International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Real Time Underground Cable Fault Monitoring with Iot

Mrs. K. Nagamani[1], B. Dinesh[2], A. Lohitha Surya[3], G. Bheeshma Sandilya[4], M. Jayanth[5]

[1]Assistant Professor M. Tech, (Ph. D), Department of EEE, LIET, VZM, INDIA
[2,3,4,5](B. Tech), Department of EEE, LIET, VZM, INDIA.

Abstract:
The objective of this project is to determine the distance of underground cable fault from the base station in kilometers and displayed over the internet. Underground cable system is a common practice followed in major urban areas. While a fault occurs for some reason, at that time the repairing process related to that particular cable is difficult due to exact unknown location of the fault in the cable. Proposed system is used to find out the exact location of the fault and to send data in graphical format to a dedicated website together with on board LCD display using a Wi-Fi module.
The project uses the standard theory of Ohms law, i.e., when a low DC voltage is applied at the feeder end through a series resistor (Cable lines), then the current would vary depending upon the location of the fault in the cable as the resistance is proportional to the distance. In case there is a short circuit (Line to Ground), the voltage across series resistors changes according to the resistance that changes with distance.This is then fed to an ADC to develop precise digital data which the programmed microcontroller of the Atmega328 displays in kilometers.
The project is assembled with a set of resistors representing the cable length in km and the fault creation is made by a set of switches at every known km to cross check the accuracy of the same. The fault occurring at a particular distance, the respective phase along with the distance is displayed on the LCD. The same information is also sent to a dedicated website over internet activated Wi-Fi module, interfaced to the microcontroller.

Keywords: Underground Cable Fault Detection, Fault Location System, Ohm's Law Application, Distance Measurement, DC Voltage Method, Resistance Proportional to Distance, ADC (Analog-to-Digital Converter), Microcontroller (ATmega328), Wi-Fi Module (Internet Connectivity), Remote Monitoring.

INTRODUCTION:

In today's rapidly advancing world, electricity plays a vital role in powering homes, industries, and infrastructure. To ensure safe and efficient power distribution, many regions have adopted underground cable systems instead of traditional overhead lines. These cables offer advantages such as reduced power theft, improved aesthetics, lower maintenance, and increased safety from environmental factors like storms and tree falls.
Despite these benefits, underground cables come with their own set of challenges—especially when

faults occur. Unlike overhead lines, where visual inspection can quickly locate a break or damage, underground cables are buried beneath the surface, making fault detection a complex and time-consuming task. Identifying the exact location of a fault often requires digging at multiple points, which is labor-intensive and costly.

Cable faults can arise due to various reasons such as insulation failure, moisture ingress, chemical reactions, or physical damage from construction work. These faults may lead to partial or complete loss of power, posing a threat to reliability and safety. Therefore, a fast and accurate fault detection system is essential to minimize downtime and restore services promptly.

Underground cable fault detection systems are designed to pinpoint the location and type of faults with minimal disruption. These systems typically use technologies like Time Domain Reflectometry (TDR), the Murray and Varley loop tests, or newer microcontroller-based systems that integrate sensors and GPS for real-time monitoring. Some modern systems also use IoT and AI to enhance accuracy and automate fault reporting.

The primary goal of such systems is to reduce the time, cost, and effort involved in locating and repairing faults. By enabling precise fault localization, they help utility companies dispatch repair teams more efficiently, minimize excavation work, and restore power quickly. This is especially critical in urban areas where cables run beneath roads, buildings, and other infrastructure.

As the demand for uninterrupted power supply and smart infrastructure grows, underground cable fault detection systems are becoming increasingly important. With continuous improvements in technology, these systems are evolving to offer better accuracy, faster response times, and integration with centralized control centers. Investing in robust fault detection not only enhances service reliability but also contributes to the overall development of smart and sustainable power networks.

1. What Is IoT?

Internet of Things represents a general concept for the ability of network devices to sense and collect data from the world around us, and then share that data across the Internet where it can be processed and utilized for various interesting purposes.

Some also use the term *industrial Internet* inter - changeably with IoT. This refers primarily to commercial applications of IoT technology in the world of manufacturing. The Internet of Things is not limited to industrial applications, however.

1.1 Battery:

A device that stores electrical energy and supplies power to the circuit. It provides a DC voltage to run the system.

1.2 Voltage Regulator 7805:

A linear voltage regulator that outputs a constant 5V DC. It protects components by regulating the input voltage.

1.3 Rectifier:

Converts AC (alternating current) to DC (direct current). It is commonly made using diodes in a bridge configuration.

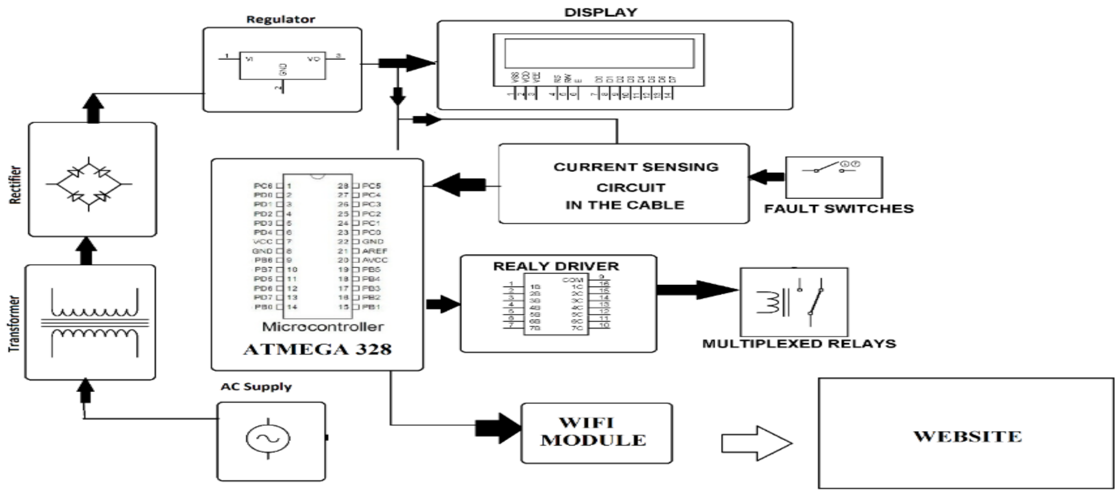
1.4 Filter:

Removes ripples from the rectified DC signal. Typically made using capacitors to smooth the output voltage.

1.5 ATMEGA 328:
A microcontroller used to control the entire system. It processes input data and controls output devices.
1.6 WIFI Modem:
Enables wireless communication with other devices or networks. It allows data transmission over the internet.
1.7 Relay:
An electrically operated switch used to control high-voltage devices. It isolates control signals from power loads.
1.8 ULN 2003:
A Darlington transistor array used to drive relays and motors. It amplifies current to operate high-power devices.
1.9 LED:
A light-emitting diode that glows when current flows through it. Used as indicators in electronic circuits.
1.10 Resistors:
Limit or control the flow of electrical current. Used for voltage division, biasing, and protection.
1.11 Capacitors:
Store and release electrical energy. Used in filtering, timing, and coupling applications.
1.12 Push Buttons:
Momentary switches that allow user input. Used to trigger actions or provide manual control in a circuit.

2. What is Embedded System?
An embedded system is a microcontroller-based combination of hardware and software, sometimes including mechanical components, designed to perform a specific function with reliability and real-time control. Unlike general-purpose computers, embedded systems are dedicated to specific tasks and operate in diverse environments, often with constraints on cost and performance. They range from high-end systems using 32 or 64-bit controllers with operating systems (e.g., mobile phones, PDAs) to low-end systems using 8 or 16-bit controllers with minimal hardware and software tailored for a particular application.

Block Diagram:



Principle of Operations:

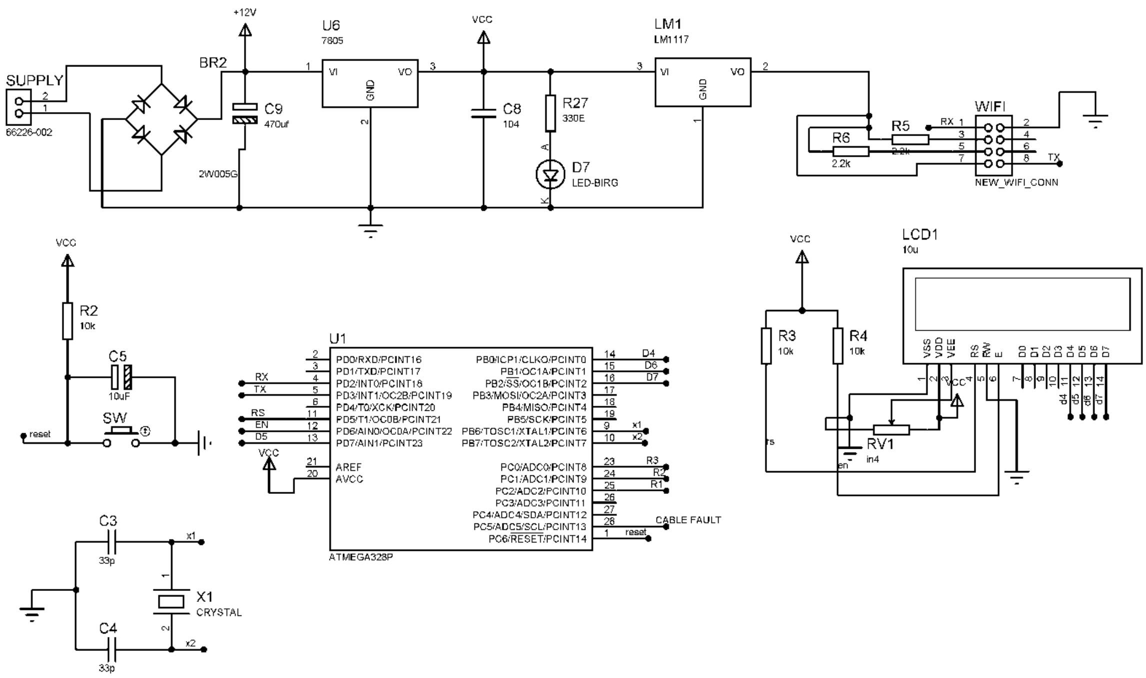
The principle of underground cable fault detection involves identifying the location of faults by measuring changes in electrical parameters such as voltage, resistance, or signal reflection. A common method uses Ohm's Law, where a low voltage is applied and the voltage drop along the cable is measured—since resistance is proportional to length, the fault location can be calculated based on abnormal readings. Another method, Time Domain Reflectometry (TDR), sends a pulse through the cable and measures the time it takes for the reflection to return from the fault point. Microcontrollers process this data, and with the help of modules like Wi-Fi and GPS, the fault can be detected and reported accurately and efficiently.

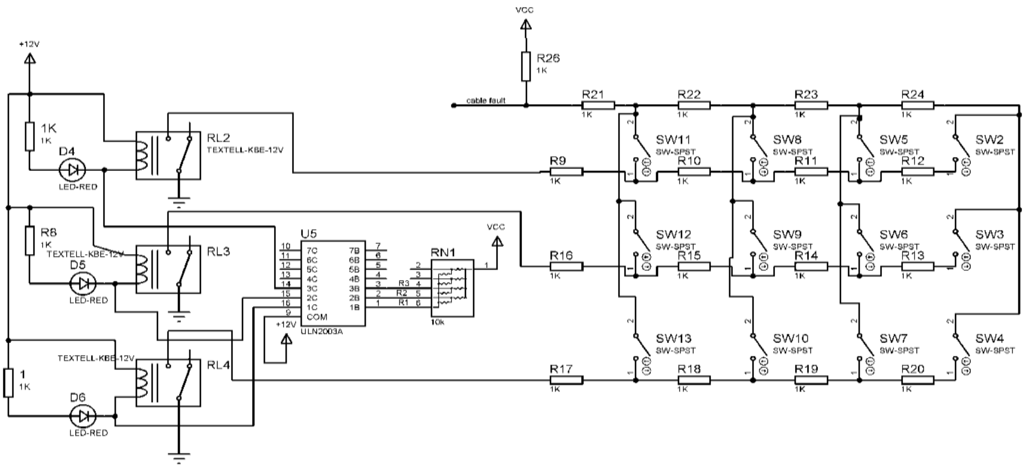
Units:

The ohm (symbol: Ω) is the SI unit of electrical resistance, named after Georg Simon ohm. An ohm is equivalent to a Volt per ampere. Since resistors are specified and manufactured over a very large range of values, the derived units of milliohm (1 mΩ = 10^{-3} Ω), kilohm (1 kΩ = 10^{3} Ω), and megohm (1 MΩ = 10^{6} Ω) are also in common usage.

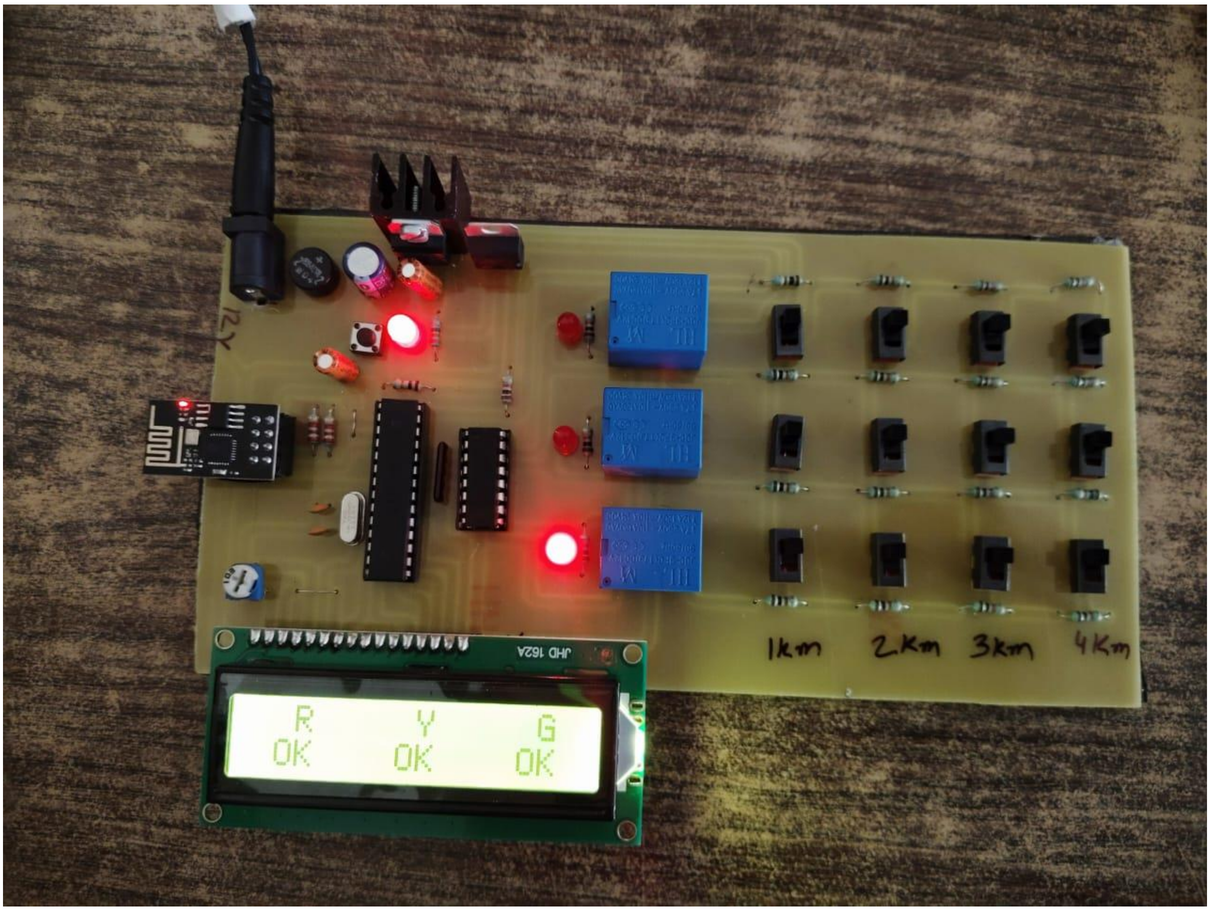
The reciprocal of resistance R is called conductance G = 1/R and is measured in Siemens (SI unit), sometimes referred to as a mho. Thus, a Siemens is the reciprocal of an ohm: $S = \Omega^{-1}$. Although the concept of conductance is often used in circuit analysis, practical resistors are always specified in terms of their resistance (ohms) rather than conductance.

Circuit Diagram:





HARDWARE KIT:



1. What is Arduino?

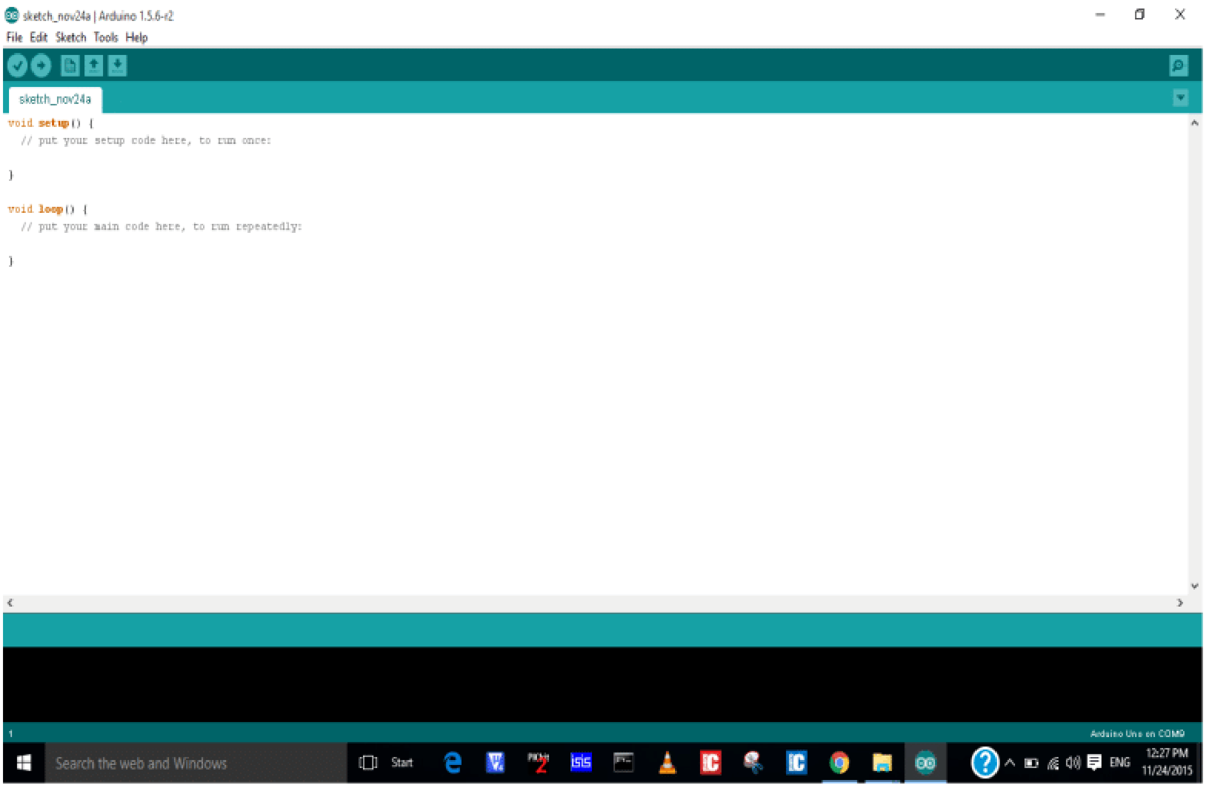
Arduino is an open-source electronics platform based on easy-to-use hardware and software, designed to make digital electronics accessible for beginners and professionals alike. It consists of a microcontroller board (like the Arduino UNO) that can be programmed using the Arduino IDE to read inputs—such as sensors—and control outputs—like LEDs, motors, and displays. Widely used in DIY projects, automation, robotics, and prototyping, Arduino simplifies the process of building interactive electronic systems.

2. Why is Arduino?

Arduino is used in underground cable fault detection over IoT platforms because it offers a simple, cost-effective, and reliable way to interface sensors, process data, and control output devices in real time. Arduino microcontrollers, like the ATmega328, can read voltage and resistance values from the cable, detect abnormalities indicating a fault, and calculate the approximate fault location using basic principles. While IoT enables remote monitoring and data transmission, Arduino serves as the core processing unit that collects and processes the data at the ground level. It can also be easily integrated with IoT modules like Wi-Fi (ESP8266) for wireless communication, making it ideal for low-power, purpose-specific, and field-deployable solutions like underground cable fault detection.

Arduino IDE:

The Arduino IDE (Integrated Development Environment) is an open-source software platform used to write, compile, and upload code to Arduino boards. It provides a simple and user-friendly interface that supports programming in a language based on C/C++. The IDE features a text editor for writing code (called "sketches"), a message area for error and status updates, a toolbar with buttons for common functions (like verify, upload, and save), and a serial monitor to communicate with the board during runtime. It supports various Arduino boards and can be extended with libraries and board packages, making it a versatile tool for developing embedded applications, from basic LED blinking to complex sensor-based systems.



Result:
The underground cable fault detection system using IoT effectively identifies and locates cable faults with accuracy and speed. It enables real-time monitoring and remote data transmission, significantly reducing detection time, manual effort, and maintenance costs. The system is reliable, cost-efficient, and enhances the overall performance of the power distribution network.

Conclusion:
The conclusion highlights that IoT-based underground cable fault detection offers a smart, reliable, and efficient alternative to traditional methods. By combining Arduino and IoT, the system ensures accurate fault detection, real-time monitoring, and faster response, making it highly suitable for modern power distribution networks and smart infrastructure.

Future OutLook:
The future of underground cable fault detection using IoT is promising, with advancements expected in predictive maintenance, real-time analytics, and AI integration. Enhanced connectivity through 5G and cloud platforms will enable smarter, more scalable, and energy-efficient systems, playing a key role in the development of intelligent and resilient smart grids.

References:
1. R. Kumar, A. Singh, "Underground Cable Fault Distance Locator using Microcontroller," International Journal of Engineering Research and Applications (IJERA), vol. 4, no. 3, pp. 117-120, March 2014.
2. B. S. Reddy, D. V. S. Raju, "Underground Cable Fault Detection using Arduino and IoT," International Journal of Recent Technology and Engineering (IJRTE), vol. 8, no. 2S11, pp. 4384-4387, Sept. 2019.
3. G. P. Ganorkar, A. D. Shaligram, "Design and Implementation of Underground Cable Fault Detection System using IoT," International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, vol. 6, no. 5, pp. 123-127, May 2018.
4. S. L. Lokhande, D. G. Thombare, "Underground Cable Fault Detection using IoT and Machine Learning," International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), vol. 7, no. 2, pp. 39-44, 2021.
5. K. Shruthi, M. M. Reddy, "Fault Detection and Location in Underground Cable using Arduino," International Journal of Scientific and Research Publications (IJSRP), vol. 7, no. 7, pp. 157-160, July 2017.
6. N. V. R. Naidu, "IoT Based Underground Cable Fault Detector," International Journal of Engineering and Advanced Technology (IJEAT), vol. 9, no. 3, pp. 564-567, Feb. 2020.
7. P. R. Sheth, D. S. Nagesh, "Detection of Underground Cable Fault Using Arduino and GSM," International Research Journal of Engineering and Technology (IRJET), vol. 5, no. 3, pp. 2500-2503, Mar. 2018.
8. M. A. Khan, A. S. Sheikh, "Smart Underground Cable Fault Detection System Using Internet of Things," IEEE International Conference on Computing, Communication, and Automation (ICCCA), pp. 1-5, 2022.

9. V. P. Jadhav, S. A. Kazi, "Arduino-Based Underground Cable Fault Detector with IoT," International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), vol. 8, no. 6, pp. 657-663, June 2019.
10. A. Patel, K. Raval, "Cable Fault Detection and Monitoring System Using NodeMCU and IoT," Proceedings of the 2021 International Conference on Smart Electronics and Communication (ICOSEC), pp. 255-259, 2021.