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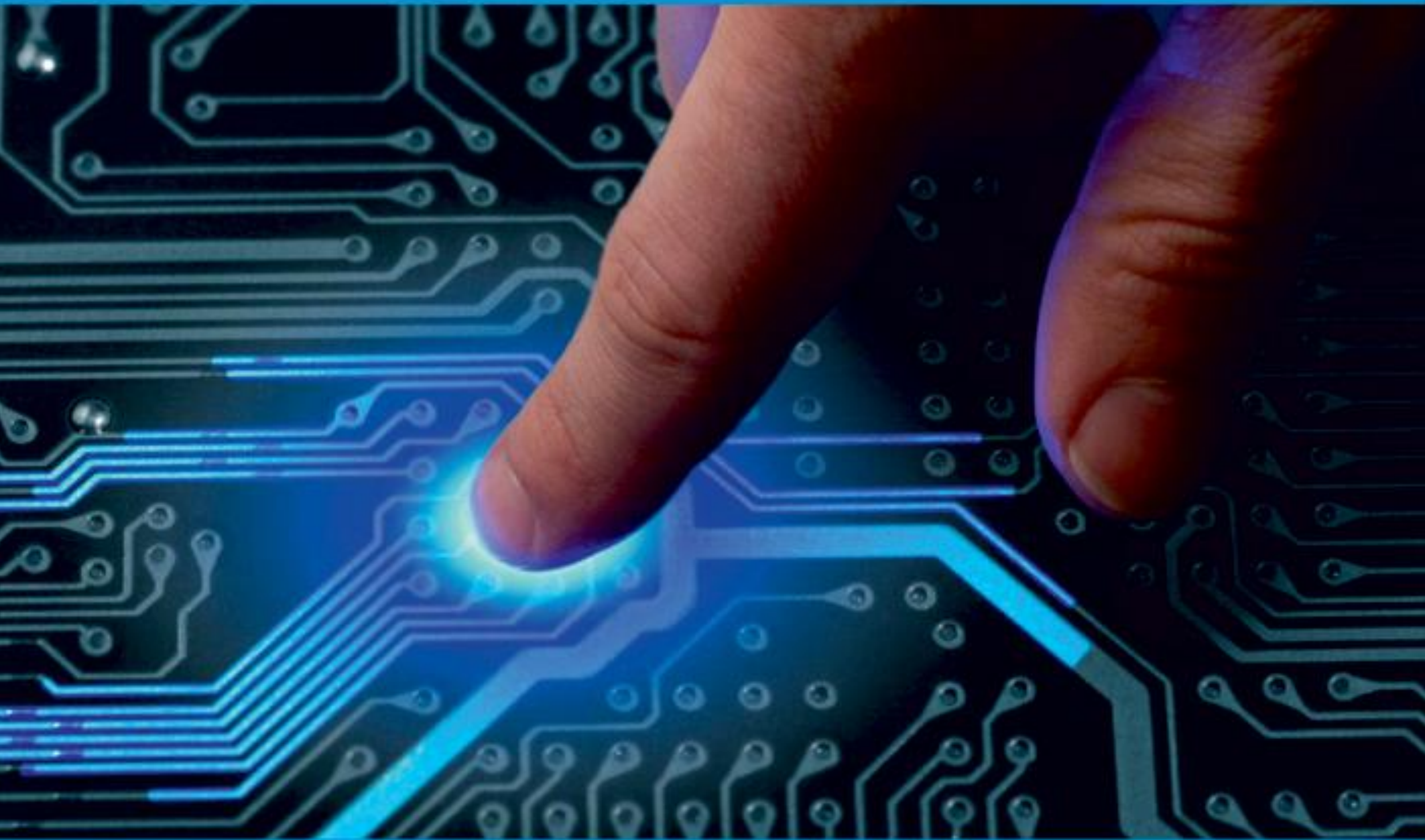

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Underground Cable Fault Detection

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ABSTRACT: Due to the lack of a reliable technique for pinpointing the exact position of the fault, it is extremely challenging to repair the wires of a defective cable whenever an underground cable line fault arises. For all three phases X, Y, and Z, a system must be created that can pinpoint the exact site of the fault that occurred in the system under various fault situations. According to Ohm's Law, under constant temperature and cross-sectional area circumstances, the cable's resistance is proportional to its length. An ESP32 microcontroller, an LCD display, a fault-sensing circuit module, and an appropriate power supply setup with regulated power output are all part of the system that has been constructed here. The relays, which are connected to the microcontroller, sense the current in the circuit. The combination of a number of series resistors and switches placed next to each resistor will be used to create the fault sensing circuit. On PROTEUS version 8.1, the suggested system was tested and simulated, and the hardware would be created using that model. In the end, the Fault will not only be identified but also precisely found, shown on ThingSpeak, and located. For the same, an Android application will be created.

KEYWORDS: Faults, NodeMcu, ThingSpeak, Murray.

I. INTRODUCTION

Due to recent improvements in circulation system dependability and security considerations, the underground power link is being used more frequently. Underground cables have been essential due to security issues and the necessity for high power in populous regions. The underground cable has the advantage of being safe and impervious to inclement weather. However, it has a limitation that prevents quick identification of underground cable line faults. Electrical engineering has long struggled with the problem of cable failures and accurate cable fault detection. Finding the fault's location and type, as well as its nature after it has happened, is the key challenge. With the development of technology and the employment of various detection algorithms, fault detection techniques for underground cable networks continue to improve daily. Identification of the fault is the initial stage in the fault detection process. There are several methods for locating the cable fault. This research focuses on how to identify the phase line in damaged cables and discover faults. Exact fault detection in the underground cable, which is challenging to find in the location, is the key challenge. Android application will be created for the same.

II. RELATED WORK

There are various methods for fault detection. This strategy manages identification and shortcomings in underground link arrange. By producing a model of transmission in MATLAB, the fault can be found in three steps. Afterward, the Fourier analysis from the model of Simulink which is important to prepare Artificial Neural Network (ANN) so as to identify the kind of shortcoming. Resulting in advancing the technology, a modern software named OrCAD is used in providing a good base for measuring the fault [1]. Another strategy proposes the mixture choice calculation of Discrete Wavelet Transform (DWT) and fuzzy so as to recognize the area of a flaw in the underground cable link. For finding the fault, the high component of frequency obtained from the transform is used. The first peak time which is calculated after the transform is of great importance as it is used to determine the fault location [2]. Modern relays combine the characteristics and qualities of different kinds of relays, one of the common relays is the quad impedance relay. There are certain advantages of using this relay in the fault detection system. A quad impedance relay can find the location of fault after it is modified in a certain way. It is known as a hybrid system of the relay. However, if the fault occurs near to the point of junction, it is difficult to address the fault. Another method is the time domain reflectometry in which a low power signal is sent and as a result, the insulation of the cable remains protected and unharmed. A cable that is not faulty returns in a specific time and behavior which is calculated and determined before sending the low signal. The incipient faults can be detected and determined by using the wavelet analysis. The relays sense the faults when it occurs

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in the system. However, extra effort may be needed for finding the cable which is faulty. The cross-linked polyethylene power cables are used in a variety of underground cable societies. The fault point is necessary to determine in this method. The previous methods like Murray loop have their own limitations regarding fault detection. The faulty cable must be separated from both sides of the power station and it needs to be connected with measurement equipment to determine the fault. Certain high voltage cable faults are a greater threat to the electrical systems and they need to be addressed with some efficient methodology. There are different methods to detect the faults in high voltage cables which are widely used these days for the detection of faults. The fault location in multi-end cable systems can be found using the signal processing technique. Both the first and second voltage wave can be identified realistically. This scheme is applied to the model coordinates of the system. Based on fault location calculations, the system detects the fault in the corresponding cable. For the protection of overcurrent, another scheme which is fast enough using different logics and can determine several faults such as through faults. The Incipient Cable Splice Failure (ICSF) method uses this scheme for the detection. Furthermore, this method has been included in a universal relay platform that has an additional function of a special protocol named User Datagram Protocol (UDP). By modifying the impedance, this method is quite effective in determining the fault location precisely. The methods in which the fault is detected based on the difference of the impedance have several errors because it does not take into account the load current parameter and non-uniform line impedances which results in an inaccurate value of the fault and its location. However, using the short circuit method, the fault is generated at different sections of the wire and this method works effectively to detect the location of the fault [2]. With the advancement in microcontrollers and their operation, another method uses a 16F887 microcontroller. This method is based on the phenomena of electromagnetic induction. As soon as the current flows through the wire, the electromagnetic field is produced. A capacitor is used to filter out the AC component in the system and a regulator is used to make the voltages stable for the system. Hence the fault is detected by the IC. Many underground faults occur due to the poor laying of underground cables. The majority of the faults are detected by digging the whole place and locate the fault which is a time taking process. The underground cable faults become difficult to detect because of the reason that faults can not be seen by eye, hence the whole cable needs to be changed. The impedance method has its own limitations, however, if the impedance method is applied with the help of microcontrollers and relays, it creates an efficient system to detect the underground cable faults and furthermore, increases the efficiency of the system.

The electricity is one of every country's major industries. Commonly (generation, transmission and distribution) are usually three components of each electrical system. They are all important to the whole power system. The power system has been sophisticated more and more over the past few years. The length of transmission lines (TL) in power system are increasingly longer. The TL voltage level is likewise higher and higher. Nonetheless, it is impossible to prevent defects on the transmission line [1]. The safety and stability of the power grid is compromised by such failures. The lengthy the electrical outage, the bigger the harm. Subsequently, the fault site is easily identified and utilities begin to get electricity. The exact detect of the failure point are the faster way to easily repair the defect. Therefore, the failure position appreciation for the transmission system is also important for electrical engineers and utilities.

III. PROPOSED ALGORITHM

A. *Design Considerations:*

To design an underground fault detection system, we used the following hardware and software units: -

- Arduino IDE
- ThingSpeak
- Thingview Free
- ESP32 – Operating Voltage 3.3 V
- SPDLT Switch
- LCD
- 4 V Relay Module
- Buzzer

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B. *Block Diagram of Project*

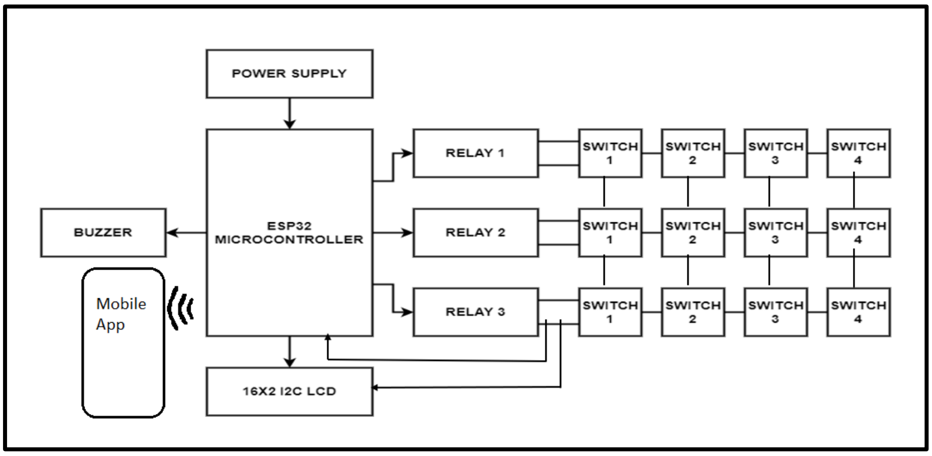

Fig 1. Block Diagram

Step 2: Selection Criteria:

IV. OPERATION

- Power supply of 3.3v is provided to the microcontroller .
- The microcontroller is switched on and the lcd screen displays underground fault detection
- When SPDT switches is used to create a hypothetical fault the microcontroller sends the signal that a fault is created at a certain distance
- The buzzer is on and the distance at which the fault is generated is displayed at the lcd
- The same value of the fault is shown for all the three phases respectively on the ThingSpeak cloud server
- The Thingview Free app also displays the distance at which the fault is created, as it takes the values from the ThingSpeak server using its apikeys.
- The app takes about 15 seconds to show the values.
- Thus, it is easily accessible to the working engineer to find the fault at the quickest of time.

V. RESULTS

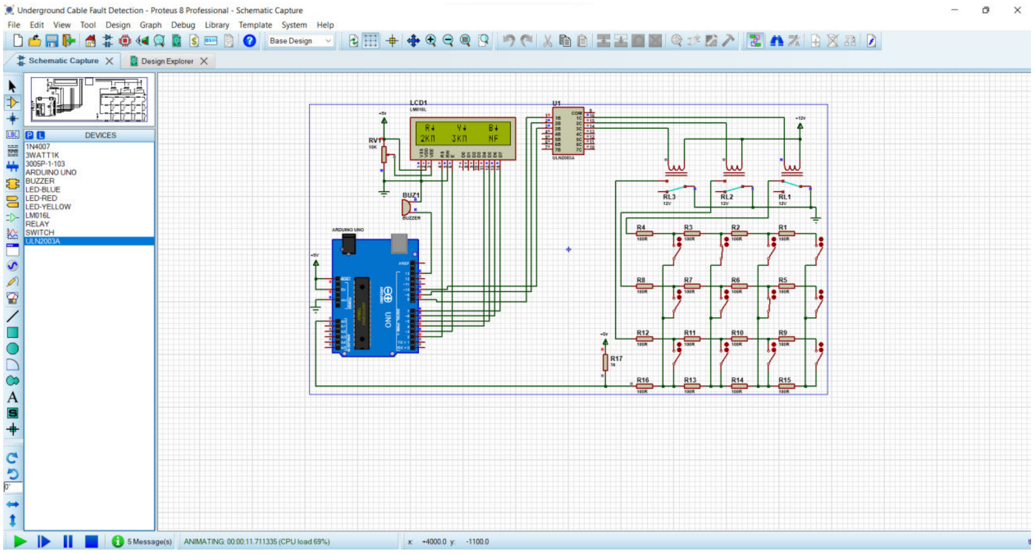

Fig1 . Simulation Result

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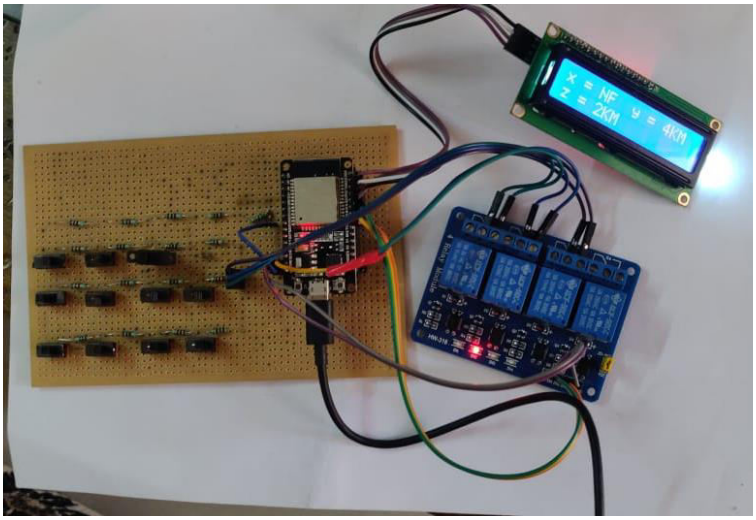

Fig.2.Hardware Output

Figure 4 App Interface with graph and fault location

VI. Conclusion and Future Work

The major problems occurring in underground cable fault detection are to locate the exact distance of faults, the nature of faults, effective monitoring system and these are difficult to repair. In order to tackle these problems, many different methods have been devised. All the previous methods used have their own significance and limitations as well. Currently, the system consists of a fault detection system that determines the location of underground cable faults in an efficient manner. However, for further effectiveness of the fault locating mechanism, a protection system may be designed which disconnects the faulty line from the system and hence will prevent the system to undergo greater damage.The proposed system can find only the location of Short Circuit in underground transmission lines. In future scope, we can use capacitor to calculate impedance and hence locate the open circuit faults. Also a desktop application can be developed for smooth controlling of the system.

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