

IOT based underground cable Fault monitoring control Using NodeMCU

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Technology degree in
Information Technology

By

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of MOHAN K (Reg.No. 39120071), G AJAY (Reg.No. 39120006), who carried out the Project Phase-2 entitled "IOT BASED UNDERGROUND CABLE FAULT MONITORING CONTROL USING NODE-MCU" under my supervision from January 2023 to May 2023.

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DECLARATION

I, MOHAN K (Reg.No-39120071), hereby declare that the Project Phase-2 Report entitled "IOT BASED UNDERGROUND CABLE FAULT MONITORING CONTROL USING NODE-MCU" done by me under the guidance of Dr. R. M. GOMATHI, M.TECH., Ph.D., is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology.

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ABSTRACT

The development and advance in technology, many thing are changes. The technology laid out to understand its importance like in urban areas, the electrical cable to go underground instead of overhead lines, which grab less space and is consider as the effective and efficient way of transmission. But the problem ascend when any fault befall in the underground cable and it's also difficult to detect the proper location of the fault during the process of repairing that especial cable and the methods existed till now follows some algorithm in order to scan the location of the fault. The raised system which constitute of current sensors, microcontroller (Node MCU) and Wi-Fi modem which creates a course between the combined hardware and internet so that the real time data can be successively communicated towards server its being successively communicate with towards server and along with this everything becomes smart and interconnected with the help of IOT (Internet Of Things) those are real time data can be retrieved in pc or mobile phones from the server. Hitherward by using useful stage provided by IOT any one can recover information whenever they necessary. By implementing the proposed system life of the cable will also get by grown because after implementing the system the supply transmission of the power can be closed till the fault gets mend and through this the inessential losses which are developed though the leakage of current can be avoided.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Underground Cable line protection is an important issue in power system engineering because 85-87% of power system faults are occurring in Underground lines. This paper is quick on the security schemes and Identify various types of defects in a transmission line and for reliable management Provides a technique for classifying. Discrimination among different types of faults on the Underground lines is achieved by application of evolutionary programming tools. PSCAD/EMTDC software is used to simulate different operating and fault conditions on high voltage Underground line, namely single phase to ground fault, line to line fault, double line to ground and three phase short circuit. The discrete wavelet transforms (DWT) is applied for decomposition of fault transients, because of its ability to extract information from the transient signal, simultaneously both in time and frequency domain. Data sets obtained from DWT are used for SVM architecture training and testing. After removing useful features from the measured signals, a fault or a fault is decided at any stage or multiple stage of the transmission line using three SVM classifiers. The ground detection function is performed by the proposed ground index. The Gaussian radial base kernel function (RBF) has been used, and The performances of the classifiers were evaluated on the basis of fault classification accuracy. To determine the optimal parameter settings for an SVM classification (such as the type of kernel function, its associated parameters, and Regularization parameter C), fivefold cross-validation has been applied to the training organization. It has been observed that an SVM with an RBF kernel provides better fault classification accuracy than an SVM with a multivariate kernel. It was found that the proposed project is very fast And Accurate and It has proven to be a powerful classifier for digital distance protection.

1.2 EARLIER RESEARCH

The vast majority of the systems in our project are computerized systems. Programmed system work is once in a while required. Considering work pay, the system will profit a great deal. In this system, lot based underground cable fault detection and Current observing system. A man can see underground cable fault detection and furthermore Current checking system. What's more, The line fault and line current states of the earth can be found in a lcd show on the project. In addition, this information can be checked from anyplace on the planet through the Internet.

1.3 IOT SYSTEM

The IOT is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers(UIDs) and the ability to transfer data over a network without requiring human-to- human or human-to-computer interaction. The definition of the Internet of Things has evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Conventional fields of inserted systems, wireless sensor systems, control systems, robotization (counting home and building computerization), and others all add to empowering the Internet of Things. In the customer showcase, IOT innovation is generally synonymous with items relating to the idea of the "IOT based underground cable fault identification", covering devices and machines, (for example, lighting apparatuses, indoor regulators, home security systems and cameras, and other home apparatuses) that help at least one normal ecosystems, and can be controlled by means of devices related with that ecosystem, for example, PDAs and shrewd speakers. There are various genuine worries about risks in the development of IOT, particularly in the territories of protection and security; and thus industry and administrative moves to start to address these.

CHAPTER 2

LITERATURE SURVEY

2.1 INFERENCES FROM LITERATURE SURVEY

Tijjani Nabeel Aminu, Nasir A. Algeelani, Samer A. Algailani, Ali Ahmed Salem, the paper titles as “Arduino based Underground Cable Fault Distance Locator”. The precise position of the underground cable fractured lines from the originating station to that spot has been identified by the writers . Due to the challenges in locating subterranean cable faults, this will make it easier to find and recognize cable failures without having to excavate up the complete length of the cable [1].

Anik Dutta;Md. Nowroz Farhan Noor;Md. Raihan Ali Khan;Shubhra Kanti Sinha Shuva;Md. Abdur Razzak, “Identification and Tracking of Underground Cable Fault Using GSM and GPS Modules”. A microcontroller-based subterranean wire failure detection and monitoring device using GSM and GPS methods. This study seeks to determine the cable fault's distance in kilometres from the base station's control center using GSM and GPS services, giving a warning of the precise fault position for cable fault repair [2].

Amirul Hamizan Bin Hamee, Suzi Seroja Sarnin, Wan Norsyafizan W Mohamad, Mohd Nor Mad Tan, Ros Shilawani S. Abdul Kadir, Nani Fadzlina Naim ”, Smart Monitoring Fault Detector using IOT . To ascertain its capability, power, flaws, and specs, is put through tests and troubleshooting. It follows the same basic concept as the Underground failed Cable Detector System, making full use of the current sensor ACS758 and the smoke sensor as input, and linking up with GSM and smartphones to alert the user of any failure or fire [3].

Asawari Dudwadkar, Amogh Gajare, Yogesh Tembe, Amey Sonje, “IOT based Autonomous Tunnel Electrical Cable Fault Detection and Maintenance Robot”. A model of a tunnel-exploring robot is capable of

traversing the tunnel on its own and checking out the area around it at each end. All of the data about subterranean passageways is relayed wirelessly by RF transmitter with the aid of the instruments used on the robot. Along with this information, the robot looks for actual harm on the cable and uses an RF transmitter to communicate the position of the problem to the receiving site [4].

Rathinamala Vijay, Gautham Prasad, Yinjia Huo, Sachin Sm, Prabhakar Tv", "Measurement based Condition Monitoring of Railway Signaling Cables". This deals with the problem of detecting mild faults in subterranean train lines. One way to prove the usefulness of flaw identification and localization using orthogonal multitone time domain reflectometry for railway electrical systems is to implement it using software defined radios [5].

M.M. Amarnath, B. Ganesh Ram, Mr. V. Chandrasekaran, Mr. G. Mohan Ram, "IOT Based on Underground Cable Fault Identification Using Arduino". Everything evolves as technology develops and advances. The importance of technology is becoming increasingly apparent to us as it develops. For instance, in densely populated areas, subterranean electrical cables are typically used instead of aerial power lines because they require less room and are generally accepted as the most reliable and efficient way to transfer energy. When a problem arises in a subterranean wire, however, it isn't always easy to determine where the problem is located in order to fix it using the techniques at hand. We employ IOT expertise that enables doyens to monitor and examine flaws online. With the assistance of probable Divider Network installed across the cable, The Edifice Advert Fault was created. Faults are quickly fixed to restore the electricity supply. increased starting expense and issues with shielding at high voltages [6].

Raushan Kumar Bhagat, Shrawan Suthar, Chandan Kumar, Sunil Kumar Mina, "UndergroundCable Fault Detector Using Arduino And Gsm Module". Using Arduino and GSM, uses flaws that are present in subterranean cables to detect and display them in LCD and mobile devices. Direct current voltage put on the supplying side modifies the current forecasts

further to manage the cable's problem areas. In the event of a short circuit, an Arduino-made ADC will adjust the highest voltage through a capacitance to a safer value. (Such as an L-G or L-L problem). The deficit is accurately predicted by the base station, and this number is produced by Arduino. This value is sent in three stages to an LCD that is attached to an Arduino board and shows the precise location of all base stations at a distance of several kilometres. Many resistors work together to convey the length of the wire in the job. This Strategy Works for All Types of Links, but Faults Switches Induced in Every 4 km to 1 km. Problems up to 4 km can be found using this method. The phase connected to that specific switch is regarded as a fault phase if a fault switch operated the condition [7].

Dhanyavathi A, Akshay Kumar A.V, Harish M., SachinChikkond, Bharath M P, "Underground Cable Fault Detection and Notification System". A problem localization model for subterranean wire using a Raspberry Pi module is presented by Dhanyavathi A. In the event of an insulation defect in a subterranean cable, the project will determine how many miles away it is from the base station and upload a live picture of the fault to a website. When there is a defect in a wire, the voltage drops by a different amount due to the varying current. A prototype wire representing a subterranean cable that is about two meters long is used to identify faults. Sensors connected to a Raspberry Pi module are used to detect voltage changes, and the fault information is then presented on an LCD screen [8].

P. Ocłon et al., "The performance analysis of a new thermal backfill material for underground power cable system". According to P. Ocon et al. the suggested system includes a microprocessor and other electrical devices that will function with the aid of an ADC converter. For the purpose of handling by the microprocessor, with the help of the ADC, the alternating current energy can be converted to direct current [9].

RoshaniShingrut, Shubham Shelar, Dakshata Mokal, Shekar Mhatre, Dr. Sharvari Sane, "Underground Cable Fault Detection". With the help of an Arduino, a fault localization model for subterranean cable lines that could

estimate the distance in miles from the underground cable defect at the base station. When a system failure happens, the distance shown on the liquid crystal monitor changes. (LCD). There is currently no subterranean wire that is higher than the prior technique because cables were created to be put above the head up until the last ten years. Storms, snowfall, flooding, and pollution have no effect on wires laid underground. However, it can be challenging to pinpoint a subterranean cable failure when it affects subsurface lines. It locates the flaw in digital form precisely [10].

2.2 OPEN PROBLEMS IN EXISTING SYSTEM

In existing they used image processing so it's difficult to find out exactly the result. Image processing is a technique used to manipulate and analyze digital images, and it is widely used in various industries such as medical imaging, surveillance, and robotics. However, the accuracy of the results obtained from image processing depends on several factors such as the quality of the input image, the algorithm used, and the expertise of the person performing the analysis. In some cases, it can be challenging to obtain precise results due to the complexity of the image or the limitations of the image processing technique. To achieve this, researchers and practitioners need to constantly improve the image processing algorithms and techniques, and also validate the results obtained through rigorous testing and validation methods. Overall, while image processing can be a powerful tool, its effectiveness relies heavily on the quality of the input data and the expertise of those performing the analysis. It is crucial to acknowledge the limitations of image processing techniques and strive for accuracy and reliability in their application.

CHAPTER 3

METHODOLOGY

To complete the project, gathered data from the internet and sourced equipment from a local market and an online shop. Designed a circuit before implementing the project. To program the NodeMCU microcontroller, the embedded C programming language was used. With these components in place, the project proceeded efficiently and logically. This comprehensive approach allowed for the achievement of expected outcomes at the end of the project.

3.1 OBJECTIVES OF THE PROJECT

- The main goal of the project is to easily find the transmission line fault that below Ground.
- To see which fault is near the pole.
- To Monitor short range fault.
- To Monitor line fault from anywhere in the world through the Internet.

ADVANTAGE:

The main advantage of this project is to **IOT based three phase underground cable fault and current monitoring** System Project for The main purpose is to create a smart system so that we can take many benefits from one project.

- Can be easily created.
- Essential instruments, readily available in the market.
- Where the fault in the line can be easily found.
- Each line can be monitored by line current.
- A very useful system for underground and river tunnel lines.
- The Internet can be monitored from anywhere in the world.
- People are less needed.
- The cost is much less.

CHAPTER 4

THEORETICAL BACKGROUND

4.1 HISTORY

A microcontroller (Node MCU) is a computer-on-a-chip used to control electronic devices. It is a type of microprocessor underline self-sufficiency and cost-usefulness, in contrast to a general-purpose microprocessor (the kind used in a PC). A typical microcontroller contains all the memory and interfaces needed for facile application, whereas a general-purpose Microprocessor requires additional chips to provide these features. So, as they have all the IOT and built on the chip it is very easy to use them in power and position limited conditions. And also, as they are very cheap likened to typical PC microprocessors, they can be used almost everywhere. Now a day's almost all electronics products take on some form of microcontroller to make our life a lot easier by automation. Although they seem to be too slow and have insanely low amount of memory, they are very energy proficient. And most of the jobs they do not require processors.

4.2 MICROCONTROLLER

The first single chip microprocessor was the 4 bit Intel 4004 released in 1971, with othermore capable processors available over the next several years. These however all required external chip(s) to implement a working system, raising total system cost, and making it impossible to economically computerize appliances. The first computer system on a chip optimized for control applications - microcontroller was the Intel 8048 released in 1975, with both RAM and ROM on the same chip. This chip would find its way into over one billion PC keyboards, and other numerous applications. Most microcontrollers at this time had two variants. One had an erasable EEPROM program memory, which was significantly more expensive than the PROM variant which was only programmable once. In 1993, the introduction of EEPROM memory allowed

microcontrollers (beginning with the Microchip PIC16x84) to be electrically erased quickly without an expensive package as required for EPROM, allowing both rapid prototyping, and In System Programming. The same year, Atmel introduced the first microcontroller using Flash memory. Other Companies rapidly followed suit, with both memory types. Cost has plummeted over time, with the cheapest 8-bit microcontrollers being available for under \$0.25 in quantity (thousands) in 2009, and some 32-bit microcontrollers around \$1 for similar quantities. Nowadays microcontrollers are low cost and readily available for hobbyists, with large online communities around certain processors.

CHAPTER 5

DESIGN AND DEVELOPMENT

5.1 DEVELOPMENT

Underground cables are vulnerable to various types of defects due to wear and tear, rats, etc. due to underground conditions. Fault sources are difficult to diagnose and the entire cable should be taken from the ground to verify and fix faults. The project work is for the purpose of detecting the fault location of the underground cable line from the base station in kilometers using the Node MCU controller. To detect an error in the cable, the cable must be checked for faults. This prototype uses the general concept of Ohms law. Depending on the cable's length, the current will vary. In urban areas, electric cables run underground instead of overhead lines. Whenever the fault occurs within the underground cable, it is difficult to identify the exact location of the fault in order to repair that particular cable. The proposed system finds the exact location of the error.

The prototype is made with a set of resistors that represent the length of the km, and the fault cream is made by a set of switches at each correct distance whose accuracy tests. In case of error, the voltage across the series resistor is changed accordingly, which is then fed to an ADC to develop precise digital data in a programmed node MCU that further shows the fault location. The fault that occurs in the distance ND current is displayed on a 20X04 LCD interfaced with a microcontroller. The IOT Wi-Fi module is used to display information on the Internet using ESP8266. A webpage is created using HTML coding, and information about the error type is displayed on a webpage.

BLOCK DIAGRAM

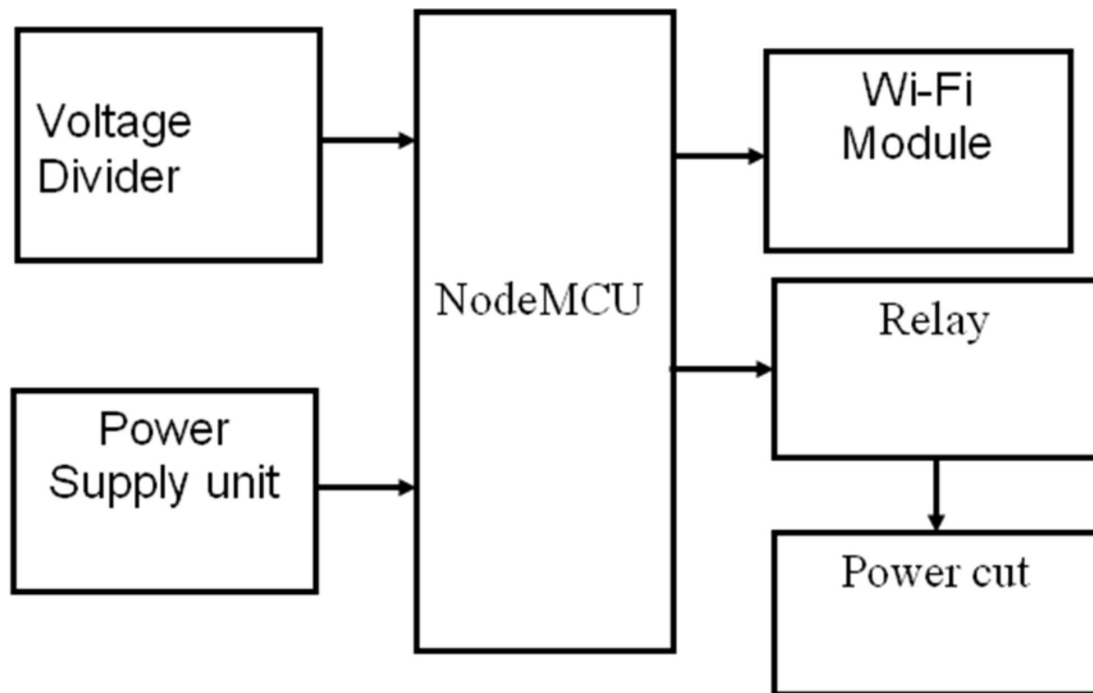


Figure 5.1 Block diagram

5.2 NODE MCU

NodeMCU is an open source IOT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP- 12 module. The term “NodeMCU” by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266.



Figure-5.2: Node MCU

NodeMCU was created shortly after the ESP8266 came out. On December 30, 2013, Espressif Systems began production of the ESP8266. The ESP8266 is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core,[citation needed] widely used in IOT applications (see related projects). NodeMCU started on 13 Oct 2014, when Hong committed the first file of nodemcu-firmware to GitHub. Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the gerber file of an ESP8266 board, named devkit v0.9. Later that month, Tuan PM ported MQTT client library from Contiki to the ESP8266 SoC platform, and committed to NodeMCU project, then NodeMCU was able to support the MQTT IOT protocol, using Lua to access the MQTT broker. Another important update was made on 30 Jan 2015, when Devsaurus ported the u8glib to NodeMCU project, enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

5.3 VOLTAGE DIVIDER

A voltage divider is a simple circuit which turns a large voltage into a smaller one. Using just two series resistors and an input voltage, we can create an output voltage that is a fraction of the input. Voltage dividers are one of the most fundamental circuits in electronics. If learning Ohm's law was like being introduced to the ABC's, learning about voltage dividers would be like learning how to spell cat.

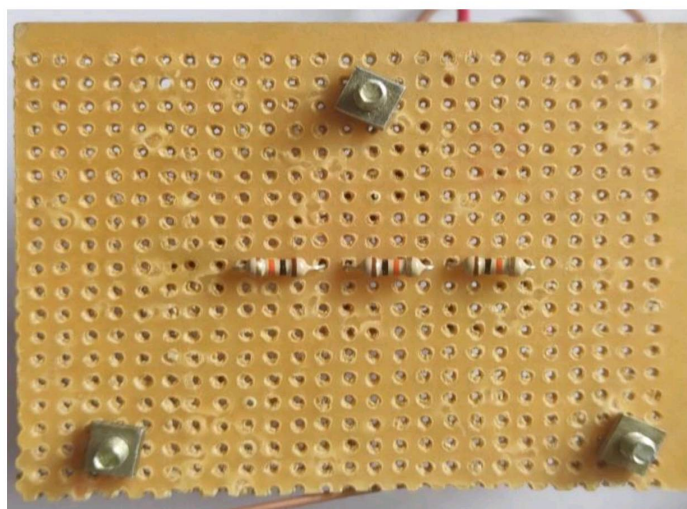


Figure-5.3 Voltage Divider

5.4 POWER SUPPLY

A power supply is an electrical device that supplies electric power to an electrical load. The essential function of a power supply is to change over electric flow from a source to the right voltage, flow, and frequency to power the load. Accordingly, power supplies are once in a while alluded to as electric power converters. Some power supplies are independent bits of gear, while others are incorporated with the load apparatuses that they power. Instances of the last incorporate power supplies found in work stations and buyer gadgets devices. Different functions that power supplies may perform incorporate restricting the flow attracted by the load to safe levels, stopping the flow in case of an electrical fault, power molding to forestall electronic commotion or voltage floods on the input from arriving at the load, power-factor remedy, and putting away vitality so it can keep on powering the load in case of a transitory break in the source power (uninterruptible power supply).

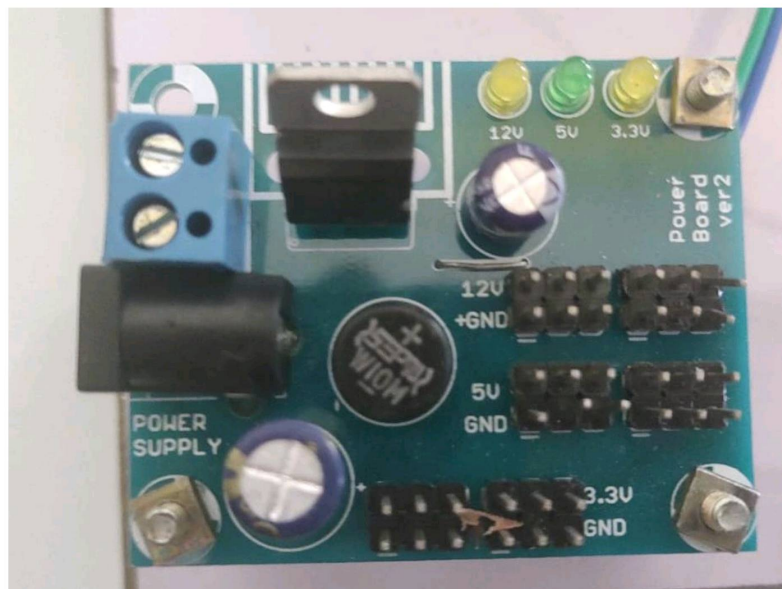


Figure-5.4 Power Supply

All power supplies have a power input association, which gets energy as electric flow from a source, and at least one power output associations that convey flow to the load. The source power may originate from the electric power lattice, for example, an electrical outlet, energy stockpiling devices, for example, batteries or power devices, generators or alternators, sun-based power

converters, or another power supply. The input and output are generally designed circuit associations; however, some power supplies utilize remote energy move to power their loads without wired associations. Some power supplies have different kinds of inputs and outputs also, for functions, for example, outer observing and control.

5.5 CONNECTING WIRES

An electrical connector is a device for joining electrical circuits together using a mechanical assembly. The connection may be temporary or serve as a permanent electrical joint between two wires. There are hundreds of types of electrical connectors. Connectors may join two lengths of wire together or connect a wire to an electrical terminal.



Figure5.5 Connecting wires

5.6 SOFTWARE

A program for Node MCU equipment might be written in any programming language with compilers that produce binary machine code for the objective processor. Atmel gives an improvement situation to their 8-bit AVR and 32-bit ARM Cortex-M based micro-controllers: AVR Studio (older) and Atmel Studio (more up to date). The NodeMCU integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It began from the IDE for the languages Processing and Wiring. It incorporates a code manager with highlights, for example, content reordering, looking and supplanting content, programmed indenting, support coordinating, and grammar featuring, and gives basic a single tick components to compile and transfer programs to an Arduino board. It

additionally contains a message territory, a book support, a toolbar with catches for normal capacities and a progression of operation menus. The source code for the IDE is released under the GNU General Public License, version 2.

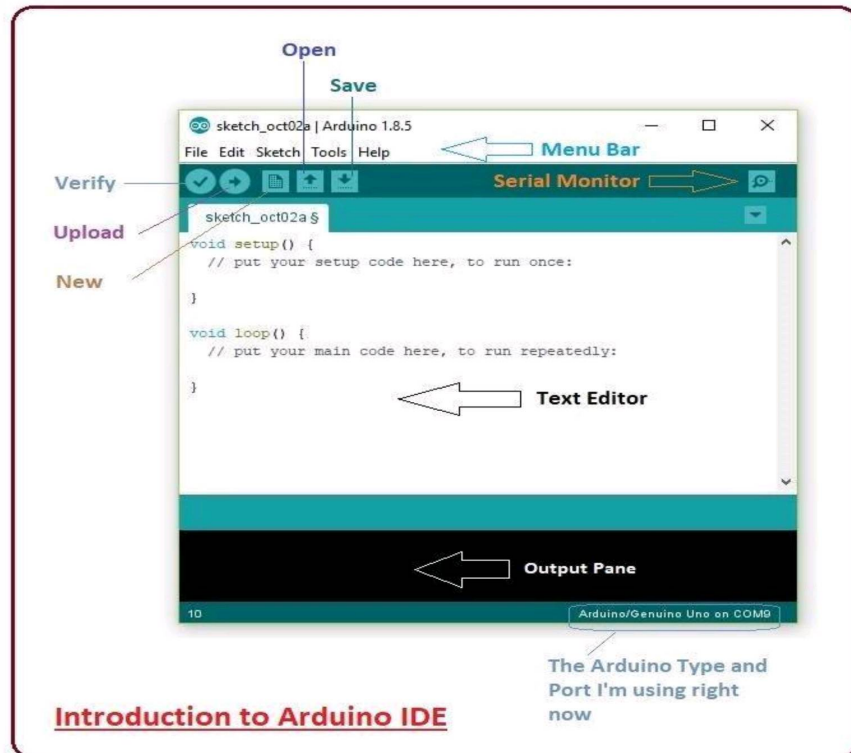


Figure-5.6 IDE software

The Arduino IDE underpins the languages C and C++ utilizing extraordinary guidelines of code organizing. The Arduino IDE supplies a software library from the Wiringventure, which gives numerous basic input and output methods. Client composed code just requires two fundamental capacities, for beginning the sketch and the primary program circle, that are arranged and connected with a program stub principle() into an executable cyclic official program with the GNU device chain, additionally included with the IDE appropriation. The Arduino IDE utilizes the program argued to change over the executable code into a book document in hexadecimal encoding that is stacked into the Arduino board by a loader program in the board's firmware.

5.7 ALGORITHM

Support Vector Machine Algorithm

Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. However, primarily, it is used for Classification problems in Machine Learning. The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane. SVM chooses the extreme points/vectors that help in creating the hyperplane. These extreme cases are called as support vectors, and hence algorithm is termed as Support Vector Machine.

CHAPTER 6

RESULT & DISCUSSION

6.1 RESULT

When the project is launched, Display and monitor all the data through the Internet display the fault and if there is a fault somewhere in the line monitoring can be done through the Internet.

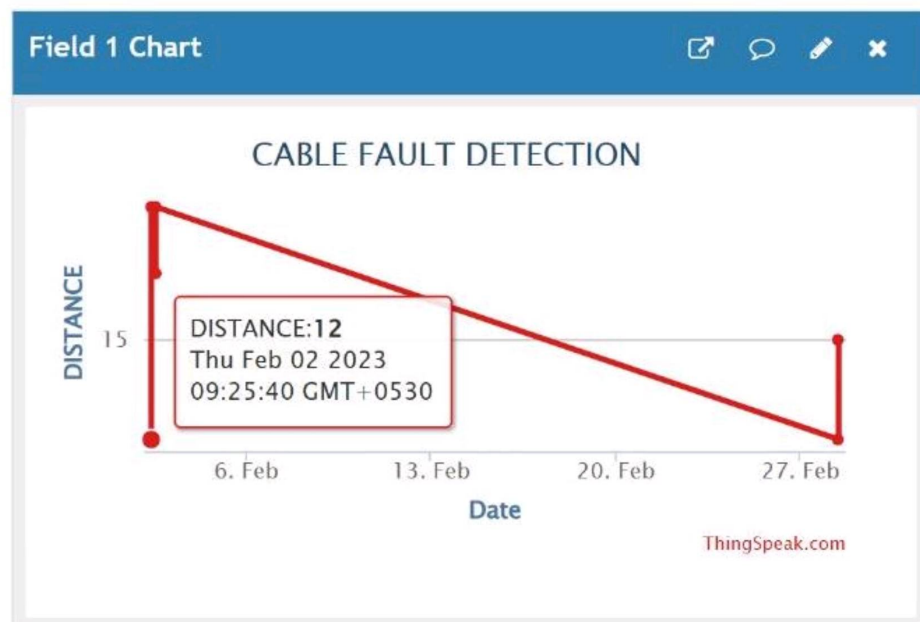


Figure 6.1: ***Accurate distance and fault occurrence time***

CHAPTER 7

CONCLUSION AND FUTURE WORK

7.1 CONCLUSION

This project has a line taken directly from Ac Current to give us power, which flows as dc power in the project. Here we have basically created a dc power source. Using a step down transformer, we have converted the voltage to 24 volts, then these 24 volts are dc by using a rectifier. So when dc is created, little something goes from ac . So we got pure DC using a capacitor. Now we need 5 volts DC for the controller, we have 5 volts DC . Here we have taken a certain amount of voltage using a buck module. We have given the controller a certain amount of voltage. The main goal of our project is to diagnose the underground cable fault, here we are for three phase lines, we have created two fault sensors on each line and we have connected the output of the fault sensor to the digital pin of the controller. Each fault sensor is created, a 6 volt step down transformer, Diode of a 1n4007 model, a capacitor , a voltage regulator 7805 model, a 10K resistor adjustment. Which is shown in the project diagram. This is another aspect of our project Monitor the load current of each phase, we have used three current sensors to monitor the current of the three phases. Connected to the current sensor's output controller's analogy pin. A display has also been attached to the project which is connected to the digital pin of the controller. Another special aspect of our project is the IoT system. On this system we can monitor data via the Internet, For which we have to work with the server. Here, if any fault is present in any of our three phases, it will show directly on the display which fault has been faulted under the switch. At the same time we can monitor the Internet where the fault has occurred. Moreover, we can monitor the current on the display and on the Internet. We have used the programming device here as nodemcu esp8266. Here we have developed the project using c programming.

APPLICATIONS

- The transmission line below the ground.
- Java transmission line in river / sea tunnels.
- Substation.
- The system can also be installed on the transmission line.

7.2 FUTURE WORK

- This system can be brought into the gsm system.
- The number of fault switchers can be increased by keeping in mind the distance.
- Line frequency monitoring systems can be connected.
- By researching the line fault system, new things can be discovered.

7.3 RESEARCH ISSUES

The Internet of Things (IoT) based underground cable fault monitoring and control using NodeMCU is a relatively new and emerging research area. As such, there are several research issues that need to be addressed to improve the effectiveness and efficiency of this technology. Some of these research issues are:

Sensor Selection and Placement: One of the most important factors for effective underground cable fault monitoring is the selection and placement of appropriate sensors. Researchers need to investigate the most suitable types of sensors and their optimal placement to accurately detect cable faults.

Data Acquisition and Analysis: The data collected from the sensors needs to be acquired and analyzed in real-time to detect faults accurately. Researchers need to explore different data acquisition and analysis techniques that can be used to achieve this objective.

Communication Protocols: IoT devices such as NodeMCU require a reliable and secure communication protocol to transmit data. Researchers need to investigate the most suitable communication protocols that can be used for this purpose.

Power Management: Underground cable fault monitoring and control systems need to be powered continuously to ensure they function effectively. Researchers need to explore different power management techniques that can be used to extend the battery life of these devices.

Fault Location Identification: Once a fault is detected, it is essential to identify the exact location of the fault accurately. Researchers need to investigate the most suitable techniques that can be used to achieve this objective.

Security: As with any IoT device, security is a significant concern for underground cable fault monitoring and control systems. Researchers need to explore different security measures that can be implemented to ensure the confidentiality, integrity, and availability of data transmitted by these systems.

In summary, IoT-based underground cable fault monitoring and control using NodeMCU is a promising area of research with several challenges that need to be addressed. Researchers need to explore various techniques to improve the accuracy, reliability, and security of these systems to ensure they are effective in detecting faults and minimizing downtime.

7.4 IMPLEMENTATION ISSUE

In addition to the research issues mentioned earlier, there are several implementation issues that need to be considered when implementing an IoT-based underground cable fault monitoring and control system using NodeMCU. Some of these implementation issues are:

Hardware Integration: Hardware integration is a crucial aspect of implementing an IoT-based underground cable fault monitoring and control system. The hardware components, such as sensors, NodeMCU, and power supply, need to be properly integrated and tested to ensure they work seamlessly together.

Connectivity: Proper connectivity between the NodeMCU and the internet is critical for data transmission and analysis. Connectivity can be established using Wi-Fi, Bluetooth, or other communication protocols, depending on the application requirements.

Power Supply: The NodeMCU and sensors need a constant power supply for proper functioning. Power management strategies like battery backup or solar power can be used to ensure uninterrupted power supply.

Cost: Implementing an IoT-based underground cable fault monitoring and control system using NodeMCU can be costly. The cost of hardware, software, and connectivity needs to be considered, and cost-effective solutions should be identified.

Maintenance and Upgrades: Proper maintenance and upgrades are necessary to ensure the system functions efficiently over time. A regular maintenance schedule should be established, and upgrades should be implemented as required.

In conclusion, implementing an IoT-based underground cable fault monitoring and control system using NodeMCU requires careful consideration of various implementation issues. Proper hardware integration, connectivity, data storage and management, power supply, cost, and maintenance and upgrades are crucial to ensuring the system functions efficiently and effectively.

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APPENDICES

A. SOURCE CODE

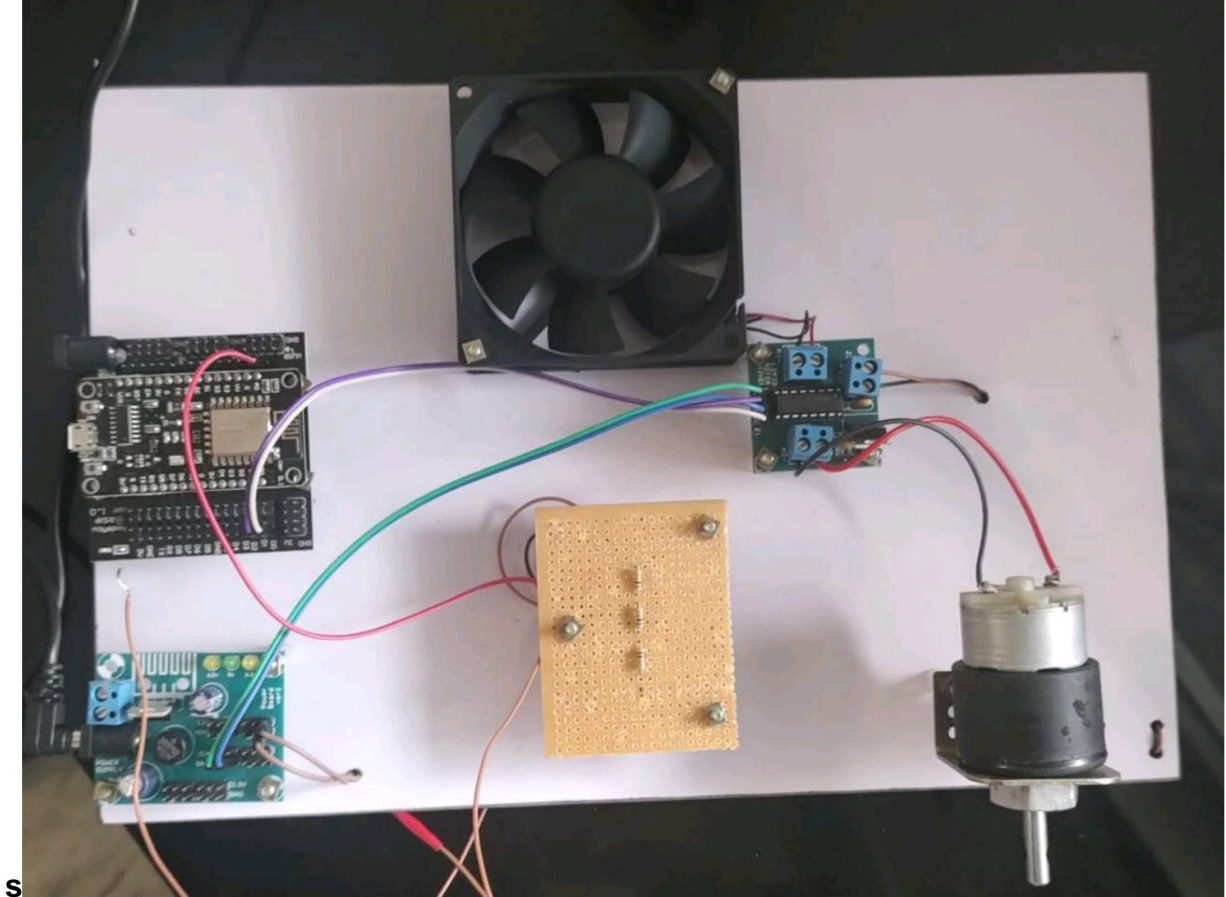
```
#include<ESP8266WiFi.h>
#include<WiFiClient.h>
#include<ThingSpeak.h>
WiFiClient client;
const char* ssid = "IOT"; //Your Network SSID
const char* password = "IOT@123456789" ; //Your Network Password
unsigned long myChannelNumber = 2020977; //Your Channel Number (Without Brackets)
const char * myWriteAPIKey = "CMFSS9FW6NKPARFV"; //Your Write API Key
void setup()
{
  Serial.begin(9600);
  WiFi.begin(ssid, password);
  ThingSpeak.begin(client);
  pinMode(16,OUTPUT);
  pinMode(5,OUTPUT);
}
void loop()
{
  int F=analogRead(A0);
  if(F==1024)
  {
    digitalWrite(16,1);digitalWrite(5,1);

  }
  else
  {
    digitalWrite(16,0);digitalWrite(5,0);
```

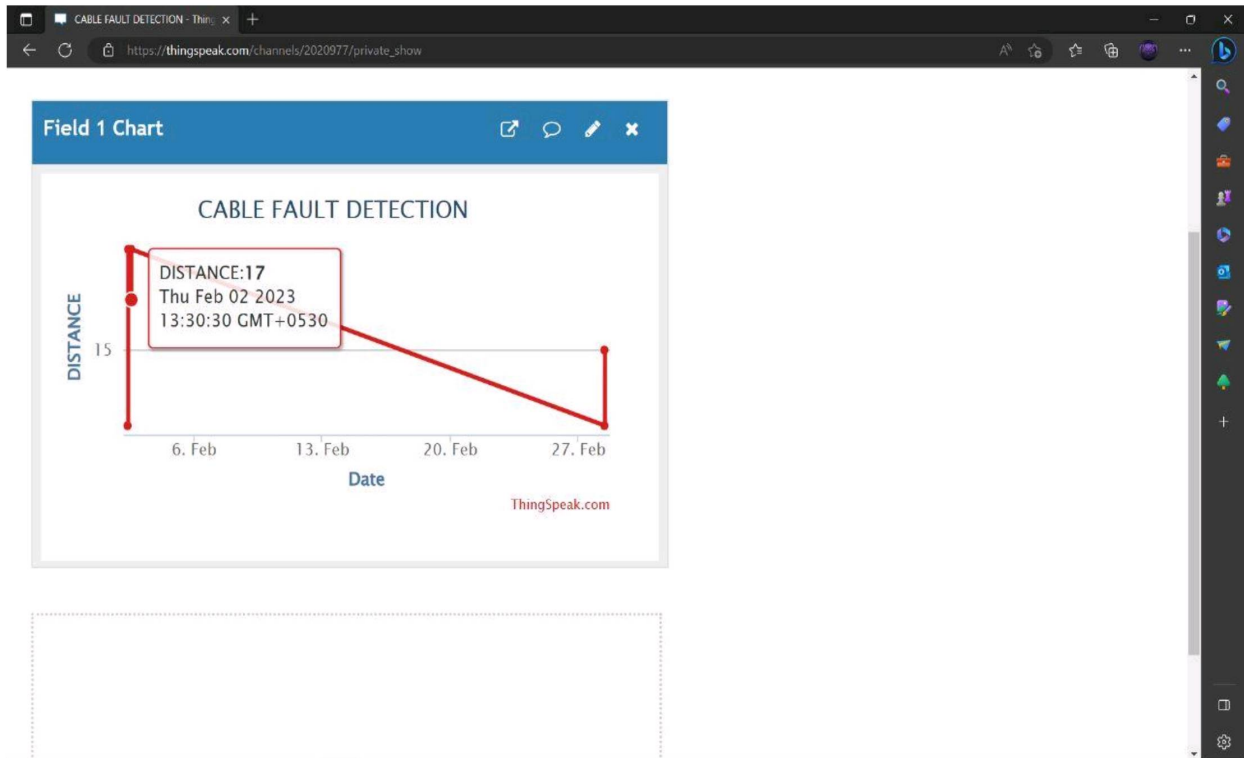


```
int rd=analogRead(A0);  
Serial.print("rd:");  
Serial.println(rd);  
ThingSpeak.writeField(myChannelNumber, 1,rd, myWriteAPIKey);delay(2000);  
delay(2000);  
while(1)  
{  
  
}  
}  
  
Serial.println(F);  
}
```

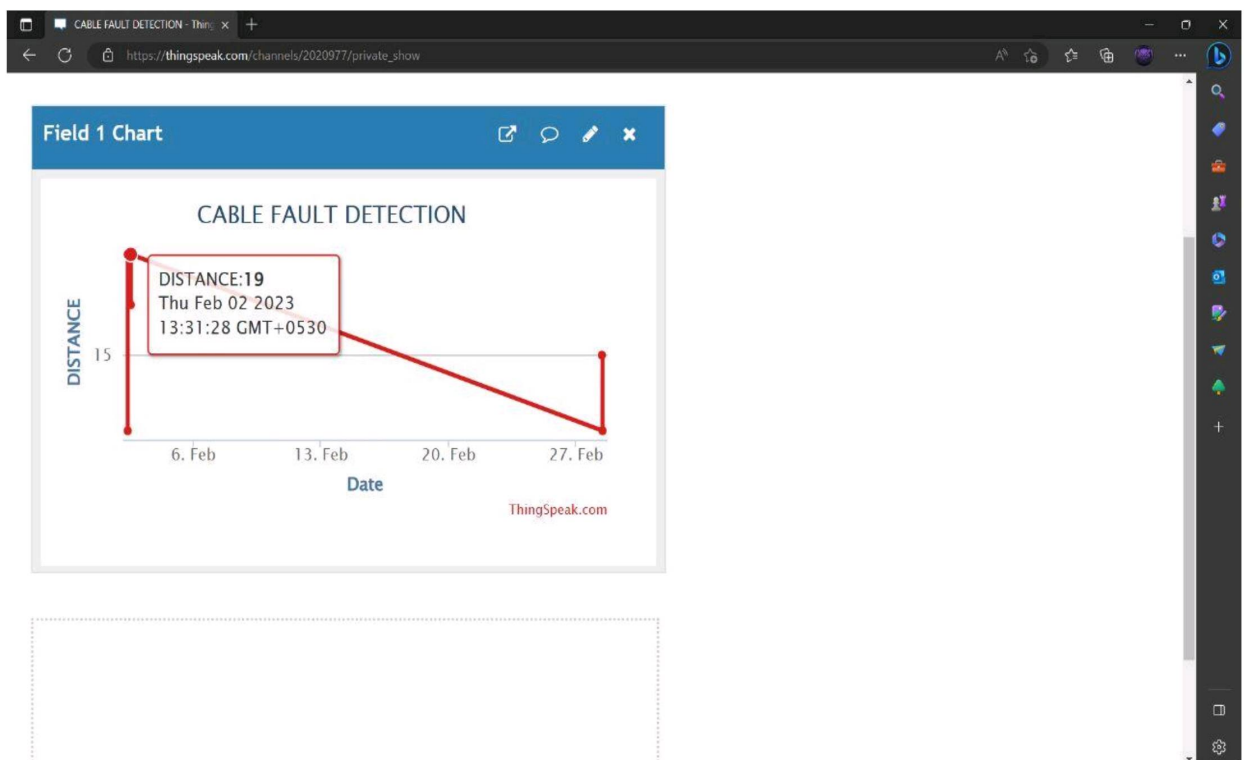
B. SCREENSHOTS



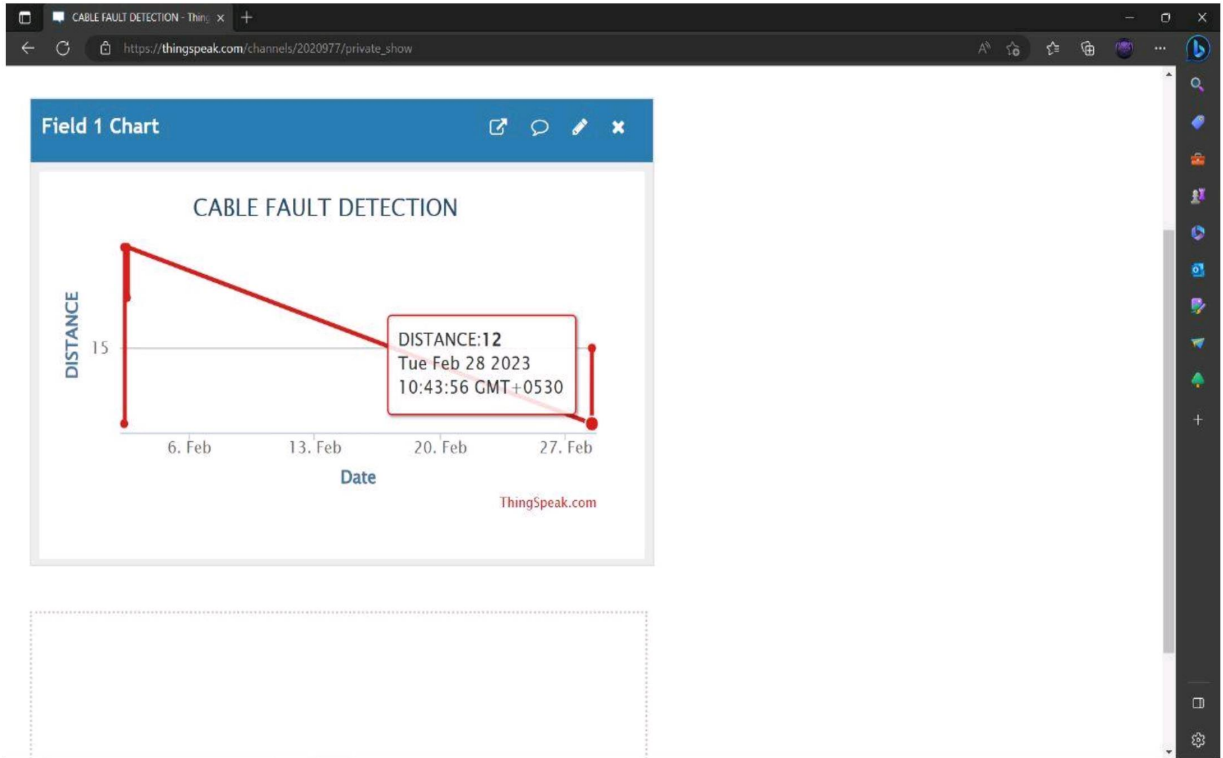
Board Image



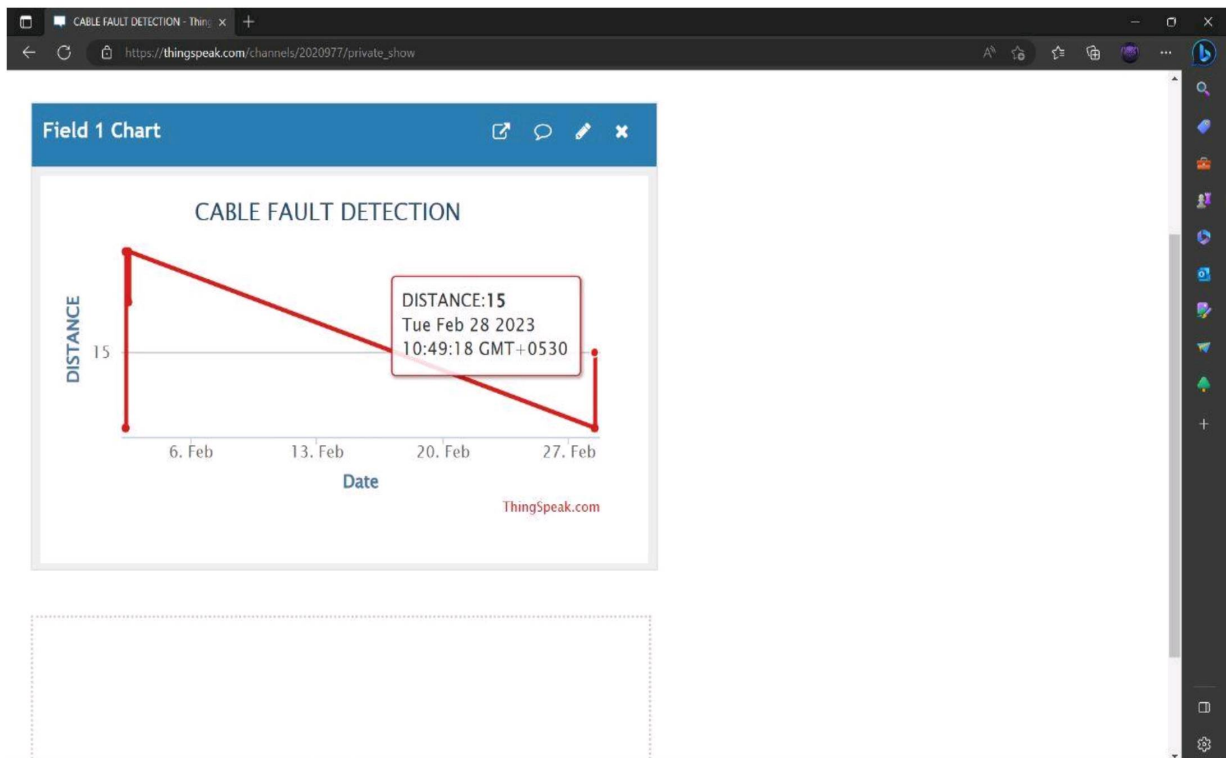
Accurate distance and fault occurrence time(A)



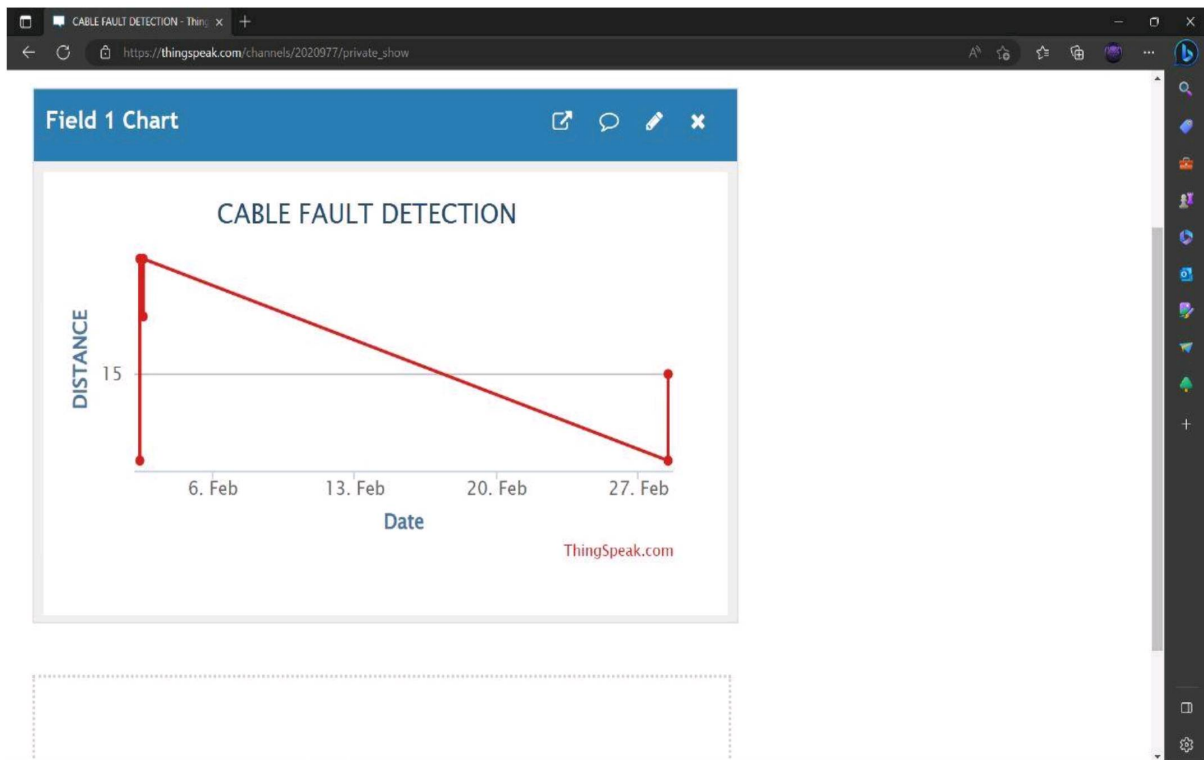
Accurate distance and fault occurrence time(B)



Accurate distance and fault occurrence time(C)



Accurate distance and fault occurrence time(D)



Accurate distance and fault occurrence time(E)

C. RESEARCH PAPER

IOT Based Underground Cable Fault Monitoring Control Using NodeMCU

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Abstract - As technology advances, many things are changing. Urban regions use subterranean electrical wire rather than aerial power lines because it takes up less room and is thought to be the most effective way to transport energy. When repairing underground cables, a problem develops when a cable failure happens and it is difficult to identify its precise position. The methods now in use are based on algorithms to pinpoint the defect. This raised system contains current sensors, microcontrollers (Node MCUs) and a Wifi modem to create a connection between hardware and internet. So that, by using IOT (internet of things), real time data can be communicated successively to a server and retrieved from it via a computer or mobile phone. Through IOT, anyone will be able to recover information whenever they need it. After implementing the proposed system, the supply transmission of power can be closed until the fault is repaired, which will reduce the inessential losses that are caused by leakage of the current.

Keywords: *Underground Cable, IOT Module, Node MCU, Fault detection, LCD, LED.*

I. INTRODUCTION

Due to the underground environment and factors such as wear and tear, rodents, etc., underground cables are prone to various failures. Diagnosing and repairing faults requires removing the entire cable from the ground due to the difficulty of identifying fault sources. The Node MCU controller's planned use is to determine how far away from the base station a subterranean cable line flaw is. To identify the cable problem, it is essential to inspect the wire for flaws. This prototype uses the basic principles of Ohm's Law. Current varies with cable length. Electrical cables run underground rather than over headlines in metropolitan areas. Identifying the precise position of a defect in a subterranean wire so that it can be fixed can be difficult. The proposed system precisely locates the problem. The prototype is built using a series of resistors that represent a kilometer length, and in order to evaluate the precision of the switches, an array of switches is used to construct the error cream. Through the use of an ESP8266 and IoT Wi-Fi adapter, the data is displayed online. An online

website written in HTML code displays details about the sort of mistake.

I. LITERATURE SURVEY

This part examines the benefits and drawbacks of the previous work that is pertinent to the suggested work. The precise position of the underground cable fractured lines from the originating station to that spot has been identified by the writers [1]. Due to the challenges in locating subterranean cable faults, this will make it easier to find and recognise cable failures without having to excavate up the complete length of the cable. A microcontroller-based subterranean wire failure detection and monitoring device using GSM and GPS methods is presented by Anik Dutta [2]. This study seeks to determine the cable fault's distance in kilometres from the base station's control centre using GSM and GPS services, giving a warning of the precise fault position for cable fault repair. To ascertain its capability, power, flaws, and specs, Amirul Hamizan Bin Hamee [3] is put through tests and troubleshooting. It follows the same basic concept as the Underground failed Cable Detector System, making full use of the current sensor ACS758 and the smoke sensor as input, and linking up with GSM and smartphones to alert the user of any failure or fire. A model of a tunnel-exploring robot, as depicted by Asawari Dudwadkar [4], is capable of traversing the tunnel on its own and checking out the area around it at each end. All of the data about subterranean passageways is relayed wirelessly by RF transmitter with the aid of the instruments used on the robot. Along with this information, the robot looks for actual harm on the cable and uses an RF transmitter to communicate the position of the problem to the receiving site. A combined diagnosis approach was put forth by Rathinamala Vijay[5] for the tracking of train facilities. This deals with the problem of detecting mild faults in subterranean train lines. One way to prove the usefulness of flaw identification and localisation using orthogonal multitone time domain reflectometry for railway electrical systems is to implement it using software defined radios. Amarnath, M.M. Everything evolves as technology develops and advances. The importance of technology is becoming increasingly apparent to us as it develops. For instance, in densely populated areas, subterranean electrical cables are typically used instead of aerial power lines because they require less room and are generally accepted as the most reliable and efficient way to transfer energy. When a problem arises in a subterranean wire, however, it

isn't always easy to determine where the problem is located in order to fix it using the techniques at hand. We employ IOT expertise that enables doyens to monitor and examine flaws online. With the assistance of probable Divider Network installed across the cable, The Edifice Advert Fault was created. Faults are quickly fixed to restore the electricity supply. increased starting expense and issues with shielding at high voltages. Using Arduino and GSM, Raushan Kumar Bhagat [7] uses flaws that are present in subterranean cables to detect and display them in LCD and mobile devices. Direct current voltage put on the supplying side modifies the current forecasts further to manage the cable's problem areas. In the event of a short circuit, an Arduino-made ADC will adjust the highest voltage through a capacitance to a safer value. (Such as an L-G or L-L problem). The deficit is accurately predicted by the base station, and this number is produced by Arduino. This value is sent in three stages to an LCD that is attached to an Arduino board and shows the precise location of all base stations at a distance of several kilometres. Many resistors work together to convey the length of the wire in the job. This Strategy Works for All Types of Links, but Faults Switches Induced in Every 4 km to 1 km. Problems up to 4 km can be found using this method. The phase connected to that specific switch is regarded as a fault phase if a fault switch operated the condition. A problem localization model for subterranean wire using a Raspberry Pi module is presented by Dhanyavathi A [8]. In the event of an insulation defect in a subterranean cable, the project will determine how many miles away it is from the base station and upload a live picture of the fault to a website. When there is a defect in a wire, the voltage drops by a different amount due to the varying current. A prototype wire representing a subterranean cable that is about two metres long is used to identify faults. Sensors connected to a Raspberry Pi module are used to detect voltage changes, and the fault information is then presented on an LCD screen. According to P. Ocon et al. [9], the suggested system includes a microprocessor and other electrical devices that will function with the aid of an ADC converter. For the purpose of handling by the microprocessor, with the help of the ADC, the alternating current energy can be converted to direct current. With the help of an Arduino, Roshani Shingrut [10] suggested a fault localisation model for subterranean cable lines that could estimate the distance in miles from the underground cable defect at the base station. When a system failure happens, the distance shown on the liquid crystal monitor changes. (LCD). There is currently no subterranean wire that is higher than the prior technique because cables were created to be put above the head up

until the last ten years. Storms, snowfall, flooding, and pollution have no effect on wires laid underground. However, it can be challenging to pinpoint a subterranean cable failure when it affects subsurface lines. It locates the flaw in digital form precisely.

II. PROPOSED SYSTEM

There is a short circuit in a cable buried underground, but it is easily repaired by following the principles of Ohm's Law. Using ESP8266 and NodeMCU hardware, the work displays the phase, position, and time of failure on the web site immediately. Rapid power system recuperation, enhanced system functionality, reduced running costs, and quicker fault location periods are just a few advantages of accurate fault location.

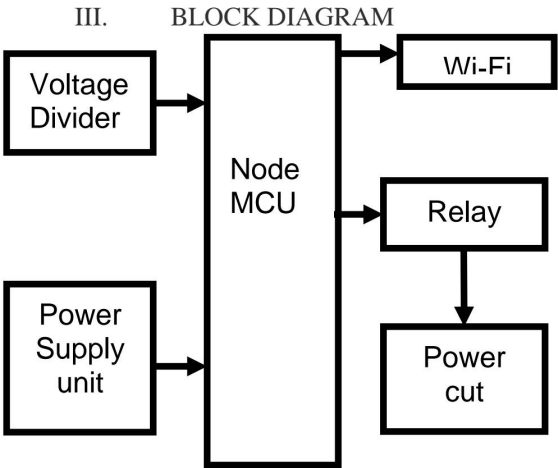


Fig. 1. Working process of NodeMCU

An open source IoT framework is NodeMCU. Its circuitry is built on the ESP-12 module, and its software makes use of Espressif Systems' ESP8266 Wi-Fi SoC A power source, or electrical instrument, delivers electricity to an electrical application. A power supply's primary responsibility is to convert the incoming energy from the source into the desired voltage, current, and frequency in order to power the application. To step down an extremely high voltage so that it can be measured with a voltmeter, use a voltage divider. This is converted by a divider to 0–3.2V. (3.3V). Wi-Fi data transmission and reception are handled by wifi modules or wifi microcontrollers. They can also get instructions over Wi-Fi. For device-to-device communication, Wi-Fi modules are employed. A magnetic drive the electrical switch in the power relay module. The microcontroller's separate low-power signal triggers the electromagnet separately. When

powered up, the magnetic pulls to either open or close an electrical circuit.

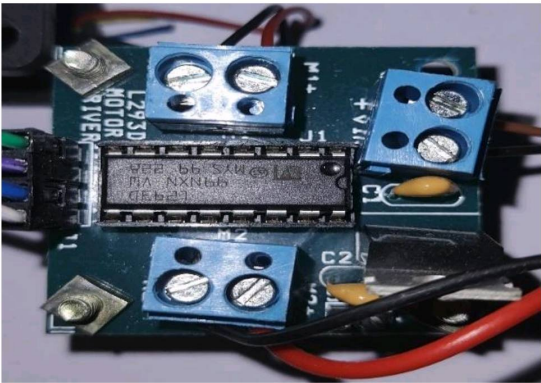


Fig. 2. Relay



Fig. 3. Voltage Divider

MODULE 1

Arduino IDE

Options, an interface with symbols for frequently used tasks, a message box, a text prompt, and a text editor are all part of the integrated Arduino development environment (IDE), also known as the Arduino Software (IDE). It communicates with Arduino boards to load programmes and facilitate exchanges between them.

MODULE 2

ThingSpeak

When you subscribe to the ThingSpeak IOT analytics platform service, you'll have access to tools for gathering, visualizing, and analysing data in real time, all from the comfort of the cloud. ThingSpeak instantly displays the information your gadgets send to it.

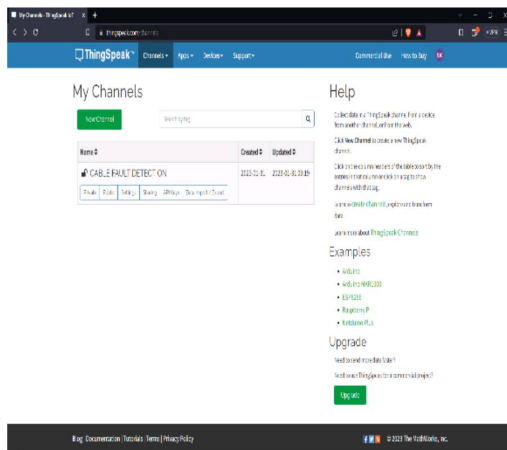


Fig. 4. ThingSpeak Website

MODULE 3

Node MCU

NodeMCU is an open source IOT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term “NodeMCU” by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266.



Fig. 5. Node MCU

IV. RESULT AND DISCUSSION

Once the project has begun, you can view and keep an eye on all the data online. If the fault is visible, monitoring can be done online.

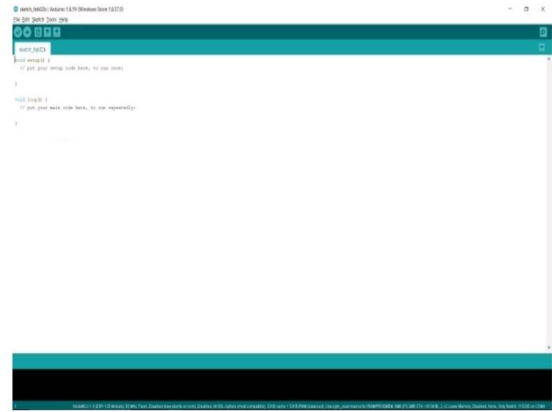


Fig. 6. Arduino Text Editor

It is used to create and send code to the NodeMcu devices is shown in Figure 4. The integrated development environment (IDE) programme is compatible with Windows, Mac OS X, and Linux. It's compatible with C and C++ programming systems. Integrated Development Environment is referred to here as IDE.

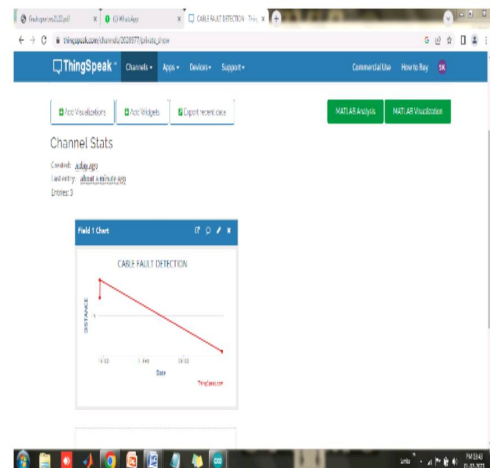


Fig. 7. Viewing Data in Graph

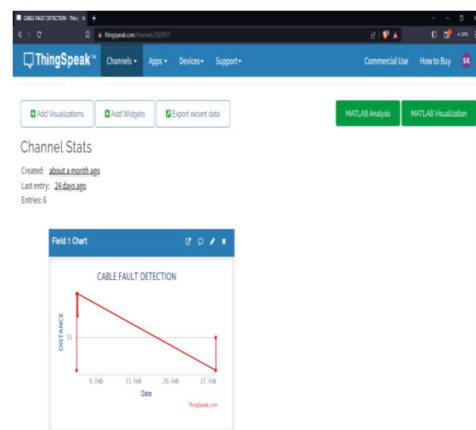


Fig. 8. Viewing data in Graph

In Fig. 7 and Fig. 8, Data access is made simple by cloud storage. You can examine and visualise data using online analytical tools. In data, you can find connections, patterns, and trends. New data can be calculated. Furthermore, graphs, charts, and gauges can be used to display it.

V. CONCLUSION

This project employs an ESP8266 microcontroller to track down circuit faults in an underground cable kilometre by kilometre, beginning at the end feeder. The ESP8266 microcontroller functions on the cable's output resistance as its foundation. Relays assist in separating faulty lines from other faulty lines. Currently, this project only finds problems with underground cable lines, but it could be expanded to find open circuit faults.

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Using NodeMCU

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1 message

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12 April 2023 at 18:04

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