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CABLE FAULT TRACKER

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Abstract **-** Underground electrical lines are preferred in metropolitan areas over overhead ones because they are not impacted by weather-related events such intense rain, snowfall, or thunderstorms. When a problem arises in an underground cable, pinpointing the precise site of the fault is challenging when it comes to fixing that specific cable. The precise position of the problem was identified by the suggested system. The study applies the common concept of Ohm's law, which states that the current will fluctuate based on the location of the cable fault short when a low DC voltage is provided at the feeder end through a series resister (cable lines). An Arduino microcontroller and a rectified power supply are used in this arrangement. In this instance, the microcontroller is coupled to the current detecting circuit, resistor, and ADC device to represent the wire's length in kilometers. A group of switches is responsible for creating errors. Relay exciter ICs are used to verify cable lines and control the relays. Information is shown on a 16x2 LCD. Another characteristic is that the base station receives information on fault detection via GSM, including the fault's location and distance in kilometers from the base station. Field workers are alerted and prompted to take rapid action when a cable failure develops thanks to the buzzer.

Key Words: *Under ground electrical cables, fault detection, Ohm's law, ADC device , Relay exciter , Resistor network ,GSM Communication , Current detection circuit.*

1 .INTRODUCTION

A cable is a group of electrical conductors that are used to transport electricity. One or more conductors coated with appropriate insulation and a protective cover are often found on an underground cable. Paper that has been impregnated or varnished cambric are common materials used as insulation. Any flaw or non-homogeneity in a cable that alters the current's path or impairs its functionality is considered a fault. For this reason, fixing the error is required. Power transmission can occur through subterranean cables as well as overhead ones. However, the disadvantage of overhead wires is that they are more vulnerable to weather-related events like rain, snow, thunder, lightning, etc. than underground cables. This calls for cables that are more dependable, robust, safe, and provide better service. Thus, subterranean cables are the ideal option in many situations, particularly in cities. An subterranean cable cannot have problems that are easily found and fixed by simple observation, unlike overhead lines. It is difficult to find the anomalies in them because they are buried down in the ground. It is extremely difficult to pinpoint the precise site of a defect, even when one is discovered to exist. This results in the entire region being dragged in order to find and fix the problem, wasting both money and labor. Therefore, pinpointing the precise position of subterranean cable faults is essential. Whenever a problem arises, the cable's voltage has a propensity to vary suddenly, regardless of the nature of the issue. To find the defect, we use this voltage change between the series resistors. Errors in subterranean.

OPEN CIRCUIT FAULTS: One or more conductors failing is the cause of these issues. Joint failures of cables and overhead lines, failure of a circuit breaker's one or more phases, and Vol-7 Issue-3 2021 are the most frequent causes of these faults. melting of a conductor or fuse in one or more phases, IJARIIE-ISSN(O)-2395-4396 14227 www.ijariie.com 489. Series faults are another name for open circuit faults. With the exception of three phase open faults, all of these are asymmetrical or unbalanced fault types.

SHORT CIRCUIT FAULTS: An anomalous, purposefully or unintentionally created connection of

very low impedance between two locations of different potential is referred to as a short circuit. These are the most prevalent and serious types of defects, causing abnormally large currents to flow through transmission lines or equipment. If these errors are ignored, even for a brief while, the equipment will sustain significant harm. Shunt faults are another name for short circuit faults. The failure of the insulation between phase conductors, between earth and phase conductors, or both, is the cause of these problems.

2. LITERATURE SURVEY

1. Presented the design and implementation of an IOT-based fault identification system for underground cables. The goal of this project is to calculate, in kilometers, the distance of an underground cable fault from the base station and present the result online. The use of subterranean cable systems is widespread in metro regions. When a defect arises in a cable for whatever reason, the precise location of the problem in the cable makes the fixing process for that specific cable difficult. This technology uses an LCD screen to display the precise position of the issue and uses a GSM module to communicate data in graphical format to our website. The project makes use of the traditional principle of Ohms law, which states that because resistance increases with distance, current will vary based on where a cable fault is located when a low DC voltage is provided at the feeder end through a series resistor (cable lines). The voltage across series resistors varies in response to the resistance, which varies with distance, in the event of a short circuit (Line to Ground). This is then sent to an ADC, which creates accurate digital data that the 8051 family's programmed microcontroller displays in kilometers.

2. An analysis of the fault distance locator for underground cables was presented. Because of the subsurface environment, deterioration, rodents, etc., underground cables are vulnerable to a wide range of problems. It is also challenging to identify the cause of a defect, and digging the entire line is necessary to inspect and correct faults. Therefore, we now suggest cable fault detection over IOT, which locates the precise fault spot over IOT and simplifies the repair process. Repairmen know precisely which section is broken, and only that region needs to be excavated in order to find the root of the problem. This enables quicker maintenance of subterranean cables while also saving a great deal of time, money, and effort.We update the monitored fault information to the internet using IOT technology. The technology uses the potential divider network that is positioned across the cable to identify faults. A particular voltage is produced according to the resistor network combination whenever a fault is established at a spot where two lines are shorted together. The microcontroller senses this voltage and updates the user. The information about defect detection that is communicated to the user is this. The microcontroller retrieves the fault line data and sends it over the internet to the Gmail server for display. It also displays the data on an LCD display.

3. A Fault Locating System for Underground Transmission Cables Using Arduino. Finding the transmission line fault involves a lot of human labor and resources. This is usually a labor-intensive procedure, and there is a chance that the insulation will be harmed during the digging of the cable. This paper automates the defect location and detection procedure, offering a straightforward and secure substitute. The project applies a low DC voltage at the feeder end using a series resistor, utilizing the straightforward idea of OHMs law. If there is a short circuit of LL, 3L, LG, etc., the current will vary based on the length of the cable fault. As a result, the series resistor voltage droop varies, identifying the precise site of the defect for the process offixing that specific cable. The suggested method pinpoints the fault's precise position. An Arduino microcontroller kit and a rectified power supply are used in this arrangement. Here, the inbuilt ADC device helps the current sensing circuits built using a combination of resistors interact with the Arduino microcontroller kit to provide digital data to the microcontroller that represents the wire length in kilometers. The group of switches is the source of the malfunction.

4. Presented GSM-Powered Subterranean Cable Fault Detector. Finding and locating the underground cable fault is the project's primary goal. Subterranean cables rather than overhead ones carry electricity in metropolitan areas. The procedure of fixing a defect gets harder every time it happens. The precise location of a defect in an underground electrical cable line is

exceedingly difficult to pinpoint. By completing this project, the technical team will be able to fix these errors more quickly. Faults can arise from short circuits, low voltage problems, or high voltage problems. Only short circuit faults can be identified using the previously suggested technique. The purpose of this project is to identify low voltage and high voltage faults in addition to short circuit faults. As the Ohm's law is the foundation of the system that was built here. The suggested method is employed not only for identification but also for sending detailed information about the malfunction to the appropriate authorities via GSM. In addition, it turns off the power at that specific area to ensure public safety. It was also utilized to show the kind of LCD display issue. The buzzer sounds when a cable malfunctions, alerting you to the situation and urging you to act quickly.

5. Underground Cable Fault Detection with Raspberry Pi and Arduino. This research suggests a fault location model for subterranean power cables utilizing a Raspberry Pi and the Internet of Things. Since the model is internet-based, data will be transmitted via an internet connection. This method's objectives are to locate the faulty location and calculate the underground cable fault's distance in kilometers from the base station. The basic idea of Current Transformer Theory (CT Theory) is used in this study. Any problem, such as a short circuit, will cause a variable voltage drop based on how long the cable fault is; as current fluctuates, current transformers are used to determine varying current. IOT devices display the fault distance thanks to the manipulation of voltage change by the signal conditioner and computations by a microcontroller. These defect information are then transmitted via the internet to any access point, where they are shown.

3. EXISTTING METHOD

Generally speaking, there are two types of fault location methods for subterranean cable networks:

1.Tracer method: By tracing the cable circuits, the tracer method is a thorough way to identify a defective segment. It is possible to identify a defective section using electromagnetic or auditory cues, in which case crew members must be sent to the affected location. Many approaches have been widely employed in the industries, such as the tracing strategy using current, electromagnetic, or acoustic waves.

2. Terminal method: Without doing a thorough trace, the terminal method locates a fault in a distribution cable network from one or both ends. One of the most widely used terminal techniques, the bridge technique connects with a resistor to pinpoint the site of a failure. It's a method for finding cable faults from one or both ends without having to trace the fault.

4. DETECTION AND SOLUTION OF PROBLEM

• The primary drawback of subterranean cables is their higher initial cost and issues with insulation at high voltages.

• The fact that faults are unseen makes it challenging to find and fix them when they do exist, which is another major disadvantage.

• A 5V DC supply is needed for the Arduino and other components. The relay needs 12V DC.

• There is a delay since the angular value takes some time to read.

• With the current system, we can manually identify the location of a cable issue, but this is a laborious and time-consuming operation.

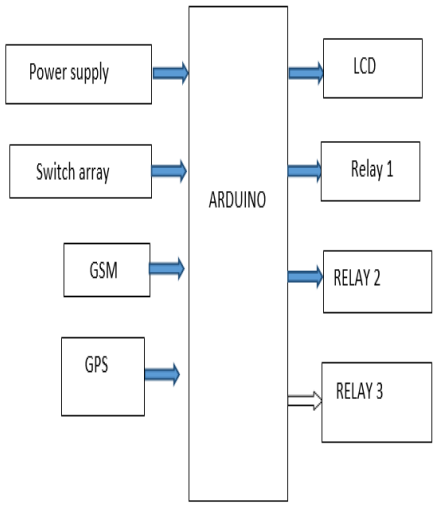
Thus, the project that resolves the aforementioned issues is presented here. That example, we are working on a project to pinpoint the precise area where an underground cable fault originates employing GPS and transmits the message via GSM to the line man and power plant. A cloud-based database including the mobile numbers of line men is utilized for database retention.

5. PROPOSED SYSTEM

The purpose of an underground cable fault detector is to pinpoint the precise position of the problem directly from the base station. The suggested method pinpoints the fault's precise position. This essay applies the conventional understanding of Ohm's law, which is... Upon applying a low DC voltage at the feeder end via a series resister, the current would fluctuate based on where the cable fault lies. There is some resistance in cables. Our first concern is the resistance. The resistance might change depending on how long the cable is. The resistance will likewise grow as the

cable's length increases We will refer to any deviation in the resistance value as a failure site and use Arduino technology to locate it. The fault point represents the standard distance (in kms) from base station. This value is shown on the LCD display unit. Another characteristic is that the base station receives information on fault detection via GSM, including the fault's location and distance in kilometers from the base station. Field workers are alerted and prompted to take rapid action by the buzzer whenever a cable failure arises.

BLOCK DIAGRAM

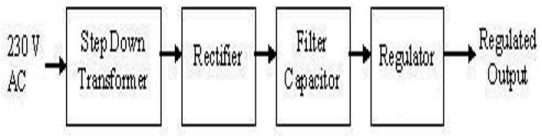


6. IMEPLEMENTATION

Hardware Requirements

POWER SUPPLY:

All digital circuits require regulated power supply. In this article we are going to learn how to get a regulated positive supply from the mains supply.



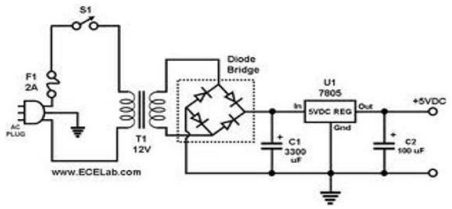


Fig 2.3 Circuit Diagram of power supply

1IC 7805:

7805 is an integrated three-terminal positive fixed linear voltage regulator. It supports an input voltage of 10 volts to 35 volts and output voltage of 5 volts. It has a current rating of 1 amp although lower current models are available. Its output voltage is fixed at 5.0V. The 7805 also has a built-in current limiter as a safety feature. 7805 is manufactured by many companies, including National Semiconductors and Fairchild Semiconductors. The 7805 will automatically reduce output current if it gets too hot. The last two digits represent the voltage; for instance, the 7812 is a 12-volt regulator. The 78xx series of regulators is designed to work in complement with the 79xx series of negative voltage regulators in systems that provide both positive and negative regulated voltages, since the 78xx series can't regulate negative voltages in such a system. The 7805 & 78 is one of the most common and well-known of the 78xx series regulators, as it's small component count and medium-power regulated 5V make it useful for powering TTL devices.

RELAY:

A **relay** is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is

called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

SWITCHES:

Switches are used to turn an electric current on and off. Relays are switching devices that use a small current to turn the larger current of switches on and off. Mercury conducts electricity and therefore can be used to complete the circuit in electric switches and relays. Depending on the switch type and use, mercury switches may contain from 1 g to 3.6 kg of mercury (Huber, 1997; IMERC, 1999). Several types of switches can be found at public water systems including tilt switches, mercury wetted-relays, and float switches. These switches and relays are found as parts of electrical systems that activate pumps (including sump pumps), alarms, and other automated systems.

Tilt switches are commonly used in control panels and thermostats. A tilt switch uses a glass or metallic bulb with electrical contacts at one or both ends. Some tilt switches contain a conductive liquid, such as mercury, inside the bulb. The liquid moves from side to side when tilted, completing or breaking the circuit.

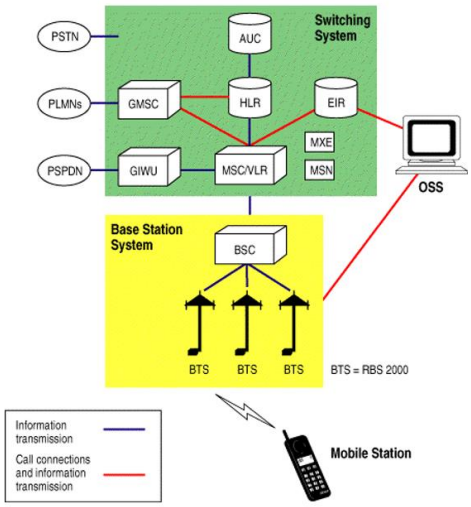
Float switches are used by public water systems to indicate changing water levels in surface storage areas or water tanks, and activate related equipment such as pumps or alarms. A float switch is comprised of a tilt-type switch housed within a buoyant float. When water levels change, the mercury inside the switch slides to one side or the other, completing or breaking the circuit. Because the switch component may be inside a buoyant float, it may not be readily apparent whether a float contains mercury based on visual inspection. Operators should check with vendors or manufacturers to identify the presence of mercury.

Control panels and electrical equipment are found throughout ground and surface water systems and often contain mercury switches and relays. (Figure 3) In a ground water system, look for mercury switches and relays in well houses, pump stations, disinfection systems, and storage facilities. In a surface water facility enclosure, check control panels used to operate pumps, pretreatment delivery systems, flocculation and settling systems, filtering systems, and disinfectant/sterilization units. In many drinking water systems, older electrical systems are being replaced by fully automated, computerized systems, making the old control panels defunct. Precautions should be taken when disposing of older systems to ensure mercury components are handled appropriately.

GSM (Global System for Mobile communications):

GSM (Global System for Mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated. The rarer 400 and 450 MHz frequency bands are assigned in some countries, where these frequencies were previously used for first-generation systems.

GSM-900 uses 890–915 MHz to send information from the mobile station to the base station (uplink) and 935–960 MHz for the other direction (downlink), providing 124 RF channels (channel numbers 1 to 124) spaced at 200 kHz. Duplex spacing of 45 MHz is used. In some countries the GSM-900 band has been extended to cover a larger frequency range. This 'extended GSM', E-GSM, uses 880–915 MHz (uplink) and 925–960 MHz (downlink), adding 50 channels (channel numbers 975 to 1023 and 0) to the original GSM-900 band. Time division multiplexing is used to allow eight full-rate or sixteen half-rate speech channels per radio frequency channel. There are eight radio timeslots (giving eight burst periods) grouped into what is called a TDMA frame. Half rate channels use alternate frames in the same timeslot. The channel data rate is 270.833 kbit/s, and the frame duration is 4.615 ms.



LCD MODULE:

To display interactive messages we are using LCD Module. We examine an intelligent LCD display of two lines, 16 characters per line that is interfaced to the controllers. The protocol (handshaking) for the display is as shown. Whereas D0 to D7th bit is the Data lines, RS, RW and EN pins are the control pins and remaining pins are +5V, -5V and GND to provide supply. Where RS is the Register Select, RW is the Read Write and EN is the Enable pin.

The display contains two internal byte-wide registers, one for commands (RS=0) and the second for characters to be displayed (RS=1). It also contains a user-programmed RAM area (the character RAM) that can be programmed to generate any desired character that can be formed using a dot matrix. To distinguish between these two data areas, the hex command byte 80 will be used to signify that the display RAM address 00h will be chosen.Port1 is used to furnish the command or data type, and ports 3.2 to 3.4 furnish register select and read/write levels.

The display takes varying amounts of time to accomplish the functions as listed. LCD bit 7 is monitored for logic high (busy) to ensure the display is overwritten. Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most common type of LCD controller is HITACHI 44780 which provides a simple interface between the controller & an LCD. These LCD's are very simple to interface with the controller as well as are cost effective.

16 X 2 Line Alphanumeric LCD Display

Arduino:

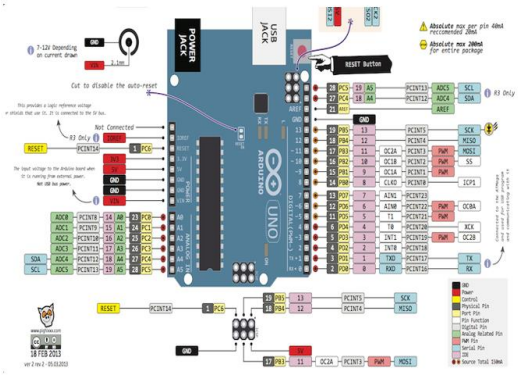
Arduino is a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL),[1] permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

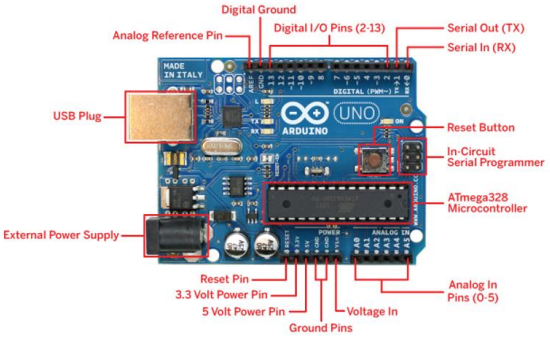
Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (*shields*) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project started in 2005 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy,[2] aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

The name *Arduino* comes from a bar in Ivrea, Italy, where some of the founders of the project used to meet. The bar was named after Arduino of Ivrea, who was

the margrave of the March of Ivrea and King of Italy from 1002 to 1014.





Esp8266 Wi-fi Module

The ESP8266 is a Wi-Fi module that allows microcontrollers to connect to a Wi-Fi network and make simple Wi-Fi applications. It has a number of GPIO (general-purpose input/output) pins that can be used to interface with external devices and sensors. The specific number and arrangement of these pins can vary depending on the specific model of ESP8266 you are using.

For example, the ESP-01 model of the ESP8266 has 8 pins, including power and ground pins, as well as GPIO pins, serial transmit and receive pins (TX and RX), and an output pin for controlling an external device such as an LED. Other models, such as the ESP-12, have more pins and additional functionality, such as an antenna connection and support for external memory.

It is important to note that the ESP8266 is not a standalone microcontroller and must be used with a microcontroller board such as an Arduino wi-fi module in order to program and control it. The specific pin configuration of the ESP8266 will need to be considered when wiring it to the microcontroller board.

The ESP8266 Wi-Fi module has a number of GPIO (general-purpose input/output) pins that can be used to interface with external devices and sensors. The specific number and arrangement of these pins can vary depending on the specific model of ESP8266 you are using. Some possible uses of the ESP8266 Wi-Fi module's GPIO pins include

- Connecting sensors such as temperature, humidity, or motion sensors to monitor the environment
- Controlling and dimming LEDs or other lights
- Operating switches and buttons to control devices
- Connecting and controlling motors or other actuators
- Connecting and communicating with other microcontroller boards or devices

The ESP8266 can be programmed using the appropriate commands and libraries to control the GPIO pins and interface with external devices. It can also be used to connect to a Wi-Fi network and send or receive data over the Internet, making it possible to create a wide range of Wi-Fi-enabled applications and projects.

GPS MODULE

GPS receivers are generally used in smartphones, fleet management system, military etc. for tracking or finding location.

Global **P**ositioning **S**ystem (GPS) is a satellite-based system that uses satellites and ground stations to measure and compute its position on Earth.

GPS is also known as Navigation System with Time and Ranging (NAVSTAR) GPS.

GPS receiver needs to receive data from at least 4 satellites for accuracy purpose. GPS receiver does not transmit any information to the satellites.

This GPS receiver is used in many applications like smartphones, Cabs, Fleet management etc.

The GPS module is a wireless chip module combined on the mainboard of a mobile phone or machine. It can communicate with the global satellite positioning system in the United States. It can locate and navigate according to the condition of a wireless network signal.

Software development

Arduino IDE Software. You can get different versions of Arduino IDE from the Download page on the Arduino Official website. You must select your software, which is compatible with your operating system (Windows, IOS, or Linux). After your file download is complete, unzip the file.

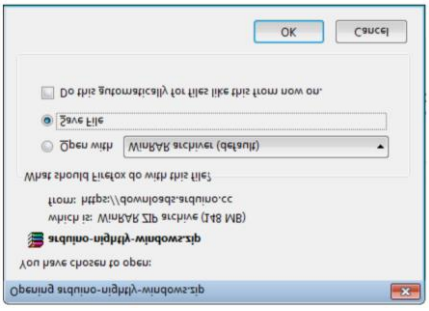


Fig. Opening arduino-nightly-windows.zip

Launch Arduino IDE. After your Arduino IDE software is downloaded, you need to unzip the folder. Inside the folder, you can find the application icon with an infinity label (application.exe). Double click the icon to start the IDE.

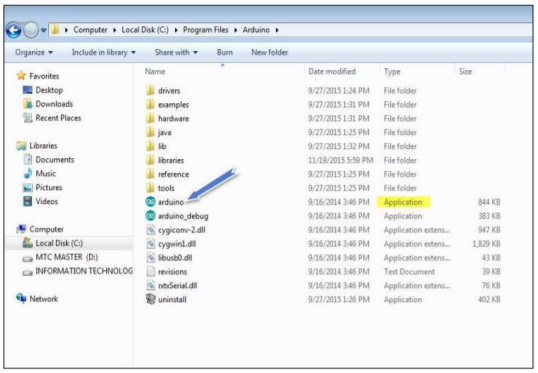


Fig: Launch Arduino IDE

Open your first project. Once the software starts, you have
two options:

- Create a new project.

- Open an existing project example.

To create a new project, select File --> New

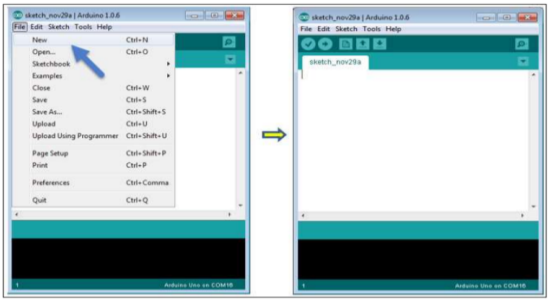


Fig: Create a new project

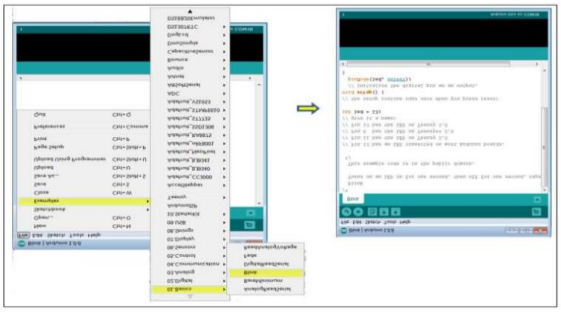


Fig: Open an existing project example

Here, we are selecting just one of the examples with the name Blink. It turns the LED on and off with some time delay. You can select any other example from the listSelect your serial port. Select the serial device of the Arduino board. Go to Tools -> Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu, the entry that disappears should be of the

Arduino board. Reconnect the board and select that serial port.

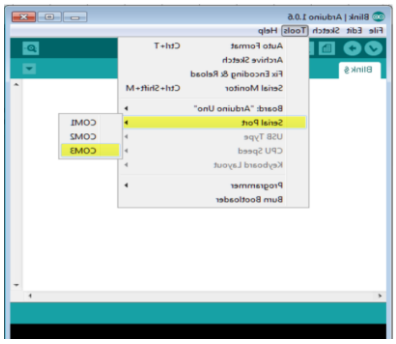


Fig: Select your serial port

Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.

A- Used to check if there is any compilation error.
B- Used to upload a program to the Arduino board.
C- Shortcut used to create a new sketch.
D- Used to directly open one of the example sketch.
E- Used to save your sketch.
F- Serial monitor used to receive serial data from the board and send the serial data to the board.

Now, simply click the "Upload" button in the environment.

Wait a few seconds; you will see the RX and TX LEDs on the board, flashing. If the upload is successful, the message "Done uploading" will appear in the status bar.

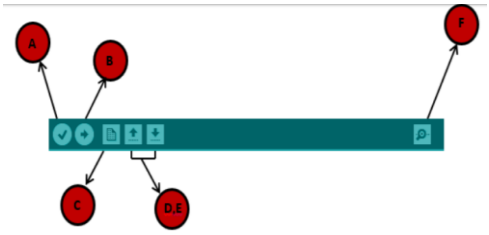


Fig: function of each symbol appearing in the Arduino IDE toolbar

In this chapter, we will study in depth, the Arduino program structure and we will learn more new terminologies used in the Arduino world. The Arduino software is open-source. The source code for the Java environment is released under the GPL and the C/C++ microcontroller libraries are under the LGPL. Sketch: The first new terminology is the Arduino program called “sketch”. Structure Arduino programs can be divided in three main parts: Structure, Values (variables and constants), and Functions. In this tutorial, we will learn about the Arduino software program, step by step, and how we can write the program without any syntax or compilation error. Let us start with the Structure. Software structure consist of two main functions:

Setup( ) function
Loop( ) function

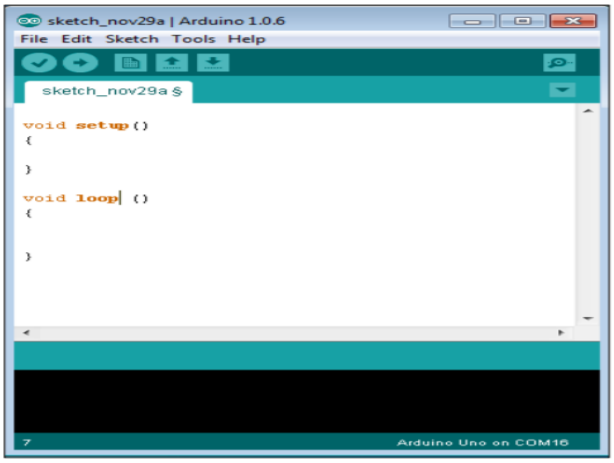


Fig: Bare minimum code

Data types in C refers to an extensive system used for declaring variables or functions of different types. The type of a variable determines how much space it occupies in the storage and how the bit pattern stored is interpreted. The following table provides all the data types that you will use during Arduino a programming.

7. CONCLUSION:

Finally, we have done this project for location of fault in underground cable in the rural areas where underground transmission system is used. It is difficult to find the fault in the cable. So this project is beneficial to use to detect the fault location. So the fault can easily locate and extinguish.

8. FUTURE SCOPE:

In this Project we detect the exact location of short circuit fault in the underground cable from feeder end in km by using Arduino. In future, this project can be implemented to calculate the impedance by using a capacitor in an AC circuit and thus measure the Open Circuit Fault.

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