UNDERGROUND CABLE FAULT DETECTOR BASED ON ARDUINO

[1] **Mohit Borde,** [2] **Aniket Kamble,** [3] **Saurabh Titirmare,** [4] **Harshal Patrikar,**
[5] **Sonali Sangole,** [6] **Pradnya Julme,** [7] **Dr. Sonali Dhurvey**
[1][2][3][4][5][6] BE Students, Department of Electrical Engineering
[7] Asst. Professor, Department of Electrical Engineering
[1][2][3][4][5][6][7] Priyadarshini Institute of Engineering and Technology, Nagpur.

ABSTRACT

The main objective of this project is to detect the faults and abnormalities occurring in underground cables using Arduino. The basic idea behind the working of this project is ohm's law. At the feeder end, when a DC voltage is applied, based on the location of fault in the cable, the value of current also changes. So in case of short circuit faults like L-G or L-L fault the change in voltage value measured across the resistor is then fed to the in-built ADC of the Arduino. This value is processed by the Arduino and the fault is calculated in terms of distance from the base station. This value is sent to the LCD interface to the Arduino board and it displays exact location of the fault from the base station in kilometers for all three phases. This project is arranged with a set of resistors which represents the length of the cable. At every known kilometer fault switches are placed to induce faults manually. Finally the fault distance can be determined.

Keywords : - *Underground cable, Fault, Arduino, Microcontroller, Open circuit, Short circuit*

1. INTRODUCTION

The purpose of this project is to determine the distance from the base station's underground cable fault in kilometers. In this project we used a simple concept of ohm's law .When a fault occurs in the system the distance located on liquid crystal display (LCD). Until the last decade, cables were designed to be placed above the head and, at present, there is no underground cable that is higher than the previous method. Adverse weather conditions such as storms, snow, torrential rains and pollution does not effect on underground lines, but when a fault occurs in underground lines it is difficult to locate the fault in underground cable. We will find the exact location of the fault. Now the world has become digitized so, the project is to detect exact location of the fault in digital form. Underground cabling system is a more common practice in many urban areas. Although the fault occurs for some reason, at that time, the repair process for this particular cable is difficult because of not knowing the exact location of the cable breakdown.

1.1 Faults in Underground Cables

Open circuit fault :- These faults occur due to the failure of one or more conductors. The most common causes of these faults include joint failures of cables and overhead lines, and failure of one or more phase of circuit breaker and also due to melting of a fuse or conductor in one or more phases. Open circuit faults are also called as series faults. These are unsymmetrical or unbalanced type of faults except three phase open fault.

Short circuit fault :- A short circuit fault occurs when there is an insulation failure between phase conductors or earth or both, further short circuit fault can be categorized in two types: Symmetrical fault (LLL, LLLG) & Unsymmetrical fault (LL, LG, LLG).

1.2 Fault Detection Methods

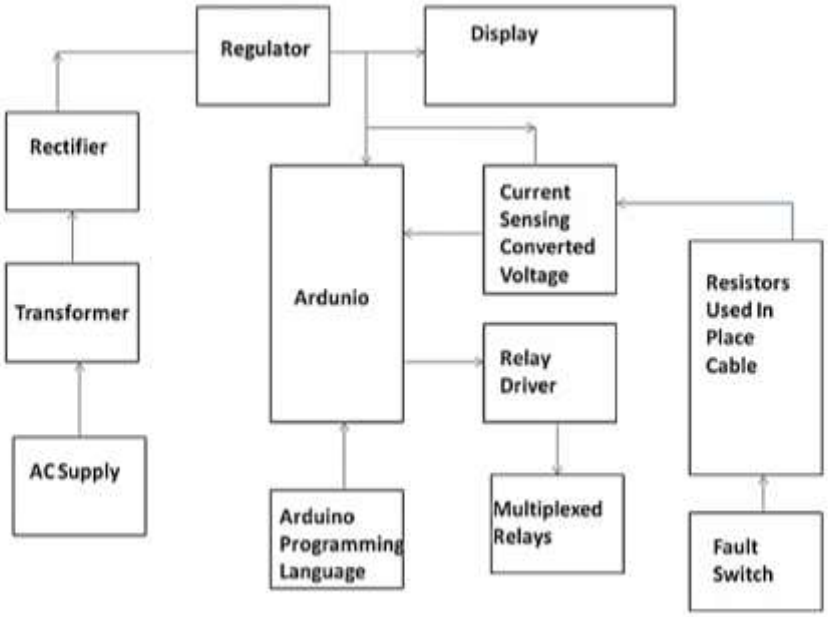
ONLINE METHOD :
This method utilizes and processes the sampled voltages and current to determine the fault points. Online methods for underground cable are less common than overhead lines.
OFFLINE METHOD :
In this method special instrument is used to test out service of cable in the field. This offline method can be divided into two methods. They are tracer method and terminal method.

- TRACER METHOD
  In this method fault point is detected by walking on the cable lines. Fault point is indicated from audible signal or electromagnetic signal. It is used to pinpoint fault location very accurately.
- TERMINAL METHOD
  It is a technique used to detect fault location of cable from one or both ends without tracing. This method use to locate general area of fault, to expedite tracing on buried cable.

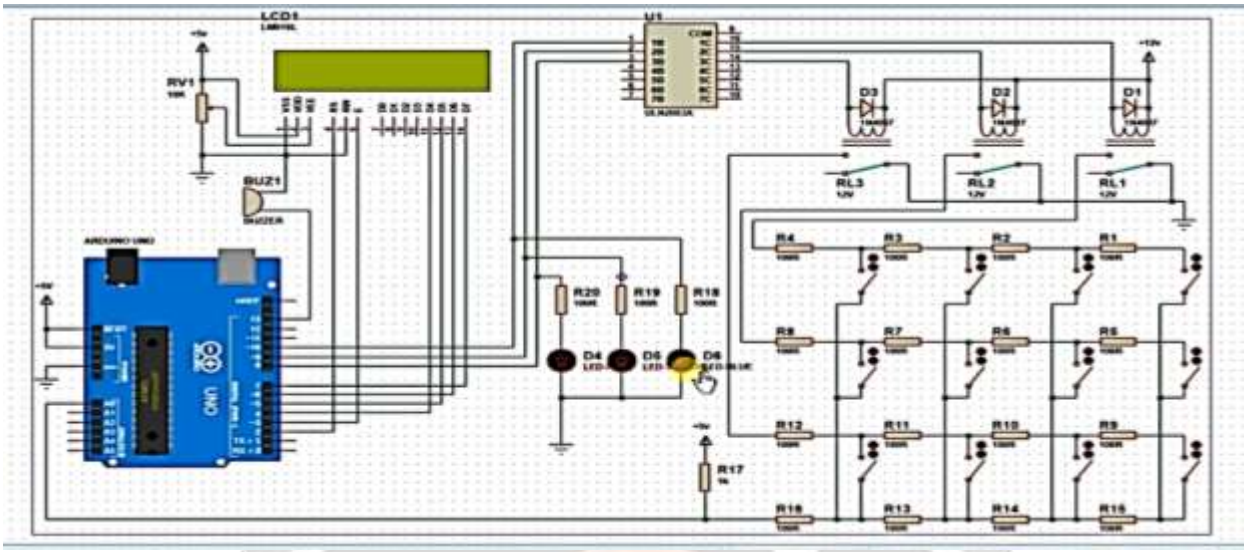
2. LITERATURE SURVEY

[4] "Arduino Based Underground Transmission Cable Fault Location System", Roshani Shingrut, Dakshata Mokal, Shubham Shelar, Shekar Mhatre , IJERT, Vol.9 Issue 02, February 2020.
The transmission line fault location requires intense human effort and resources. Typically this process is time consuming and while digging the cable there is a risk of damaging the insulation. This paper provides a simple and safe alternative by automating the process of fault detection and location. The project uses the simple concept of OHMs law where a low DC voltage is applied at the feeder end through a series resistor. The current would vary depending upon the length of fault of the cable in case there is a short circuit of LL or 3L or LG etc. The series resistor voltage droop changes accordingly which detects the exact location of the fault for process of repairing that particular cable. The proposed system finds the exact location of the fault. This system uses an Arduino micro controller kit and a rectified power supply. Here the current sensing circuits made with a combination of resistors are interfaced to Arduino micro controller kit to help of the internal ADC device for providing digital data to the microcontroller representing the cable length in kilometers. The fault creation is made by the set of switches. The relays are controlled by the relay driver. A 16x2 LCD display connected to the microcontroller to display the information. In case of short circuit, the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data to a programmed Arduino micro controller kit that further displays exact fault location from base station in kilometers. The project in future can be implemented by using capacitor in an AC circuit to measure the impedance which can even locate the open circuited cable.

3. BLOCK DIAGRAM



4. CIRCUIT DIAGRAM



4.1 Circuit Description & Working

A 230V AC supply is applied to the transformer from where it is stepped down to 12V AC. From the transformer the alternating current gets converted into direct current when it passes through a Bridge wave rectifier. The 12V DC then goes to the voltage regulator where it gets converted from 12V DC to 5V DC . Voltage regulator is used also converts the variable Dc supply into constant DC supply. This 5V DC is used to supply power to the arduino and the LCD. Power supply to the LCD is given from the voltage regulator.

The circuit consists of a power supply, 4 line display, arduino and resistance measurement circuit. To induce faults manually in the kit, fault switches are used. About 12 fault switches are used which are arranged in three rows with each row having 4 switches. The 3 rows represent the 3 phases namely R, Y and B. The fault switches: have 2 positions-No fault position (NF) and fault position (F).

So starting from the reference point 4 sets of resistances are placed in series. These 4 sets of resistances represent the three phases and the neutral. Short circuit faults, Symmetrical and unsymmetrical faults can be determined by this method. This project uses three set of resistances in series (ie) (R1-R2- R3-R4) ; (R5-R6-R7-R8) ; (R9-R10-R11-R12) one for each phase. Each series resistor represents the resistance of the underground cable for a particular distance and so here four resistances in series represent 1-4 kilometers. Value of each resistance is 1kΩ.

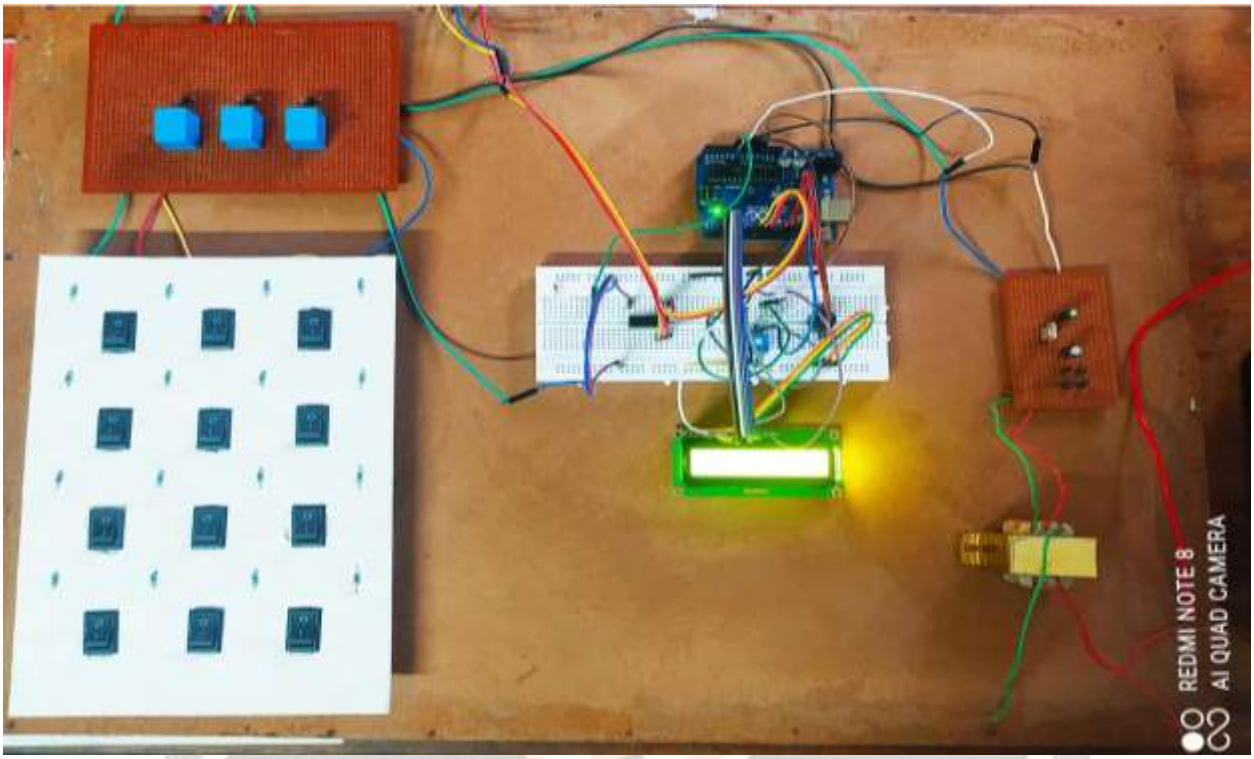
One relay for each phase R, Y and B. three relays are used and the common points of the relays are grounded and the NO points are connected to the inputs of R4, R8 and R12 and being the three phase cable input. As supply needed for the relays is higher than that of the arduino, Relay driver is used to boost the supply and provide it to the relays.

When fault is induced by operating any of the 12 switches (to F position), they impose conditions like LG, LL, LLG fault as per the switch operation. As a result of the fault, there is a change in voltage value. This voltage value measured across the resistance is fed to the ADC of the Arduino. Using this value, the arduino computes the distance. Finally the distance of the fault from the base station is displayed in kilometers.

5. ADVANTAGES

- Lower storm restoration cost
- Lower tree-trimming cost
- Increased reliability during severe weather (wind related storm damage will be greatly reduced for an underground system, and areas not subjected to flooding and storm surges experience minimal damage and interruption of electric service.
- Far fewer momentary interruptions Improved utility relations regarding tree trimming
- Improved Public Safety.
- Fewer motor vehicle accidents. Reduced live-wire contact injuries
- Less maintenance
- It has higher efficiency

6. SYSTEM MODEL



7. CONCLUSIONS

This is proposed model of underground cable fault distance locator using microcontroller. 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 stepdown using transformer, bridge - rectifier converts ac signal to dc & regulator is used to produce constant de 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 consist of analog to digital convertor which receives input from the current sensing circuit, converts this voltage into digital signal and feeds the microcontroller with the signal. The microcontroller also forms part of the controlling unit and makes necessary calculations regarding the distance of the fault. The microcontroller 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. The display part consists of the LCD display interfaced to the microcontroller which shows the status of the cable of each phase and the distance of the cable at the particular phase, in case of any fault.

7. REFERENCES

[1] “Detection of Underground cable fault using Arduino and GSM module”, P. Hari chandana, M. Venkataramana, K. Satyanarayan, P. Yogendra, Srinivasa Acharya, IJIRT, Vol.5 Issue 11, April 2019.
[2] “Underground Cable Fault Detection using Raspberry Pi & Arduino”, R.K.Raghul Mansingh, R.Rajesh, S.Ramasubramani, G.Ramkumar, IJETER, Vol.5 Issue 04, April 2017.
[3] “Under Ground Cable Fault Detection Over IOT”, Durgesh Pathak, Mithil Rathod, Sandeep Vishvakarma, Harindar Maurya, Mahalaxmi Palinje, IJERT, Vol.5 Issue 01
[4] “Arduino Based Underground Transmission Cable Fault Location System”, Roshani Shingrut, Dakshata Mokal, Shubham Shelar, Shekar Mhatre , IJERT, Vol.9 Issue 02, February 2020.
[5] “Underground Cable Fault Location”, B.Clegg.New York: McGraw-Hill, 1993.
[6] “Underground Cable Fault Detection using Arduino”, T.Nandhini, J.Shalini, T.Sai Sangeetha, IJESC, Vol.7, Issue 04, April 2017.