

UNDERGROUND CABLE FAULT DETECTION ROBOTIC SYSTEM

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Abstract

Underground electrical cables play a crucial role in modern power distribution systems, especially in urban areas where overhead lines are unsafe or impractical. However, detecting faults in underground cables is a complex and time-consuming process using traditional methods, as it requires extensive digging, leading to traffic congestion, increased repair costs, and significant inconvenience. To address these challenges, this project presents the design and implementation of an intelligent robotic car for accurate underground electrical cable fault detection.

The proposed system operates by moving along the ground surface directly above the buried cable while continuously monitoring current flow using electromagnetic sensing techniques. An LEDLDR optical detection system is employed to detect variations in signal intensity caused by faults in the cable. When a fault occurs and the current flow is interrupted, the robotic car automatically stops at the precise fault location. Relay-controlled motors enable smooth movement and precise control of the robot, while capacitors are used for delay stabilization to eliminate false triggering and ensure reliable fault detection.

This automated approach minimizes the need for manual inspection and unnecessary excavation, significantly reducing fault detection time and maintenance costs. The system is economical, portable, and easy to operate, making it highly suitable for power distribution maintenance, urban infrastructure management, and smart city applications.

Keywords: Underground Cable, Fault Detection, Robotic System, Controller Unit, Sensors.

INTRODUCTION

Underground electrical cables are widely used in modern power distribution systems due to their safety, reliability, and aesthetic advantages. However, detecting faults in these cables is a challenging task. Conventional fault detection techniques involve digging up large sections of roads or land to trace the damaged portion of the cable, leading to traffic disruptions, increased repair time, high labor costs, and inconvenience to the public.

To overcome these limitations, this project focuses on the development of an intelligent robotic car designed to accurately detect underground electrical cable faults without unnecessary excavation.

The system operates by moving along the surface above the buried cable while continuously monitoring the presence of current using electromagnetic sensing and LED-LDR optical detection techniques. When a fault occurs, the current flow is interrupted, and the robotic car automatically stops at the exact fault location.

The integration of relay-controlled motors ensures precise movement and automatic stopping of the robot, while capacitor-based delay stabilization improves system reliability by preventing false triggering. This automated approach significantly reduces fault detection time, minimizes digging, and lowers maintenance costs. The proposed system offers a practical, efficient, and cost-effective solution for underground cable fault detection, making it highly suitable for urban infrastructure and power maintenance applications.

1. DEFINITION

Underground cable fault detection refers to the process of identifying the location of faults such as short circuits, open circuits, or insulation failure in underground cables using electronic systems or robotic technologies.

2. PURPOSE

1. To detect faults in underground cables automatically.
2. To reduce the time required for fault detection.
3. To improve the reliability of power distribution systems.
4. To use robotic technology for inspection of underground cable lines.

3. METHODOLOGY

The methodology of the Underground Cable Fault Detection Robotic Car project Explains the step by-step working process used to detect faults in underground cables Accurately and efficiently.

First, the system is divided into two main parts:

1. Fault Detection Circuit
2. Robotic Car Mechanism

In this project, the basic principle used for fault detection is the voltage drop Method (Ohm's Law). When a fault occurs in an underground cable (like short circuit Or open circuit), the voltage changes according to the distance of the fault. By Measuring the voltage drop across the cable, the exact location of the fault can be Calculated.A microcontroller such as Arduino Uno is used as the main control unit of the System. It continuously monitors the voltage values from the cable using an ADC (Analog to Digital Converter). The measured analog voltage is converted into digital Form and processed by the microcontroller to calculate the distance of the fault.

4. NEED OF STUDY

1. Underground cables are widely used in modern power distribution systems because they provide safety and reduce environmental impact. However, when a fault occurs in underground cables, it becomes very difficult to identify the exact location of the fault. Manual inspection requires more time and effort, which may lead to delay in repairing the cable and restoring power supply.

2. Traditional fault detection methods are not always efficient and may require excavation at multiple locations to find the fault. This increases maintenance cost and time. Therefore, an automated system is required to detect the fault quickly and accurately.
3. The use of robotic systems in electrical maintenance can improve the efficiency of fault detection. A robotic system equipped with sensors and a controller unit can monitor underground cables and help in identifying the fault location easily.
4. This study focuses on developing a robotic system that can detect underground cable faults and provide a reliable solution for power distribution maintenance.

5. OBJECTIVES

The objective of this project is to develop an intelligent robotic car capable of detecting underground electrical cable faults with high accuracy. Traditional cable-fault detection methods require digging long stretches of road, causing huge inconvenience, delays, and financial loss. This project aims to eliminate unnecessary digging by automatically locating the exact fault point using electromagnetic sensing, LEDLDR optical detection, relay-driven motor control, and delay stabilization using capacitors. The robot moves above the ground surface directly over the underground wire and stops exactly where the current disappears, marking the precise fault location.

5. SCOPE OF STUDY

1. This project focuses on the development of a robotic system for detecting faults in underground cables. The system is designed to move along the cable path and monitor the cable condition using sensors and electronic components.
2. The robotic system helps in identifying the exact location of the cable fault, which reduces the time required for maintenance and repair. This improves the reliability of the electrical power distribution system.
3. The proposed system can be used in electrical industries, power distribution networks, and maintenance departments to detect faults efficiently and safely.
4. In the future, this system can be further improved by integrating advanced technologies such as wireless communication, IoT, and GPS tracking to provide more accurate monitoring and fault detection.

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