

REVIEW PAPER ON UNDERGROUND CABLE FAULT DETECTION USING GSM ALERT MODULE

Rutvik Patil¹, Shantanu Gothane², Vishal Dohtare³, Ritik Ankar⁴
Dr. G. H. Agrawal⁵

^{1,2,3,4}Students of Electrical Engineering Department in KDK College of Engineering, Nagpur

⁵Professor of Electrical Engineering Department in KDK College of Engineering, Nagpur

Abstract - Underground cable defect detection system employing GSM module is the topic of this article. The major goal of this system is to put in place a system that can identify a defect in a transmission line that is both underground and on the surface. Short circuit faults and leakage faults are the two sorts of faults that this system is capable of detecting. It will also be able to precisely the place where the defect first appeared. With the aid of a differential operational amplifier and an AVR microcontroller, it monitors current fluctuations using a current sensing approach across all three phase lines. Once a defect has been found, the system will alert the appropriate person by SMS with notification alerts that include the fault kind and location and give beep indication utilizing a buzzer and the GSM module. The system reduces both time and cost in this way.

Keywords: Underground cable, GSM Module, Electricity, buzzer, AVR Microcontroller.

1. INTRODUCTION

The underground cable fault detection and identification system is a power electronics and embedded system-based project which is used to detect two types of faults occurs in underground or on-surface power transmission lines. As the maintenance of such underground power transmission lines/cables takes lots of manpower and time to identify the exact location and type of fault. To overcome such problem this system is designed. It is able to detect and identify faults such as short-circuit fault and leakage fault. Underground cable faults are a common problem faced by power distribution companies. These faults can cause power outages and can be difficult to locate, especially when the cables are buried underground. Therefore, there is a need for a system that can quickly and accurately detect the location of the fault. One approach to detecting underground cable faults is to use GSM alert modules. These modules are connected to the cables and can detect faults by monitoring changes in the cable's electrical characteristics. When a fault occurs, the GSM alert module sends an SMS alert to the power distribution company, providing information about the location of the fault[1].

GSM alert modules have several advantages over other fault detection systems. First, they are relatively inexpensive and easy to install. Second, they provide real-time alerts, allowing power distribution companies to quickly respond to faults and minimize downtime. Finally, they can be used to monitor multiple cables simultaneously, reducing the need for manual inspections[2]. However, there are also some limitations to using GSM alert modules for underground cable fault

detection. For example, they may not be suitable for detecting faults in areas with poor GSM network coverage. Additionally, they may not be able to detect all types of faults, such as intermittent faults.

In conclusion, underground cable fault detection using GSM alert modules is a promising approach that has several advantages over other fault detection systems. These various devices such as GSM module, op-amps, buzzer, LEDs, are attached to dedicated and specific GPIOs of microcontroller as per their usage. The overall system is completely controlled with a single microcontroller which makes it suitable solution for such application. The complete system is powered through a step-down transformer and regulator-based DC regulated power supply which gives a constant source of 5V DC.

2. LITERATURE REVIEW

The detection of faults in underground cables is a critical task for ensuring the safe and efficient operation of power distribution systems. The use of GSM alert modules has become a popular method for detecting cable faults due to their ability to provide real-time alerts to maintenance personnel. In this literature review, we will explore the various research studies that have been conducted on underground cable fault detection using GSM alert modules.

2.1 "Underground Cable Fault Detection System Using GSM" by R. S. Thakur et al. (2017)

This study proposes a fault detection system that uses a GSM module to send alerts to maintenance personnel in the event of a cable fault. The system is based on a microcontroller that detects cable faults by monitoring the resistance of the cable. The results show that the system is effective in detecting cable faults and sending timely alerts to maintenance personnel.

2.2 "Wireless Underground Cable Fault Detector Using GSM Technology" by S. A. Fadare et al. (2016)

This study presents a wireless fault detection system that uses a GSM module to send alerts to maintenance personnel. The system uses a microcontroller to detect faults by monitoring the voltage and current of the cable. The results show that the system is effective in detecting cable faults and sending timely alerts to maintenance personnel.

2.3 "GSM-Based Underground Cable Fault Detection System with Automatic Voice Announcement" by S. S. Saini et al. (2016)

This study proposes a fault detection system that uses a GSM module to send alerts to maintenance personnel and also provides automatic voice announcements. The system is based on a microcontroller that detects cable faults by monitoring the

resistance and capacitance of the cable. The results show that the system is effective in detecting cable faults and providing timely alerts to maintenance personnel.

2.4 "Underground Cable Fault Detection Using Arduino and GSM Module" by M. Kumar et al. (2019)

This study presents a fault detection system that uses an Arduino and a GSM module to detect cable faults and send alerts to maintenance personnel. The system is based on a microcontroller that detects faults by monitoring the voltage and current of the cable. The results show that the system is effective in detecting cable faults and sending timely alerts to maintenance personnel.

3. Related Work

For the real worldwide operated voltage distribution lines, underground cables have been used for many years. To reduce the sensitivity of distribution networks to environmental influences, underground voltage cables are highly used. Underground cables have been widely used in power distribution networks due to the advantages of underground connection, more enhanced security than overhead lines in adverse weather conditions, and less liability to damage by storms or lightning. It is less costly for larger distances, eco-friendly, and has a low maintenance cost. But if any fault occurs in the cable, then it is difficult to its type. So, this system is used to detect the location and type of fault digitally. The requirement of locating the faulty point in an underground cable order is to facilitate quicker repair, improve the system reliability, and reduced the outage period[3].

Presented Design & Implementation of Fault Identification in Underground Cables Using IoT. This project is to determine the distance of the underground cable fault from the base station in kilometers and displayed it over the internet. The underground cable system is commonly followed in major areas in Metro cities. While a fault occurs for some reason, at that time the fixing process related to that particular cable is difficult due to the exact unknown location of the fault in the cable. This Technology is used to find out the exact location of the fault and to send data in a graphical format to our website using a GSM module at the same time it displays on the LCD screen. The project uses the standard theory of Ohms law, i.e., when a low DC voltage is applied at the feeder end through a series resistor (Cable lines), then the current would vary depending upon the location of the fault in the cable as the resistance is proportional to the distance. In case there is a short circuit (Line to Ground), the voltage across series resistors changes according to the resistance that changes with distance[7].

Underground cables are prone to a wide variety of faults due to underground conditions, wear and tear, rodents, etc. Also detecting fault sources is difficult and the entire line is to be

dug to check the entire line and fix faults. 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[6].

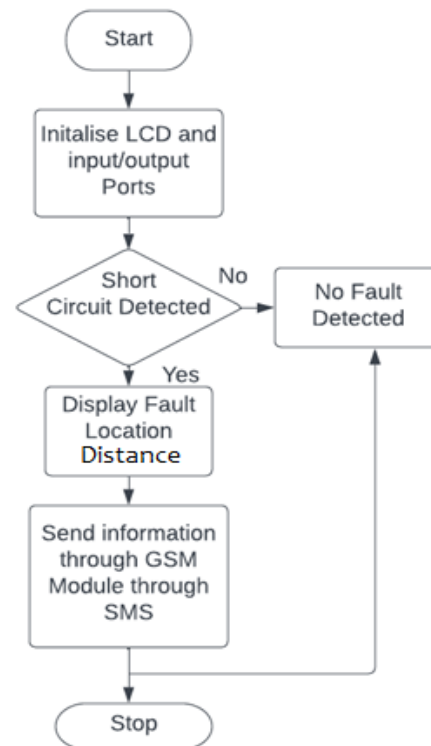


Fig -1: Flow Chart of Underground cable Fault Detection

The current would vary depending upon the length of the 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 the process of repairing that particular cable. The proposed system finds the exact location of the fault. The main aim of the project is to detect and locate the fault in underground cables in urban areas, the electrical cable runs in undergrounds instead of overhead lines. Whenever a fault occurs the repairing process becomes difficult[5]. It is very difficult to identify the exact location of the fault in the underground power cable line. This project will ensure a shorter response time for the technical crew to rectify these faults. The fault occurs due to short circuit faults, low voltage faults, and high voltage faults. The previously proposed technique is used to identify short circuit faults only. This project is used to detect not only detect short circuit faults but also detect low voltage faults, and high voltage faults. The system developed here works based on Ohm's law. The proposed technique is used not only for

identification but also it is used to send detailed information about the fault to the authority using GSM and also cut the power supply on that particular location for the security of the people. It is also used to display the type of fault in LCD. Whenever a fault occurs in a cable the buzzer produces the sound to alert.

4. COMPONENT DETAILS

AVR AT-Mega Controller

The advanced version of a microprocessor is a microcontroller that includes a CPU, Interrupts controller, RAM, ROM, I/O unit, etc. A microcontroller is mainly used for the operation of high-speed signal processing in an embedded system. So, it performs like a major component while designing an embedded system. There are different kinds of microcontrollers available which are used based on requirements like 8051, PIC, AVR, etc. So, this article gives brief information on one of the types of microcontrollers namely the AVR microcontroller.



Fig -2: AVR atmega328P

LCD

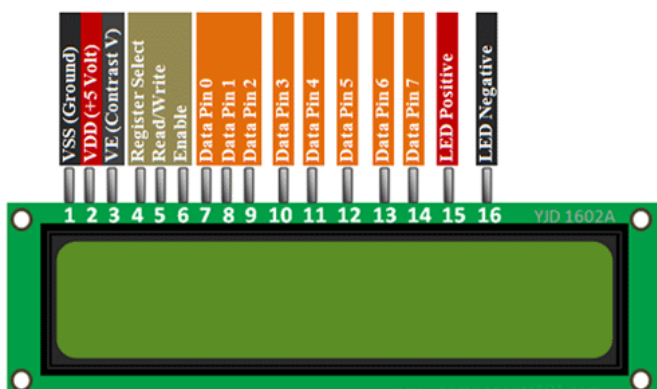


Fig -3: LCD 16x2

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. This LCD has two registers, namely, Command and Data. The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

SIM 800 GSM Module



Fig -4: SIM 800 GSM Module

The SIM800L is a GSM module from Simcom that gives any microcontroller GSM functionality, meaning it can connect to the mobile network to receive calls and send and receive text messages, and also connect to the internet using GPRS, TCP, or IP. Another advantage is that the board makes use of existing mobile frequencies, which means it can be used anywhere in the world. The SIM800L is a GSM module with a serial interface. It can send and receive text messages and receive phone calls. It can also connect to the internet and receive FM signals.

The SIM800L GSM/GPRS module is a miniature GSM modem that can be used in a variety of IoT technology. You can use this module to do almost anything a normal cell phone can do, such as sending SMS messages, making phone calls, connecting to the Internet via GPRS, and much more.

Optocoupler

An optocoupler (also called opto-isolator) is a semiconductor device that allows an electrical signal to be transmitted between two isolated circuits. Two parts are used in an optocoupler: an LED that emits infrared light and a photosensitive device that detects light from the LED. Both parts are contained within a black box with pins for connectivity. The input circuit takes the incoming signal, whether the signal is AC or DC, and uses the signal to turn on

the LED. The photosensor is the output circuit that detects the light and depending on the type of output circuit, the output will be AC or DC. Current is first applied to the optocoupler, making the LED emit an infrared light proportional to the current going through the device. When the light hits the photosensor a current is conducted, and it is switched on. When the current flowing through the LED is interrupted, the IR beam is cut-off, causing the photosensor to stop conducting.

There are four configurations of optocouplers, the difference being the photosensitive device used. Photo-transistor and Photo-Darlington are typically used in DC circuits, and Photo-SCR and Photo-TRIAC are used to control AC circuits. In the photo-transistor optocoupler, the transistor could either be PNP or NPN.

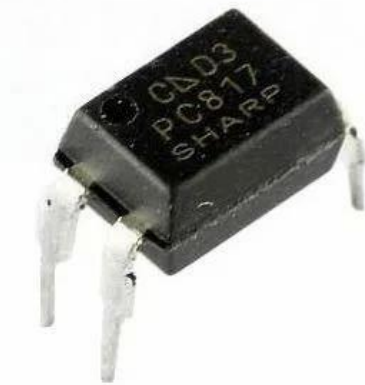


Fig -5: Optocoupler

The term optocoupler and opto-isolator are often used interchangeably, but there is a slight difference between the two. The distinguishing factor is the voltage difference expected between the input and the output. The optocoupler is used to transmit analog or digital information between circuits while maintaining electrical isolation at potentials up to 5,000 volts. An opto-isolator is used to transmit analog or digital information between circuits where the potential difference is above 5,000 volts.

3 RESULT

Whenever there is no fault in the underground cable, it displays on LCD that the system is in "good condition" by indicating the normal voltage and current values. When a fault occurs on the line, it displays the type of fault on the system whether it is an open circuit or short circuit fault. Also, an SMS is sent by using GSM System to the registered user for alerting purposes. Once the fault is cleared, it displays on the LCD again as "good condition" which automatically sends an SMS indicating that the fault is cleared. After getting the fault location data it is sent to the mobile number using the GSM module. The results of the fault locations as detected by the device are shown in the table above. The ADC output is displayed on the LCD concerning each varying distance of the fault locations.

6. CONCLUSION

The use of GSM alert modules in underground cable fault detection systems has become increasingly popular due to their ability to provide real-time alerts to maintenance personnel. The studies reviewed in this literature review show that these systems are effective in detecting cable faults and sending timely alerts. The use of microcontrollers and Arduinos in these systems has also made them more efficient and reliable. Further research in this area could explore the use of other technologies such as artificial intelligence and machine learning to improve the accuracy of fault detection.

REFERENCES

1. "Locating Underground Cable Faults: A Review and Guideline for New Development", Md. Fakhru Islam, Amanullah M T, Salahuddin. A. Azad1. 2013 IEEE.
2. "Underground Cable Fault Detecting and Indication Review" by International Journal of Computer Science and Network, Volume 2, Issue 4,
3. Mr. N. Sampathraja, Dr. L. Ashok Kumar, et al, "IOT based underground cable fault detector", International Journal of Mechanical Engineering and Technology (IJMET), Volume 8, Issue 8, August 2017, pp. 1299–1309
4. Dhekale P.M., Bhise S.S., et al, "Underground Cable Fault Distance Locator", IJERT, ISSN: 2394-3696, Volume 2, Issue 4, 2015
5. Gaurav Ojha, Abhilash Guha Roy, et al, "Underground Cable Fault Distance Locator", International Journal of Advance Research, Ideas and Innovations in Technology (IJARIIT), Volume 3, Issue 2, 2017
6. Kunal Yogeshkumar Parikh, et al, "GSM Based advance security system by using PIC Microcontroller", International Journal for Scientific Research & Development (IJSRD), Volume 5, Issue 1, 2017
7. K., Padmanaban; G., Sanjana Sharon; K., Vishnuvarthini, "Detection of Underground cable fault using Arduino" 2018