INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 07 ISSUE: 05 | MAY - 2023 SJIF 2023: 8.176 ISSN: 2582-3930

IoT-based Underground Armoured Cable Fault Detection

Prof. S. S. Mahulkar
JSPM's Jayawantrao Sawant College of Engineering, Pune, India
sachinmahulkar@jspmjscoe.edu.in

Shrikant Soshte
JSPM's Jayawantrao Sawant
College of Engineering, Pune, India
shrikantsoshte72@gmail.com

Alok Maurya
JSPM's Jayawantrao Sawant
College of Engineering, Pune, India
alok25maurya@gmail.com

Rutuja Dhanawade
JSPM's Jayawantrao Sawant
College of Engineering, Pune, India
dhanawaderutu9730@gmail.com

***Abstract* - The aim of this study is to develop an Internet of Things (IoT)-based underground cable fault detection system. The proposed system utilizes IoT technology to monitor and detect faults in underground cables, which can lead to significant economic and safety losses if not detected and repaired promptly. The system consists of a network of sensors that are installed at strategic locations along the underground cable. These sensors measure various parameters such as temperature, current, and voltage and transmit this data wirelessly to a central monitoring station. The monitoring station processes the data and uses advanced algorithms to detect and locate any faults in the underground cable. Once a fault is detected, the system generates an alert that is sent to maintenance personnel for prompt repairs. The system is designed to be cost-effective, easy to install, and operate. The proposed system has the potential to improve the reliability and safety of underground power distribution networks and reduce downtime due to cable faults.**

I. INTRODUCTION

The global demand for electricity continues to grow at an unprecedented rate, leading to an increase in the installation of underground power distribution networks. While underground cables offer numerous advantages such as aesthetic appeal, reduced electromagnetic interference, and increased reliability, they are prone to faults, which can cause significant economic and safety losses if not detected and repaired promptly. Underground cable faults are challenging to locate due to the lack of visibility and accessibility, making it difficult for maintenance personnel to identify the exact location of the fault. This can lead to prolonged downtime and increased repair costs, resulting in inconvenience to customers and loss of revenue to power distribution companies.

To address this problem, researchers have been developing new technologies to improve the reliability and safety of underground power distribution networks. One of these technologies is the Internet of Things (IoT), which has been gaining popularity in recent years due to its ability to connect devices and transmit data wirelessly. IoT technology can be used to monitor and detect faults in underground cables, providing real-time data on the condition of the cable and enabling maintenance personnel to identify and repair faults quickly.

This study proposes an IoT-based underground cable fault detection system that utilizes sensors installed at strategic locations along the underground cable to measure various parameters such as temperature, current, and voltage. The data collected by these sensors is transmitted wirelessly to a central monitoring station, where it is analyzed using advanced algorithms to detect and locate any faults in the cable. The system is designed to be cost-effective, easy to install, and operate, and has the potential to significantly improve the reliability and safety of underground power distribution networks.

NEED FOR IOT-BASED UNDERGROUND CABLE FAULT DETECTION

The installation of underground power distribution networks has become increasingly popular in recent years due to their aesthetic appeal, reduced electromagnetic interference, and increased reliability. However, underground cables are prone to faults, which can cause significant economic and safety losses if not detected and repaired promptly. Detecting faults in underground cables can be challenging due to the lack of visibility and accessibility, making it difficult for maintenance personnel to identify the exact location of the fault. This can result in prolonged downtime and increased repair costs, which can inconvenience customers and lead to revenue losses for power distribution companies.

The need for an efficient and reliable system for detecting faults in underground cables is, therefore, of utmost importance. Traditional fault detection methods, such as visual inspection and manual testing, are time-consuming, costly, and often inaccurate. These methods also pose safety risks to maintenance personnel as they involve working in hazardous conditions.

The Internet of Things (IoT) provides a promising solution to these challenges by enabling the deployment of a network of sensors along the underground cable to monitor and detect faults in real time. This technology allows for the collection of data on various parameters such as temperature, current, and voltage, which can be analyzed using advanced algorithms to identify and locate faults. The use of IoT-based fault detection systems offers numerous benefits, including faster fault detection and repair, increased reliability and safety of power distribution networks, reduced maintenance costs, and improved customer satisfaction.

RELEVANCE TO THE PRESENT INDUSTRIAL SCENARIO

The present industrial scenario is characterized by a growing demand for electricity, increasing urbanization, and the rapid deployment of underground power distribution networks. The reliability and safety of these networks are crucial for the efficient functioning of industries, businesses, and households. However, underground cables are prone to faults, which can cause prolonged downtime, revenue losses, and safety risks for maintenance personnel.

The traditional methods for detecting underground cable faults, such as visual inspection and manual testing, are time-consuming, costly, and often inaccurate. These methods are not suitable for the present industrial scenario, where fast and accurate fault detection is essential to minimize downtime and reduce repair costs.

The IoT-based underground cable fault detection system is highly relevant to the present industrial scenario as it offers a real-time, accurate, and cost-effective solution to the problem of underground cable faults. The system utilizes a network of sensors deployed along the underground cable, which collect data on various parameters such as temperature, current, and voltage. This data is transmitted wirelessly to a central monitoring station, where it is analyzed using advanced algorithms to identify and locate faults. The system generates alerts in real-time, enabling maintenance personnel to take immediate action to repair the fault, reducing downtime, and improving the reliability and safety of power distribution networks.

I. Related works

There are several related works on IoT-based underground cable fault detection. One example is a paper by M. M. Azad and M. S. Alam, which proposes an IoT-based system for detecting and localizing faults in underground power cables. The system uses sensors to detect faults and then sends the data to a central server via IoT technology. The data is analyzed to determine the location of the fault.

Another related work is a paper by A. H. A. Aziz, N. A. M. Yunus, and N. Z. Abdullah, which presents a smart grid-based system for detecting and locating faults in underground power cables. The system uses IoT technology to collect data from sensors and then analyzes the data to determine the location of the fault.

A paper by K. R. Kotecha and R. K. Jain proposes an IoT-based system for detecting and localizing faults in underground power cables using wireless sensor networks. The system uses a combination of sensors and algorithms to detect faults and then sends the data to a central server via IoT technology.

A paper by A. Kumar and A. Yadav proposes an IoT-based system for detecting and localizing faults in underground power cables using machine learning algorithms. The system uses sensors to collect data and then analyzes the data using machine learning algorithms to determine the location of the fault.
Finally, a paper by S. Patil and S. Mane presents an IoT-based system for detecting and localizing faults in underground power cables using a Raspberry Pi. The system uses sensors to detect faults and then sends the data to a central server via IoT technology. The data is analyzed to determine the location of the fault.

II. Proposed system

The Internet of Things, which is dependent on the internet and so indicates that information will be supplied via the internet, is used in this study to illustrate how to locate a fault in an underground power wire. In order to use this technique, you must know both the position of the cable fault and the distance in km between it and the base station. In this study, the straightforward concept of current transformer theory (CT Theory) is employed.
The voltage drop that results from a problem, such as a short circuit, changes according to the length of the cable that is affected; because the current fluctuates, a current transformer is used to determine the fluctuating current. The relevant calculations are performed by a microprocessor, and the voltage change is managed by the signal modifier. The specifics of the issue are then published online for anybody to These fault details are then displayed and disseminated over the internet to every access point. According to how the system is operating, when a short circuit fault occurs with a single line to ground fault, a double line to ground fault, or a three-phase to ground fault, the current varies depending on the length of the cable from the point of fault. Due to the altered voltage drop across the series resistors, the fault signal is then transmitted to the microcontroller's in-built ADC for the creation of digital data.

The microcontroller subsequently processes the digital data, and the results are displayed. According to the fault circumstances, an LCD is coupled to an Arduino controller and measured in kilometers and phases. The technology for finding subsurface string faults has been devised and tested satisfactorily. This device uses an Arduino microcontroller to detect circuit faults in underground lines. The detector values are the basis on which the Arduino microcontroller operates. Find the precise location of the defect using the Arduino regulator. When a defect occurs in the string, the display unit shows the precise location of the fault. The measured current in this system is identified as being in the low- to medium-current range.

To establish real-time monitoring, the RMS value per current cycle is sent to a back-end covering system. This system only recognizes the location of a short circuit fault in an underground string line and does not recognize the location of an open circuit fault. To recognize the open circuit fault, an

AC circuit uses a capacitor to monitor the change in impedance and determine the fault's distance.

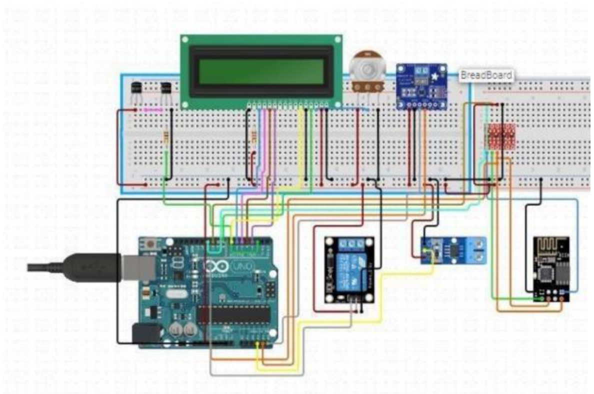

Fig.2 Circuit Diagram

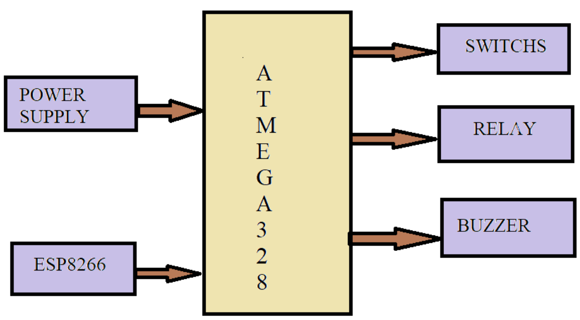

Fig.3 Block Diagram

The suggested system aims to locate the fault's exact location. When a series resistor (cable wires) and low DC voltage are used at the feeder end, the current will fluctuate based on where the cable fault is located. IOT-based underground cable fault detection operates in the exact same way.
The voltage between the resistors will change in response to a short circuit or other cable issue, and this new voltage will be relayed to an ADC to provide precise digital data that the programmed microcontroller family will display in miles.
At each known KM in the project, a set of switches is positioned to cause failures, and a collection of resistors is used to indicate cable length in KMs. The proposed system seeks to identify the precise position of the fault. The location of the cable fault will affect the current when a series resistor (cable wires) and low DC voltage are used at the feeder end. The same principles govern IOT-based subterranean cable failure detection. In reaction to a short circuit or other cable issue, the voltage between the resistors will change. This new voltage will be transmitted to an ADC, which will produce exact digital data that the programmed microcontroller family will display in kilometres. A set of switches is placed to create failures at each known KM in the project, and a set of resistors is used to show cable length in KMs.

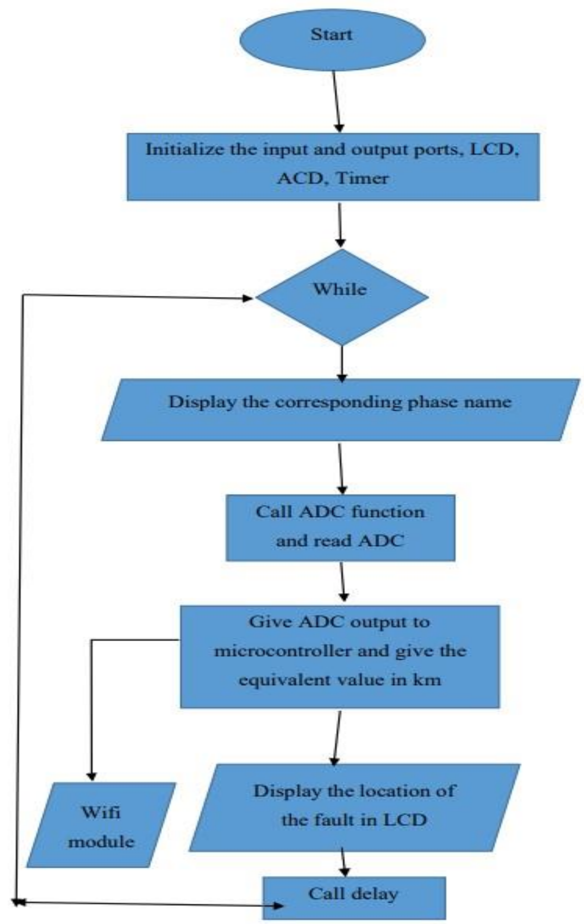

Fig.4 Flow Chart

FUTURE SCOPE

The future scope for IoT-based underground cable fault detection is vast and promising. One potential area for future development is the integration of IoT-based underground cable fault detection systems with smart grid technologies. This could enable real-time monitoring and control of the entire grid, leading to faster fault detection and response times.

Another promising area for future development is the use of AI and machine learning technologies. By analyzing data from the sensors, machine learning algorithms could be used to improve the accuracy of fault detection and localization.

Predictive maintenance is another potential area for future development. IoT-based underground cable fault detection systems could be used to implement preemptive maintenance strategies, reducing downtime and maintenance costs.

The use of IoT-based underground cable fault detection systems could also be expanded to other industries, such as telecommunications and transportation, where underground cables are also used. This could lead to new opportunities for innovation and growth in these industries.

Finally, the development of more advanced and cost-effective sensor technologies could further improve the performance and affordability of IoT-based underground cable fault detection systems, opening up new possibilities for their use and deployment.

III. CONCLUSION

IoT-based underground cable fault detection systems have the potential to revolutionize the way we monitor and maintain underground power cables. With the ability to collect data from sensors and transmit it via IoT technology, these systems can quickly detect and localize faults, allowing for faster and more efficient maintenance.

The related works on IoT-based underground cable fault detection highlight the variety of approaches and technologies that can be used to develop such systems, from wireless sensor networks to machine learning algorithms. The future scope for IoT-based underground cable fault detection is significant, with opportunities for integration with smart grid technologies, the use of AI and machine learning, predictive maintenance, and expansion to other industries.

REFERENCES

[1] IEEE Std. 738-2012 (Revision of IEEE Std. 738-2006). 2012. IEEE standard for calculating the current- temperature of bare over head conductors.
[2] International Journal of Pure and Applied Mathematics Voulme 118 no.8 2018, 377-381; ISSN:1311-8080(printed version);(Fault Detection in Overhead Power Transmission) ISSN: 1314-3395 (on-line version)url: http://www.ijpam.eu
[3] A. Bose, “Smart transmission grid applications and their supporting infrastructure,” IEEE Trans. Smart Grid, vol. 1, no. 1, pp. 11–19, Jun. 2010.
[4]R.Nagarajan and M,Saravanan “Staircase Multicarrier SPWM Technique for Nine Level Cascaded Inverter,” Proceedings of the International Conference on Power, Energy and Control, IEEE Press, pp-668-675. 2013
[5] A.S.Pabla, “Electric Power Distribution”, Pg. 213-215, Fifth Edition,Eleventh Reprint, Tata McGraw Hill Publications, 2008