# UNDERGROUND CABLE FAULT DETECTION USING IoT

**Vivek KR Verma[1], Mayank Kumar[2], Kushal Patel[3], Pankaj Kr Singh Kushwaha[4], Shashi KR Sharma[4]**

[1]*Assistant Professor, ABES Engineering College, Ghaziabad, Uttar Pradesh, India*
[2-5]*Students, ABES Engineering College, Ghaziabad, Uttar Pradesh, India*

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**Abstract -** *The main aim of this paper is to find the accurate and specific location of the fault occur in the underground cable with the help of IoT device and by using Arduino Mega microcontroller kit. The result is shown on a web page and also the message is being sent on the mobile phone with the help of GSM. The urban region uses an underground electrical cable wire rather than using the overhead lines. But it is hard to spot the fault location in underground cable accurately that leads to difficulty in repairing. This system finds the specific location of the fault in the cable. The underground cables are prone to get faults due to wear and tear, underground conditions, rodents etc. The whole cable is to be dugout for the invigilation and fault fixing as we not know the fault location accurately. Our propose is to find the location of fault exactly that is to be fixed for the ease in the process of repairing. The potential divider network system is used to detect the fault that laid across the cable. When lines are short together then a fault is created at that point, a particular voltage is generated as per the network combination of the resistors. The microcontroller sensed the voltage change and send a signal to the user. The information about the location at which that voltage coincide is sent to the user.*

*The information of the fault is shown over LCD with the help of microcontroller, also this information is sent to the internet browser with the help of Wi-Fi module.*

**Key Words: Arduino Mega, GSM, Wi-Fi, LCD, Transformer**

## 1. INTRODUCTION

### 1.1 BACKGROUND

The electrical energy is sent through the electrical transmission and distribution system to the customers from the generation unit. When a line hit with a fault, it is necessary to detect fault for the power system and to clear it before the damage of the power system is increased. The underground cable system has an edge over the overhead line system but to find the fault location is hard. The development of locating fault techniques are on demand for reliable service. The resistance in the cables gets affected by the cable faults. If allowed to continue, a voltage breakdown can happen. The fault location method is a technique that helps in finding the fault that occurs periodically in the line, an Arduino microcontroller which is programmed shows the accurate and specific value of the resistance voltage drop digitally, which are connected in series. The ADC converts the distance in units from the base station. This paper comprises with LCD, GSM, Arduino and IoT. The time of the system is reduced and constructively operates on the system.

### 1.2 OBJECTIVE

This paper deals with the location of fault occurs in the cable by using the Arduino board that gives us the fault distance from the station. In common, urban region practices the digging method to find the underground cable fault which consume huge amount of time to find exact location of fault.

The method used by underground lines fault detection is a technique for locating the fault. This paper shows us the way to find the fault location which helps in avoiding the digging method for the whole line. This will save time and reduce human efforts.

## 2. SYSTEM ANALYSIS

### 2.1 EXISTING SYSTEM

The electrical energy is distributed to the different loads which are generated in the stations and consumed by villages, towns and cities then. The voltage is stepped up in this process to minimize the heat energy loss in the lines. The grid station sends the stepped-up voltage which is stepped down by the local transformers and send to the consumers for the use. The physically cutting and splicing the cable is the basic method of locating a cable fault. For the fault location, we start diving the cable into smaller parts so that the search is narrow down and fault get detected. For example, let's take a 1000-ft length wire which has to be divided and cut into

further smaller section i.e.500- ft length. Again this 500-ft length wire is cut into 250- ft length sections. This section is then measured by ohmmeter or by an insulation resister (IR) tester at both ends. The lower IR is shown by the defective section than at the correct section of the wire. The method of divide and conquer is used until we can find the smaller section of the cable at which fault occurs. This process becomes very hectic and involves repetition in cable evacuation.

## 2.2 LIMITATIONS OF EXISTING SYSTEM

There are many disadvantages to the present system. For the detection of the fault in a cable whole cable is checked whenever a fault occurs in a cable. It is time- consuming and requires a lot of human efforts. This method is used by the short distance case only. During the repair work the probability of mishappening increases. The interruption is caused due to striking of light on overhead cables as they are vulnerable to it. The bare conductors are used which causes damage if they break. The voltage drop is high and the maintenance cost is also high.

## 3. PROPOSED SYSTEM

This document mainly focuses to detect location range of the underground wire fault. This is going to use the idea of Ohm's law. As per this principle, when small DC voltage is feed at one end of cable using network of resistors, there is change in current based on position of fault in the wire.

If there occur any Short Circuit, then there is change in voltage in the wire, now this is given to the Analog to digital Converter of Arduino Mega development board that provide accurate digital data and will be displayed on LCD. In this way, we are able to get the specific range of defected wire(fault) from the base station. This System alarms when defect in wire occurs. It may also be used for the transmission of wire under the ground. Wires have their own resistance; Our prior concern is that, the resistance of cable may change in accordance with the wire length.

When there is increase in cable length, the resistance value increases accordingly. The Fault point occur whenever there is fluctuation in the resistance and we identify this point using GSM module. This location shown on LCD display measuring from the base station.

## 3.1 Outcomes and Benefits

- We are able to find exact range of fault.
- Saves Man Power
- Saves cost and Convenient.
- This may utilize for overhead and underground cables.

## 3.2 SOFTWARE AND HARDWARE REQUIREMENTS

### 3.2.1 HARDWARE REQUIREMENTS

Hardware i.e. all the physical components, are essential to govern the flow of process by sensing the values and send it to Arduino. Following hardware, we are going to use:

**LCD Display:** LCD refers to **L**iquid **C**rystal **D**isplay, used in many devices (to display output). Similar to gas-plasma technologies and light-emitting diode (LED), Unlike Cathode Ray Tube (CRT), display of LCD is much thinner. It uses very low energy as compared to LED(s), gas displays as LCD is based on the principle of intercepting beam of light in spite of emitting the light. LCD is based on alpha-numeric pattern. Meaning, this is able to show alphabets, numbers and special symbols as well. This is very convenient device that is used to display various information.

**Switches:** Push buttons switches are the tactile switches which allows to power the circuit or make any connection within the circuit. These switches have power rating of 50mA 24V DC. In our project we use then to create fault in the circuit.

**Transformer:** A transformer is an important part of circuit which is used to convert electrical energy from one coil to another coil. This is based on the principle of mutual induction among the coils. It can convert power from one circuitry to other having no alteration of frequency, but there can be difference in the amplitude of voltage. It can either increase or decrease amplitude of V or I in circuit. In today's times, most of these devices increases amplitude of voltage in order to minimize any kind of trouble along the path. This is mainly employed to regulate the voltage. Depending upon the behaviour, there may be two types of transformers available: Step up and Step-down.

**Diodes:** It's a device that used as one-way switch for flow of current. The main functionality is to pass the current in only one direction while restricting in the other direction. In this way, this may be seen as a replica of electronic check valve. The one-way

switch behaviour is known as rectification, usually operated within rated level. It basically restricts the flow in reverse direction. Also, a reverse voltage lies within a limited range so that to retain reverse barrier from breakdown.

**Voltage Regulator**: Voltage regulator is a device that gives the voltage of constant level itself. This produce a voltage having constant magnitude. This constant voltage is fixed irrespective of changes in load value or its input voltage.

**Resistors**: Rresistor is a passive component having two terminals. It executes the electrical resistance in the form of circuit element. Resistors are connected in series which show the cables. We are using resistorsof 10 kilo ohm in the paper.

**Capacitors**: Capacitor is a passive component having two terminals. The electrical energy in stored in the form of electric field. Electric charge is stored in it. It consists of more than one pairs of conducting plates segregated by an insulating material.

**LEDs**. It represents which cable line is working perfectly. In this device fault is created by the switches.

**Arduino board**: Arduino is a publicly-available gadget that stages work on the simple to-utilize system and programming. Microcontroller boards easily understand inputs - light fall on a sensor, easily sense touching of a button or can read a Twitter information – and provide an effective output -starting a motor, turning ON a LED, circulate information on the web. The Arduino Mega is a board that dependent on the ATmega2560. It consists of 56 I/P and O/P pins (in which 15 pins are allocated for the output of PWM).

A sixteen MHz fired resonator, a USB contact, a power jack, an ICSP header, and a reset button, it has all the features which are required for the the microcontroller: basically, interface PC with Arduino through a USB connection or give supply with a battery or a connector to get started.

**GSM Module (SIM900):**

This module is a GSM/GPRS four-band module developed for the worldwide market. It supports four frequencies with the different range of GSM 850MHz,900MHz,1800MHz and 1900MHz. Its unique quality of GPRS multi-slot classes support coding schemes of GPRS with multi-slot class having 10/8GPRS mobile station of class B. With a small configuration, SIM 900 can provide different basic space requirements in users' applications, like M2M and smart phone. SIM 900 consist of sixty-eight SMT pads, and they provide all hardware interfaces. SIM 900 combine TCP/IP protocol and spread TCP/IP the AT commands of TCP/IP which are important for the transfer of data.

**Wi-Fi (ESP 8266):**

In this paper we are using ESP8266, a Wi-Fi module which is used for sending the data to the cloud. For sending the data first we create an account on Ask Sensors IoT platform. Ask Sensors is an IoT platform providing communication between the cloud and different internet connected devices. This platform provides a free account so you not need to pay to get started.

### 3.2.2 SOFTWARE REQUIREMENT

Software Requirements explain the need of different software program and precondition that are required to install in the computer system to give best functioning of the software. These different requirements and preconditioning are basically, not covered in the software so, we need to set up a package which must be install independently before the installation of software. The software which is required for the fault detection system is:

**Arduino programming language:**

Arduino Software (IDE): The publicly available Arduino Software (IDE) that provide a platform to write code in simple way and send to the microcontroller. This works on Linux, Mac OS and also on Windows. The domain of this software is composed in Java which work on Processing and different publicly-available software.

HTML is ideal mark-up language used for generating Web pages. HTML stands for Hyper Text Mark-up Language. HTML define the basic structure of webpages. HTML element is basic block of HTML page by using different tags we can easily represent the HTML elements.

**BLYNK Application:**

This application was created for the IoT and used to manage the hardware. This app shows the data of sensor and visualize it. This application creates an interface between the project and various widgets also responsible for the remote communication between device and the user.

## 4. GENERAL DESCRIPTION

### 4.1 Product Perspective

Today in many metro cities underground cable system is largely familiar where repairing of cable it very problematic because finding the location of fault is really a tough task.

With this device, we can easily find exact position of fault. An LCD display and a web net page are two important part of this system. This system work on the principle of Ohms law i.e, whenever a small voltage (DC) is given through the network of resistor at the end of the cable, then there is change in the current value which depend on the exact position of the fault within the cable. If any short circuit occur, their is a voltage change across the resistors. This change in voltage is given to A/D convertor which generate the accurate digital data tand displayed on LCD. This paper consist of the set of resistors which are connected in series showing the length of the cable in km and switches are used to generate the fault at each km to verify the perfection of this system. The location of the fault can be shown on the display of LCD display which is connected to the Arduino Mega.

There is change in the value of resistance occur when the switches are open, and the fault distance is easily calculated. The distance can be shown on the display of the LCD in Km. The Blynk App will show the location of faults.

### 4.2 Product Functionality

**Arduino:** Arduino Mega is a microcontroller development board that cause the different application

maximum reachable that includes very interactive objects around its surroundings. Arduino work as a server in the underground wire fault detector.

This paper consists the resistors which are connected in series. These series resistors are used to show that cables are conductors having current carrying capability. Whenever we choose any specific cable the particular LED which is analogous to the cable bloom showing the line is active. The set of switches is used for fault generation. If switch is open it indicate the fault. Arduino read the resistance value and calculated the distance. The distance which is calculated is shown on the display of LCD and the BLYNK App.

**Wi-fi Module:**

ESP8266 is a Wi-Fi microchip. It has microcontroller Capability having full TCP/IP stack. ESP8266 is 32-bit microcontroller. It has 16 input GPIO pins. It consists of 32kiB instruction and 80 KiB user data, a power jack, a RJ45 connection, an ICSP header, and button to reset is used.

This tiny module provides the feature of connecting to the Wi-Fi network and generate simple connections of TCP by using different types of commands. The ESP8266 with 1MiB of built-in Flash memory help in making the devices having single-chip which having capability of connecting to Wi-Fi network. It has authentication of WEP or WPA, or open network. It is having a UART with the dedicated pins, and consists of a transmit-only UART that can be enabled on 10-bit ADC and GPIO2.

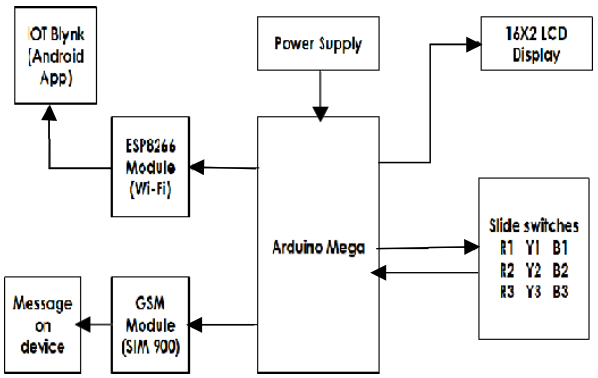
ESP8266 module can introduce an application. It has feature of unloading networking functions of Wi-Fi with the help of other application processor. ESP8266 is a pre-programmed module having set of an AT command. ESP8266 can be easily connect with the microcontroller.

It has powerful storage capability due to which it can be easily integrated with application devices and the sensors through GPIO.

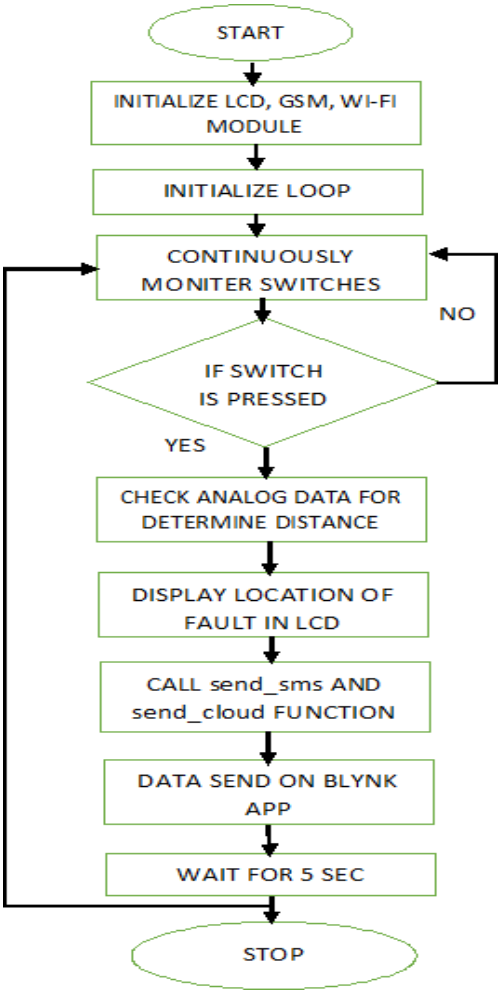
## 5. BLOCK DIAGRAM

In this project the concept of OHMs law is used. When we applied low voltage (DC) at the end in the resistors which are connected in series then the value of current would depend on the length of fault of the cable. The changed voltage value in the circuit is fed to an ADC which send the value to the microcontroller. We made this project with the set of resisters which are connected in series that represent the length of cable in KMs. This project is made in five major parts –Power supply, controlling, cable part, GSM and Wi-Fi module and display. Power supply which converts ac signal to dc signal with desired voltage with the help of bridge rectifier. The set of switches which are connected in series represent cable length and that represents faults in the cable. Microcontroller Arduino Mega is the controller which send signals to the connected module and also make calculation regarding fault.

The LCD screen is used to show the fault location which is connected to the microcontroller. Simultaneously microcontroller send signal to the GSM module which send fault location message to the connected device and also this message signal is send to the server by using wi-fi module to the BLYNK application which maintain record and real time analysis for the faults.




**FLOW CHART**



## 6. ALGORITHM

Step1: Initialize LCD, GSM and Wi-Fi module. Step2: Start an infinite loop.
Step3: Check weather fault is created or not.

Step4: If fault is not created then continuously monitor.

Step5: Fault is created then check analog data for distance.

Step6: Display fault on screen and call send_sms and send_cloud function.

Step7: Data send to Blynk app.

Step8: Repeat step3 to step7 for other phases.

## 7. CONCLUSION

Electrical Cables help in distribution of electrical energy. These cables face so many failures. Which is very complicate task to detect the faults in these cables. This system with the help of Arduino find the exact position of fault in cable from the base station in Km. Nowadays in many non rural areas, the wires in underground are frequently used rather than atop lines. Whenever there is a fault in underground cable it become very tough to locate the correct position of the fault for the repairing of the cable. This system will work effectively for underground as well as atop cables. An Arduino Mega board used in this system. Here the Arduino is interfaced by the current sensing circuits which is made of combination of many resistors. The fault is generated by the set of switches. To increase the remote controlling capability of this industrial system we have proposed the low-cost solution. This project on detection of fault with working Arduino was made and fault distance in km from the ground station will be shown on the screen of LCD and webpage. Whenever there is the fault occurs then the switch which is analogous to the phase is recognized as the faulty phase to which fault switches are operated. In this way the sector having fault can be easily positioned.

It is durable, safe and low consuming power device. This device can run on various channels to escape the interference with equipment or another wireless device. With the help of microcontroller, we can accurately detect the fault position. As faults occur in the cable, the fault location is displayed on the LCD display.

## 8. FUTURE SCOPE

We can further develop a better user interface by which detection of open circuit fault is possible in near future. To find the fault in ac circuits, fluctuation in impedance is measured with the help of capacitor. In this way we can find the fault distance.

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