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Underground Cable Fault Detection and Location Using IOT

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ABSTRACT

Instead of using overhead transmission lines, underground cables are utilized in downtown areas. India's reputation as a nation on the rise is contributing daily to the growth of the civilized world. Underground links are susceptible to a wide range of problems due to subsurface conditions, distance, rats, and various components. In this research, we present a novel method for Internet of Things (IoT)-based subsurface cable fault finding and detection. Real-time monitoring and analysis provided by the suggested system allow for accurate localization of fault locations and timely fault identification. Our method reduces downtime and maintenance expenses related to fault occurrences by utilizing IoT technology to improve the efficiency and dependability of subterranean cable networks. Experiments show how the suggested system can recognize objects with precision and efficiency. And identifying problems with subterranean cables, enabling preventive maintenance and guaranteeing continuous power delivery.

Key words: Blynk app, IOT, and fault detection.

INTRODUCTION

A key component of contemporary infrastructure, the subterranean cable network serves as a conduit for electricity transmission over a variety of terrains. Ensuring the dependability and integrity of these subterranean connections becomes critical as our dependence on power grows. Subterranean cables are crucial, but they can malfunction for a number of reasons, such as environmental influences, physical harm, and deteriorating insulation. Due to their hidden nature, defects in these subterranean cables are difficult to find and diagnose, which frequently leads to extended outages, interruptions in service, and large financial losses.Conventional techniques for locating and detecting faults in subterranean cables sometimes depend on laborintensive, time-consuming, and inaccurate physical inspections. Furthermore, these techniques are reactive in nature, thus necessitating lengthy downtime for locating and fixing errors. An increasing number of people are interested in using cutting-edge technologies, such the Internet of Things (IoT), to improve the management and monitoring of subterranean cable networks in order to overcome these constraints. The Internet of Things (IoT) refers to the network of physical objects that are implanted with sensors, actuators, and communication features. This allows the objects to gather and share data on their own. The installation of Internet of Thingscapable sensors throughout the subterranean cable network makes it feasible to continuously and real-time monitor important characteristics like voltage, current, and temperature. Early detection of anomalies and possible flaws is made possible by the abundance of data, which provides priceless insights into the condition and operational state of the subterranean cables. The use of IoT technology for locating and detecting faults in subterranean cables has enormous potential to improve the dependability, effectiveness and security of subterranean cable systems. Our suggested technique gives utilities and operators the ability to precisely localize defects, detect them early, and monitor them in real time. This allows them to manage their infrastructure proactively, save downtime, and maximize repair efforts. We will examine the planning, execution, and assessment of our Internet of Things (IoT)-based subterranean cable failure detection system in the ensuing sections, showcasing its effectiveness and possible implications for critical infrastructure management.

LITERATURE REVIEW

2.1 Dividing into Sections

Because this process necessitates physically cutting and splicing the cable, cable reliability is decreased. The search for a fault can be focused by cutting the wire into progressively smaller portions and measuring both ways using an ohmmeter or highvoltage insulation resistance (IR) tester. Typically, this arduous process entails repeatedly excavating cable.

2.2. Leaning forward

When a defective cable receives high voltage, a high current arc forms that produces noise loud enough to be heard ab ove ground. This method has its own drawback even if it does away with the cutting and splicing involved in the sectionalizing method. For thumping to produce a subsurface noise that can be heard above ground, voltages as high as 25 kV and currents on the order of tens of thousands of amps are needed. The cable insulation frequently deteriorates as a result of the heating from this high current. It is possible to lower the limit of damage by passing the test with the least power needed .

2.3. Reflectometry in the Time Domain

The Time domain reflectometer (TDR) is an electronic device that locates and characterizes metallic cable problems using time domain reflectometry. Without creating any damage in the insulation, the TDR sends a low-energy signal across the cable. That signal is returned in a known time and in a known profile via a theoretically flawless wire. The TDR screen or printout graphically depicts the time and profile, but impedance differences in a "real-world" cable change both. The inability of TDR to identify errors is one of its weaknesses.

2.4. Method of Arc Reflection

This technology, which gets around low-voltage radar's 200 °C limit, is frequently referred to as a high voltage radar technique. Arc reflection filter and surge generator are needed in addition to the TDR. A transient short circuit is produced by the surge generator crossing the shunt fault, which the TDR can detect as a downward reflection. Low-voltage pulses are sent down the wire by the filter, which shields the TDR from highvoltage pulses produced by the surge generator. The most straightforward and accurate prelocation technique is arc reflection. There is no need for interpretation because the problem is shown in connection to other cable landmarks such splices, taps, and transformers. It is made feasible by arc reflection for cable signatures or "before" and "after" traces to be displayed by the TDR. All cable landmarks are visible on the low-voltage radar signature known as the "before" trace, but the downward reflection of a high resistance shunt fault is not visible. The high-voltage signature that contains the fault location, even though its resistance could exceed 200 Ω, is known as the "after" trace. The cursors are placed to read the distance to the high resistance fault while this trace is digitalized, saved, and presented on the screen .

2.5 Blavier test

The Blavier test can be used to identify a single cable defect when it arises in a single cable and there isn't another cable present. Put another way, the blavier test refers to measuring the resistance from one side or end when there isn't a sound cable available to identify the cable's defect. With Blavier's test, a single cable's ground fault can be found. This type of test uses a bridge network with a low voltage source, voltmeter, and ammeter. While the "Far End" of the cable is isolated from the earth, the resistance between the sending end and the earth is measured .

PROPOSED SYSTEM

Using the Internet of Things, which is reliant on the internet, the project provides an example of how to locate faults in subterranean power cables. This indicates that information will be distributed online. The purpose of this technique is to locate cable faults and measure their separation from one another. We can also pinpoint the precise position of the defect in the suggested system. It makes it simple for skilled workers to fix errors quickly.

Data Analysis and Processing

Process and analyze the data in real-time as soon as it is received to look for anomalies or changes from standard operating procedures. Use statistical techniques or machine learning algorithms to find patterns that point to cable issues.

Defect Identification and Categorization Create algorithms based on the Examination of sensor data to Identify various fault Types, such as open circuits, short Circuits, and insulation Breakdowns. Sort Discovered errors according to Functioning of the wire .

Localization of Fault To pinpoint the exact position Discovered faults along the Subterranean cable's length, apply Localization can be achieved Using strategies like distributed Sensing, impedance-based Approaches, or Time Domain Reflectometry (TDR).

Creation and Notification of Alerts Once an issue has been identified and located, send out alerts and messages to utility operators or maintenance staff. For quick action, alerts can be incorporated into current SCADA systems or communicated via email, SMS, or mobile applications.

Fixing and Maintaining Faults

Send maintenance personnel to the site of the issue to fix and restore the cable. To enable effective repair procedures, provide maintenance professionals with the precise location data and diagnostic information gathered from the IoT system.

Constant Observation and Feedback Loop

Once the cable has been repaired, keep an eye on it to make sure the maintenance efforts were successful. Examine past data to spot trends or possible problems, allowing for preventative maintenance and reducing downtime.

Combining Management Systems with Integration

To improve network reliability and streamline operations, integrate the IoT-based fault detection system with the current asset management or predictive maintenance systems. For better administration of the subterranean cable system, enable remote monitoring and control features.

Frequent updates and system maintenance

To guarantee peak performance, regularly maintain communication networks, sensors, and monitoring hardware. Periodically update software modules and algorithms to add new features, enhancements, or improvements based on user feedback and deployment experience in the real world.

METHODOLOGY

In order to improve reliability, safety, and efficiency in many technical processes, advanced methods like fault diagnosis and detection have become crucial. There are two different kinds of fault location methods: offline and online.

1. Online Method: This method uses and processes the sampled voltages and current to identify the fault sites. Subterranean cable has fewer online methods than above wires.
2. Offline Method: In this method, cable service is tested in the field using a specialized device. The following are the offline methods: Tracer Method: Using footwork on the ground, this method locates the cable cables' fault points. An audible orelectromagnetic signal indicates the fault point.It is used to pinpoint the exact location of fault.

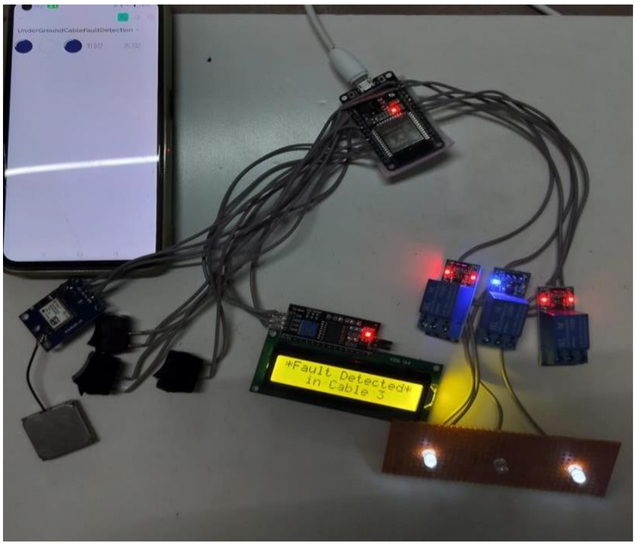
Example: -A] Current Tracing Technique

B] Sheath Coil Method Terminal Method: This method locates the cable's fault from one or both ends without requiring tracing. Using this method, the general area of fault is determined, speeding up the tracing of buried wire. • Murray Loop Method, for instance

• Method of Impulse Current.

RESULT

The Arduino Uno is used to simulate the fault detection system, and the LCD shows the defect data.Because it takes less time to find the precise site of a defect, the system described in the work "Underground cable fault detection and location using IOT" is effective.



CONCLUSION

Electrical energy is distributed with the aid of electrical cables. These cables break so frequently. It is an extremely difficult effort to find the problems in these wires. This method uses an Arduino to pinpoint the precise location of a cable problem in kilometers from the base station. These days, underground cables are widely utilized rather than above-ground ones in a large number of non-rural places. It becomes extremely difficult to detect the exact location of an underground cable fault so that the cable can be repaired whenever one occurs. This method is suitable for both above-ground and subterranean wires. The board used in this system is an Arduino Mega. Here, the current sensing circuits, which are composed of a combination, interface with the Arduino comprises numerous resistors. The group of switches is what causes the fault. We have suggested a low-cost way to improve this industrial system's capacity for remote control. This project was created to detect malfunctions in functioning Arduino boards, and the fault distance, measured in kilometers from the ground station, will be shown on webpages and LCD screens. The switch that is equivalent to the phase is identified as the faulty phase, to which fault switches are operated, if a problem occurs. This makes it easy to locate the problematic area. It is a low-power, safe, and long-lasting gadget. This gadget can operate on multiple channels in order to avoid interference from other wireless devices or equipment. With the assistance of of microcontroller, enabling precise defect location detection. The LCD display indicates the location of cable failures as soon as they happen.

FUTURE SCOPE

This project solely uses the base station to pinpoint the precise position of an underground cable problem. One robot could be designed to perform an autonomous fault clearing project in the future.

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