ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Impact Factor: 8.206

Volume 8, Special Issue 2, November 2025

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| | Monthly Peer Reviewed & Refereed Journal |

|| Volume 8, Special Issue 2, November 2025 ||

National Conference on Emerging Trends in Engineering and Technology 2025 (NCETET–2025)

Organized by

Mookambigai College of Engineering, Keeranur, Tamil Nadu, India

Underground Cable Fault Detection System

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ABSTRACT: Underground cables have been widely used with the development of power system grid. Underground cables are prone to a wide variety of faults due to underground conditions, wear and tear, rodents. Detecting fault source is difficult because entire line is to be dug in order to check fault at cable line. The repairmen know exactly which part has fault and only that area is to be dug to detect the fault source. Thus it saves a lot of time, money and allows to service underground cable lines faster. The aim of this project is to determine the distance of underground cable fault from base station in Km using ARDUINO NANO. The prototype uses simple concept of ohm's law. The prototype is modelled with a set of resistors representing cable length in km and fault creation is made by a set of switches at every known distance. The fault occurring distance, phase, is displayed on a 16X2 LCD interfaced with the microcontroller. Buzzer make alarm sounds whenever the fault occurs in three phase line.

KEYWORDS: Underground cable, Arduino Nano, Fault detection, Ohm's law, Microcontroller.

I. INTRODUCTION

The increasing demand for reliable and secure power transmission has led to a rapid shift toward underground cabling systems. These systems minimize exposure to environmental hazards such as storms, pollution, and vandalism. However, identifying the precise location of a fault in an underground cable is complex, as faults are hidden beneath the ground surface. Conventional fault-finding methods often require extensive excavation, resulting in higher maintenance costs and prolonged downtime. This paper introduces a microcontroller-based fault detection model that determines the fault location accurately using voltage measurement principles derived from Ohm's law. The system uses Arduino Nano, resistor networks, and voltage sensing circuits to detect and display the distance of the fault from the base station.

II. SYSTEM OVERVIEW

Underground cable faults can generally be categorized into two main types: open-circuit and short-circuit faults. In open-circuit faults, the current flow is interrupted due to a discontinuity in the conductor, whereas short-circuit faults occur when insulation failure causes two conductors to make contact. These faults can be further divided into symmetrical and unsymmetrical types depending on the magnitude and phase relationship of currents. The proposed system simulates the underground cable using resistors and uses a DC supply to measure voltage drops along the cable model. Based on the measured voltage, the microcontroller calculates the corresponding fault distance and displays it on an LCD screen.

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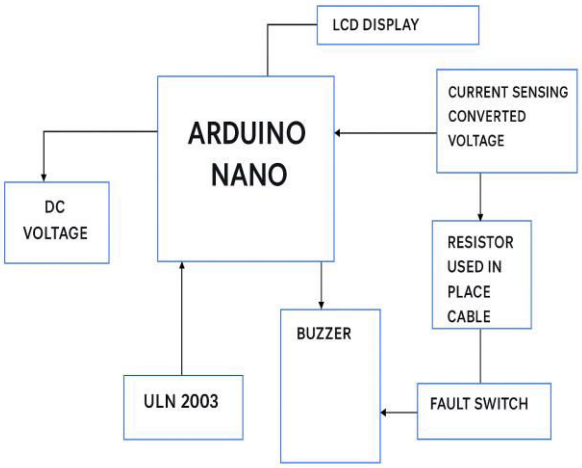

Fig. 1.1 – Block diagram of underground cable

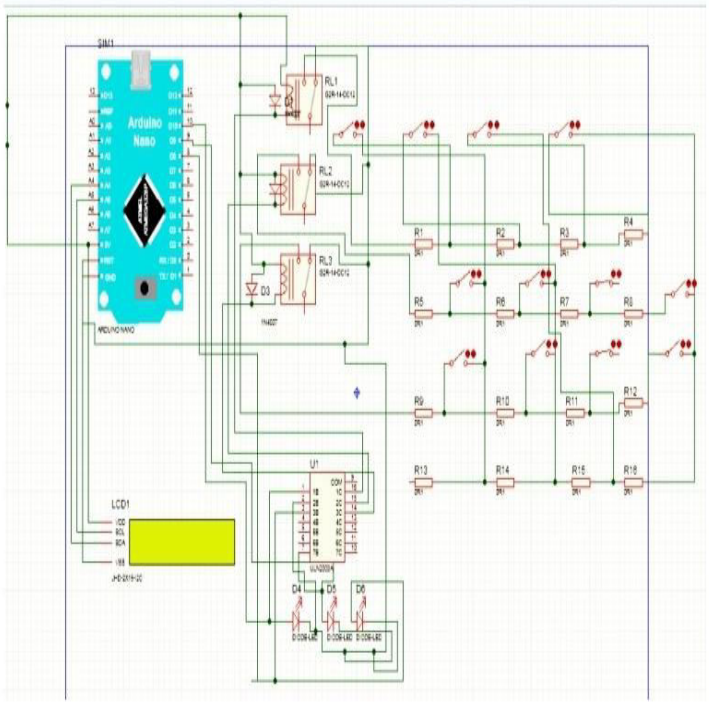

Fig 1.2 - Circuit diagram of underground cable fault detection system

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form Factor.Arduino Nano is a small, complete, flexible and breadboard-friendly Microcontroller board, based on ATmega328p, developed by Arduino.cc in Italy in 2008 and contains 30 male I/O headers, configured in a DIP30 style. Arduino Nano Pinout contains 14 digital pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins. It is programmed using Arduino IDE, which can be downloaded from Arduino Official site.Arduino Nano is simply a smaller version of Arduino UNO, thus both have almost the same

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functionalities. It comes with an **operating voltage of 5V**, however, the input voltage can vary from **7 to 12V**. Arduino Nano's **maximum current rating is 40mA**, so the load attached to its pins shouldn't draw current more than that. Each of these Digital & Analog Pins is assigned with multiple functions but their main function is to be configured as Input/Output. Arduino Pins are acted as Input Pins when they are interfaced with sensors, but if you are driving some load then we need to use them as an Output Pin. Functions like pinMode() and digitalWrite() are used to control the operations of digital pins while analogRead() is used to control analog pins. The analog pins come with a total resolution of 10-bits which measures the value from 0 to 5V. Arduino Nano comes with a crystal oscillator of frequency 16 MHz. It is used to produce a clock of precise frequency using constant voltage. There is one limitation of using Arduino Nano i.e. it doesn't come with a DC power jack, which means you can not supply an external power source through a battery. This board doesn't use standard USB for connection with a computer; instead, it comes with Type-B Micro USB.

Sl.no	Nano features	value
1	Microcontroller	ATMEGA328p
2	Crystal oscillator	16MHz
3	Operating voltage	5V
4	Input voltage	6V-12V
5	Maximum current rating	40mA
6	USB	Type-B Micro USB
7	ICSP Header	Yes
8	DC Power jack	No

Table 2.1 - Component details

III. METHODOLOGY

The working principle of the system is based on Ohm's law, which relates voltage, current, and resistance. A set of resistors represents different sections of the underground cable.

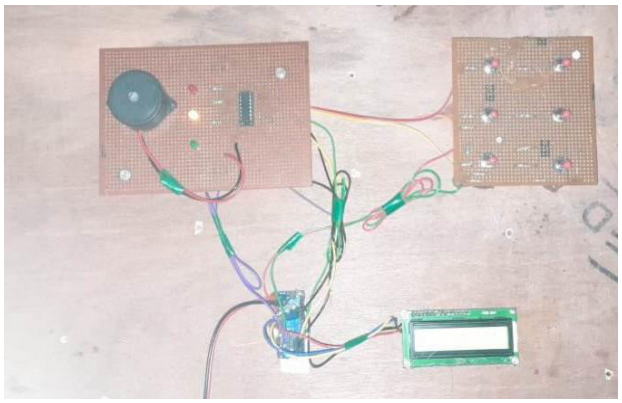

Fig. 3.1 – Hardware Setup

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A DC voltage source is applied at one end of the circuit, and any variation in resistance caused by a fault leads to a measurable change in voltage. The Arduino Nano reads these voltages through its analog-to-digital converter (ADC) pins and processes them to calculate the exact fault distance from the base station. The system also uses the ULN2003 driver IC to control a buzzer, providing an audible indication whenever a fault is detected. The calculated distance is displayed on a 16x2 LCD screen in real-time for the three phases—R, Y, and B.

IV. CONCLUSION

This paper presented a microcontroller-based underground cable fault detection system capable of locating faults accurately and efficiently. The prototype determines the fault distance using Ohm's law principles and displays the information on an LCD while alerting maintenance personnel through a buzzer. The system offers a simple, cost-effective, and reliable approach for fault localization in urban power distribution. Future enhancements can include IoT-based remote monitoring and integration of open-circuit fault detection capabilities to further improve system performance.

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