board computer, an open source hardware platform allowing creating interactive electronic objects. It consists of Arduino board, set of various analog and digital I/O pins, serial communication interfaces, including USB on some models, for loading programs from personal computers. Its platform provides an integrated development environment (IDE) based on the processing project, which includes support for C, C++ and Java programming languages. This method features an Atmel Atmega328 operating at 5v with 2kb RAM, 32kb of flash memory for storing programs and 1kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to executing about 300,000 lines of C source code per second.

Fig.2: Arduino Microcontroller

2) **Power supply**

The power supply circuit consists of step down transformer which is 230v step down to 12v.In this circuit 4diodes are used to form bridge rectifier which delivers pulsating dc voltage and then fed to capacitor filter the output voltage from rectifier is fed to filter to eliminate any AC components present even after rectification. The filtered DC voltage will be given to regulator to produce 12v constant DC voltage.

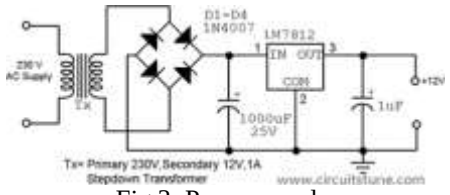


Fig.3: Power supply

3)Analog to Digital converter ADC0804

An analog to digital converter is any device that convert analog signal (continuous quantity) into digital signals (discrete time digital representation). The analog signal is a continuous sinusoidal waveform that cannot be read by Arduino so here ADC0804 is used

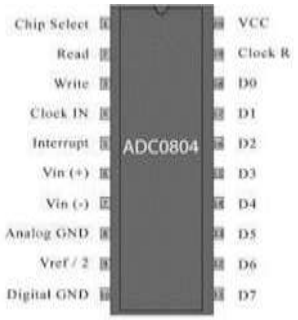


Fig. 4: ADC0804

4) **LCD (Liquid crystal display)**

Liquid crystal display are interfacing to microcontroller 8051.Most commonly LCD used are 16*2 and20*2 display. In 16*2 display means 16 represents column and 2 represents rows. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7- segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

Fig.5: Liquid crystal display

5) GSM (Global system for mobile communication)

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A GSM is an open, digital cellular technology which accepts a SIM card and operates over a subscription to a mobile operator, it works just like mobile phone. In this paper GSM is also used when user is at long distance. Where the fault is occurs this information send in the form of message via GSM.

Fig.6: GSM

WORKING

Working of this project is divided into four parts – DC power supply Part, cable part, controlling part, display part.

DC power supply part consist supply of 230v AC then it is step down using transformer, bridge rectifier converts ac signal to dc & voltage regulator 7805 is used to produce constant dc voltage.

The set of resistors denote the cable part along with switches. The set of resistors & switches are used as fault creators to indicate the fault at each location this shown by the current sensing part of cable. The change in current is sensed by this part by sensing the voltage drop.

Controlling part uses the analog to digital (ADC) to converter the input current sensing signal from the current generating circuit to the voltage drop into digital signal and supply the Microcontroller. The microcontroller makes necessary calculations regarding the distance of the fault. The driver is ran by the microcontroller and controls the switching of the relays for proper connection of the cable at each phase.

Display part consists of the LCD display interfaced to the microcontroller and it shows the status of the cable of each phase and the fault distance of the cable at the particular phase, in case of any fault and GSM used to send message to the base station. Buzzer is used to alerts the field workers.

ADVANTAGES

1.Provides precise accuracy in determining the location of fault.
2.Consumes low power in Nano watts.
3.Compact size, Easy to handle.
4.Serial on board programming.
5.No external programming voltage needed.
6.Less maintenance cost.
7.It has higher efficiency.
8.Lower tree trimming cost.
9.Safe and secure to use.
10.It is fast, effective & flawless service.
11.Highly reliable and efficient to use.
12.Useful for all type of underground cable.
13.Public safety is improved

IV. LIMITATIONS

1.The Arduino and other component require 5V DC Supply.
2.Relay requires 12V dc.
3.Sometimes network Problems for rural areas may happen.
4.Angular value required time to read so some delay occur.

V. CONCLUSION

It's a difficult task to find the faults in underground cables. This paper is intended to study how to detect the exact location of circuit fault in the underground cables from the feeder end in km by using an Arduino microcontroller. The Arduino microcontroller work is based on the output of the cable resistance. As soon as fault occurs in the cable, the display unit displays the exact fault location and also displays which phase is affected in the cable and how long it's affected and buzzer system is used to create an alerting signal which is helpful to humans. Also using GSM the message of fault detection send to the base station.

VI. ACKNOWLEDGMENT

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