



Short Review Paper

A review of Arduino based underground cable fault detection

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Available online at: www.isca.in, www.isca.me

Received 3rd September 2021, revised 10th February 2022, accepted 9th April 2022

Abstract

The paper represents a fault detection or location scheme for an underground cable using an Arduino-based system. Underground cable fault can be classified into two categories- Open and Short circuit fault. We will use the concept of Ohm's Law to precisely detect the exact location of the underground fault. This paper is all about a smart technology-based system that accurately and adequately detects and locates the exact spot of the underground fault. Because of this system, the time required for detection of the fault diminishes and the response of the system becomes faster. Due to the short response time of the system, we can rectify this fault easily.

Keywords: LCD, IOT, Underground Cables, Arduino, series fault, shunt fault, open circuit fault, short circuit fault, earth fault.

Introduction

The underground cable system is a complex part of the power system and is dependent on secure or reliable distribution and transmission services. Deterioration of insulation of underground cables can be caused due to aging of the insulation of the wire, sometimes small animals like rats, snakes, scorpions, etc. when they enter switchgear to create fault and due to the environmental condition like temperature, humidity, pressure, heat, etc, vibrations, mechanical harm and construction of buildings are also a cause of deterioration of underground power cables. But due to lightning or other factors there are less chances of supply interruption in underground cables.

Faults

Faults occur in the underground cables such as series faults in which the circuit remains open hence open-circuit fault occurs. Shunt fault also occurs in the system in which the insulator gets cut while the conductor remains not damaged.

There is other classification of faults in underground cables: i. Open circuit fault, ii. Short circuit fault, iii. Earth fault.

Open circuit faults in underground power cables occur due to tearing or breaking of core of the power cable or conductor, it leads to detachment of supply. It is because of snakes, rats, and scorpions etc. This detachment or discontinuity is also due to mechanical stress and high intensity vibration.

Short circuit faults in underground cables occur only in multi-cored power cables. Whenever two or more power cable cores or conductors come in contact with each other then the fault

occurs is known as short circuit fault. This fault generally occurs when insulation of individual is deteriorated. It is very difficult to find out the short circuit fault by visual. Without taking the conductors apart it is impossible to detect this fault.

Earth fault occurs whenever the core or conductor of the cable comes in contact with ground or earth. It occurs usually when the outer layer called sheath of the power cable is deteriorated due to chemical effect or chemical reaction with soil. It also occurs due to mechanical stress, crystallization and intense vibrations. In this, current takes lowest resistance path to flow through earth.

The underground faults are pinpointed by excavating the length of the cable to enable us to carry out the operation and watch it manually. In cases when we cannot see the fault through the exposure then we have to replace the whole section of the faulty cable. Because we have to do it manually not only it costs us more it also takes too much time and because of this, the distribution companies' revenues take a very huge amount of loss.

The location of the fault in electric power lines is very vital for the cost-effectiveness of the system. The accuracy of the fault location will provide quicker repair, improve system availability and performance, reduce operating costs, and save time and expense of crew searching in bad weather and tough terrain. It is important to ensure a comfortable operation of transmission lines to deliver a very less interrupted power supply making it necessary for much reliable operation of the electrical power system².

The use of underground cables is increasing day by day due to their very limited environmental impact and good reliability. To improve the system reliability precise identification of a fault is required for reduction of time during the faulty conditions. This Arduino-based system with relays is used to detect underground faults⁴.

Advantages and Disadvantages of the System

Advantages: i. The chance of developing faults is very low in underground cables and the maintenance costs are also very low here. ii. Easy to handle the system. iii. Less consumption of power, iv. Improved public safety. v. This method of detection is very much time saving. vi. Accuracy of the system is above 90 percent. vii. Arduino based system is inexpensive. viii. It is an open source in software and hardware in which a microcontroller is connected. ix. It is very easy to program. We do not need any external burner or programmer for this.

Disadvantages: i. The cost of underground cables is very high if we go into the IOT based or GPS based system. ii. If the system fails for some reason it might be because of a power cut or power failure it is very difficult to find the faulty wire and repair it. Also, the process of determining the exact location of the faulty wire sometimes takes days or weeks just only to identify the problem and after that the repair also takes time and because of this, the system takes a huge hit. iii. These cables are underground which means during the time of maintenance it is very hard to be worked on thus making the process of maintenance very difficult. iv. These cable strains can't be trendy to increase the potential to advantage or increase the power output. These cables are particularly subject to destruction due to the floor motion required to an earthquake. v. The disadvantage of the current device is it deals only with detecting the location o faults of underground power cable.

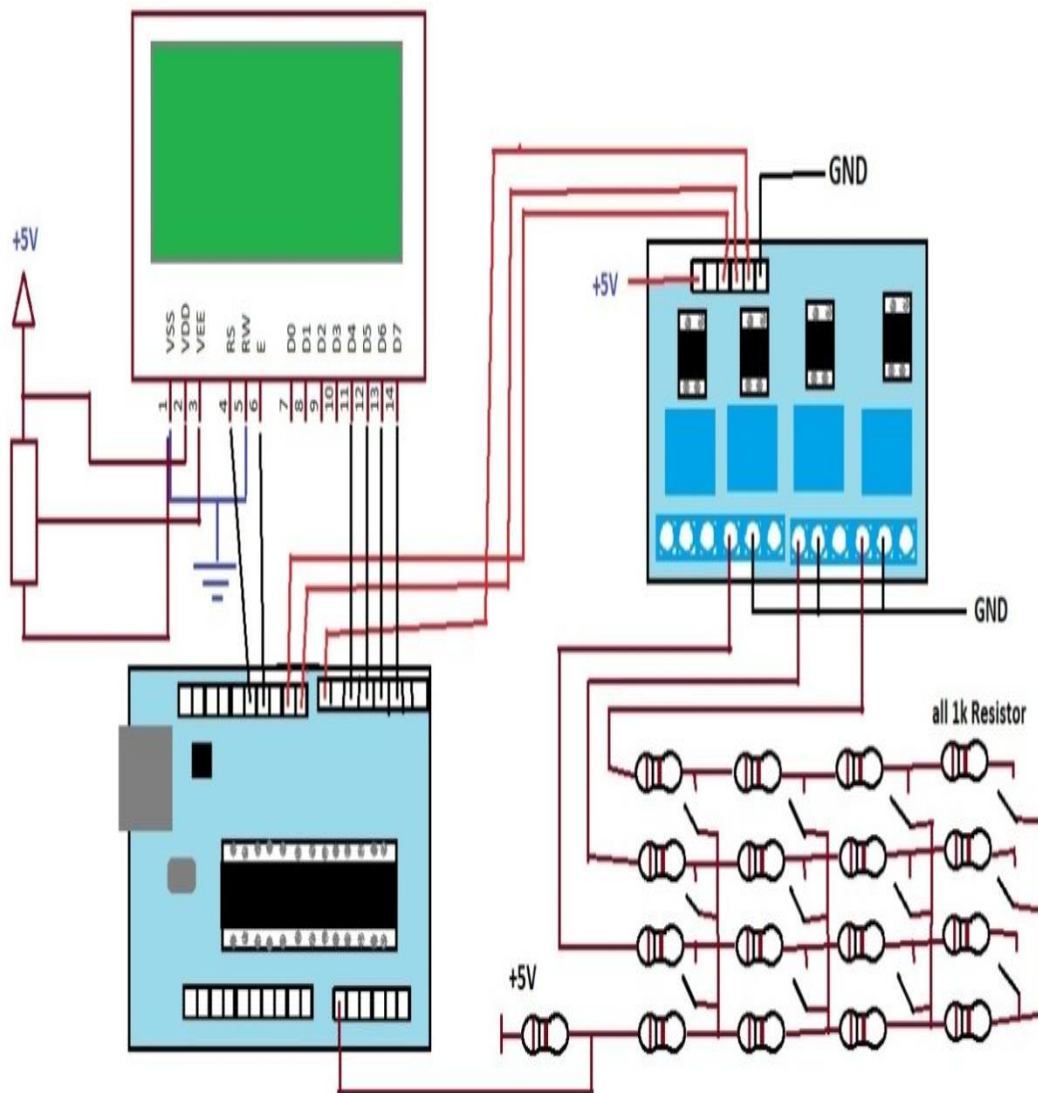


Figure-1: Arduino based underground fault detection system⁵.

Future Scope

By adding Wi-Fi: As all of us recognize that the sector has followed the Wi-Fi era in these days. We don't want to be a bodily gift to attain the fault statistics at the same time as needed. We can upload an easy issue WLAN 802.11 and an adapter. WLAN is a famous Wi-Fi community that makes use of radio waves to offer Wi-Fi high-pace net and community connection. The adapter utilized in a Wi-Fi interprets the output studying indicators right into a radio sign and transmits it to the use of an antenna. A Wi-Fi router gets the sign coming from the transmitter and decodes it. Then the router sends the sign to the Internet Ethernet Connection and from there we will without difficulty attain the statistics of the fault without being a bodily gift or working the machine with inside the process. They transmit at frequencies starting from 2 GHz or 5 GHz depending upon the needs. The better frequency permits the sign to hold extra statistics with efficiency.

By adding ESP and ubidots app: ESP is used in IOT projects. ESP8266 is a WI-FI module it can be connected with Arduino or any microcontroller such as ATMEGA328p chip. ESP8266 WI-FI module is a cost affordable board with vast community. Coding can be done by a simple programmer or burner. If we go to the IOT project, we will develop an app for this called ubidots in which R, Y and B power lines are mentioned. It is coded as per the location of fault. If the fault occurs in R line at 1KM, in app 1 will show. In this way we can identify the exact location of fault.

By adding GPS and GSM: GPS and GSM are the other tools of making this device very easy to use by any customer, industry etc. By using GPS, we can deal with the google maps and other location apps. Through GSM module, we can use it in mobile phones. In this way it will be a very useful and reliable device to use.

Conclusion

This paper on underground fault detection is very important when the whole world is accepting or going towards underground cables. This article reviewed the techniques that are based on Arduino and are very useful for the future. This method of underground fault protection is very effective and quick. The efficiency of this method has been evaluated. The research works related to this fault detection scheme have been studied. Advantages of based fault location and detection method using ohm's law are simple measurement setup, improved public and money safety, less power consumption, and very cost affordable. Very little time is required for this fault detection method. i. The paper proposes the location of a fault scheme for underground cables based on Arduino and relay. ii. This paper also proposes the IOT technology for location and detection of underground fault as a future aspect. iii. Arduino will be programmed as per the requirements. For this, various components are used like LCD display, relays, ICs, etc.

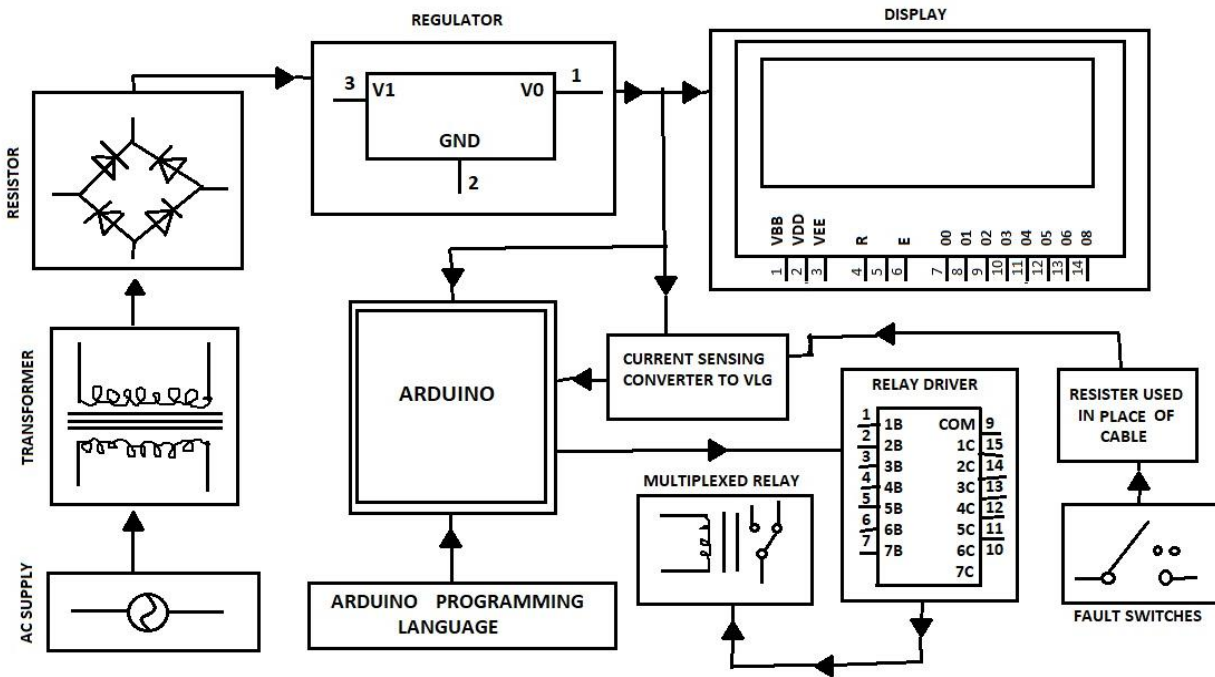


Figure-2: Block diagram of Arduino based underground fault detection system⁶.

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