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Fault Detection in Underground Cables Using A Microcontroller

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Abstract

The project's goal is to use a microcontroller kit to find the location of a fault in underground cable lines from the base station to the closest point in terms of distance. Instead of using overhead wires, the electrical cable travels undergroundin metropolitan areas. It can be challenging to locate the closest defect whenever it affects an underground cable, making it harder to repair that line. The suggested system locates the fault's closest location. Here, theinternal ADC device of the microcontroller kit is used tointerface the current sensing circuits made with a mixture of resistors, which provide digital data to the microcontroller indicating the wire length in kilometers.The group of switches is what causes the fault to occur.The relay driver is in charge of managing the relays. Theinformation is shown on a 16x2 LCD screen that is connected to the microcontroller. The relay driver is in charge of managing the relays. The information is shown on a 16x2 LCD screen that is connected to the microcontroller.

Keywords: Wi-Fi Module, Arduino Nano board, Relay, Resistors, Slide switch, Wi-Fi Module, 16X2 LCD display, power supply, Arduino IDE.

I. Introduction

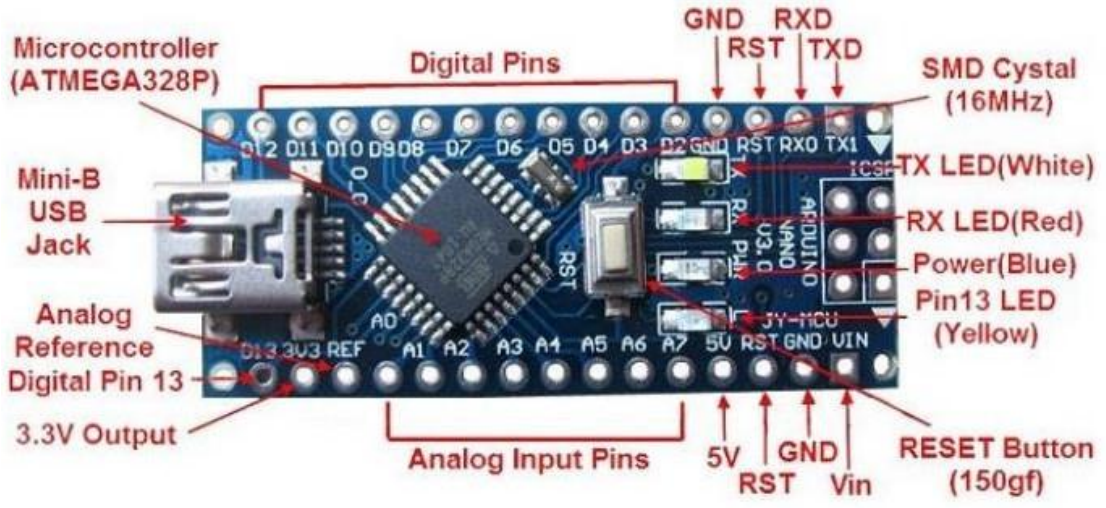
Due to subsurface circumstances, wear and tear, rats, etc., underground cables are susceptible to a variety of problems. In addition, police examination of faulty supply is difficult and the complete line must be examined to detect and correct defects. As a result, we tend to suggest cable fault detection over IoT, which pinpoints the exact issue location and makes repair workquite simple [1]. The repairmen are aware that only that portion of the system needs to be examined in order to see the faulty supply, and that

the other half of the system contains no faults. As a result, you may save a ton of time, money, and energy, and America can service underground cables more quickly**.** We frequently use IOT technology, which enables the government to monitor and examine issues online.

With the aid of a potential divider network installed across the cable, the system finds a defect. When two lines are partially shorted by a fault, a specific voltage is produced according to the resistor network configuration [2]. The microcontroller alerts the user after detecting this voltage. The distance to which that voltage correlates is the data sent to the user. The microcontroller receives the line data and displays it on the alphanumeric display [3]. It also sends this data over the internet to be displayed online. We frequently use websites to create online systems that connect with systems to display cable issues online.

II. Arduino Nano

The Arduino Nano, developed by Arduino.cc, is a microcontroller board that utilizes the Atmega328 microprocessor. This versatile board offers a compact size and can be employed in various applications. It provides 14 digital pins, each of which can be configured as either input or output using functions like pinMode (), digitalWrite (), and digitalRead (). The Nano operates at a voltage of 5 volts and has a built-in pull-up resistor ranging from 20 to 50 ohms for each pin. These resistors are initially disconnected and can handle a maximum current of 40 mA. Furthermore, a few pins serve special purposes. To power the Arduino Nano, you have the option of utilizing the Mini-B USB connector, an unregulated external power source with a voltage range of 6 to 20V (connected to pin 30), or a regulated 5V external power supply (connected to pin 27).



Arduino Nano

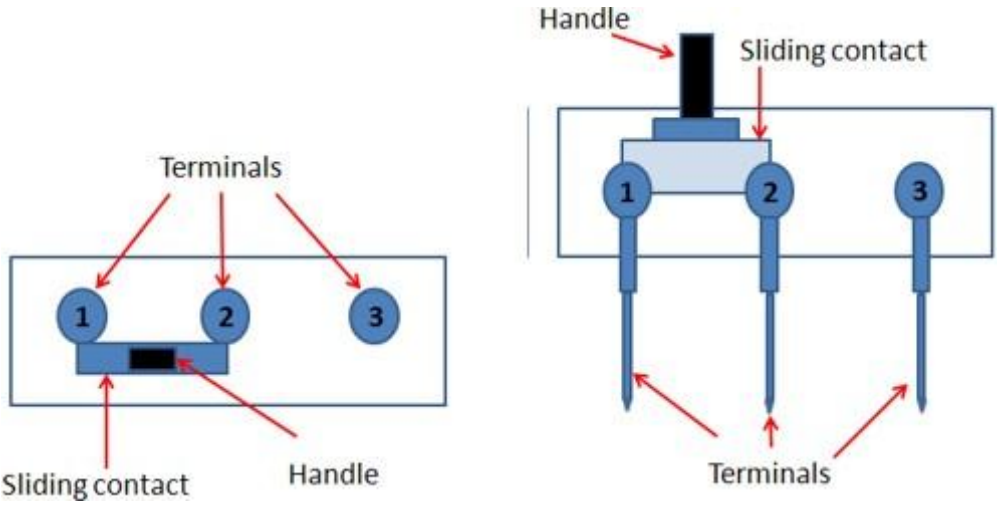
III. Relay

The relay is an electro-mechanical componentcommonly used as a switch. It operates by energizing the relay coil with a DC current to either open or close contact switches. A single-channel 5V relay module typically consists of a coil and two contacts, namely normally open (NO) and normally closed (NC). This article provides an overview of the operation of the 5V relay module and its pin configuration. In automatic control circuits, a 5-volt relay is often employed as an automatic switch to control high currents using low-current signals. The input voltage for the relay signal ranges from 0 to 5V. Below is the pin configuration fora 5V relay, which comprises five pins, each with its specific function. Additionally, the 5V relay module hassix pins, and the roles of each pin will be explained**.**

Relay

IV. Slide Switches

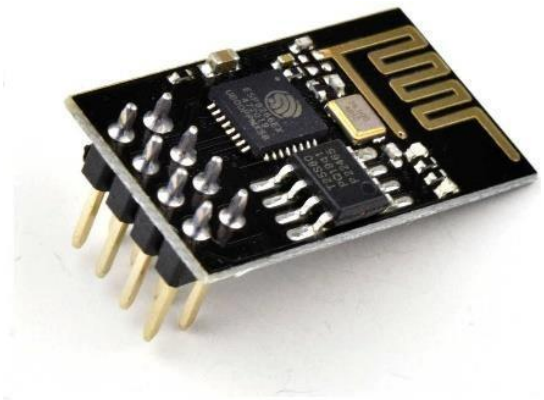
A slide switch is one of the types of mechanical devicesthat slide from the OFF (open) position to the ON (close) position to control the amount of current flowing through a circuit. This switch doesn't manually cut any wires; it just regulates the current within a circuit. Untilmanually switched into a different position, these switches will remain in that position. The slide switch utilizes metal slides that make contact with the flat metalcomponents of the switch. When the switch's slider is moved, the metal slide contacts undergo a transition from one set of metal contacts to another, resulting in the switch being activated. This particular switch includes its own connections, sliding contact, and handle. This particular switch is equipped with three terminals: one common pin and two additional pins that compete to establish a connection with the common pin.These work best when switching inputs and choosing between two power sources. Current travels through a sliding contact in a switch, which is an electrical contact.These contacts mostly consist of a rotating component, such as a commutator or slip-ring, and a stationarycomponent, such as a brush. These contacts' materials primarily require continuous, low contact voltage, and slow wear. A slide switch has a bar handle that can be used to slide between positions to change its state.



Slide Switch

V. Wi-Fi MODULE-ESP8266

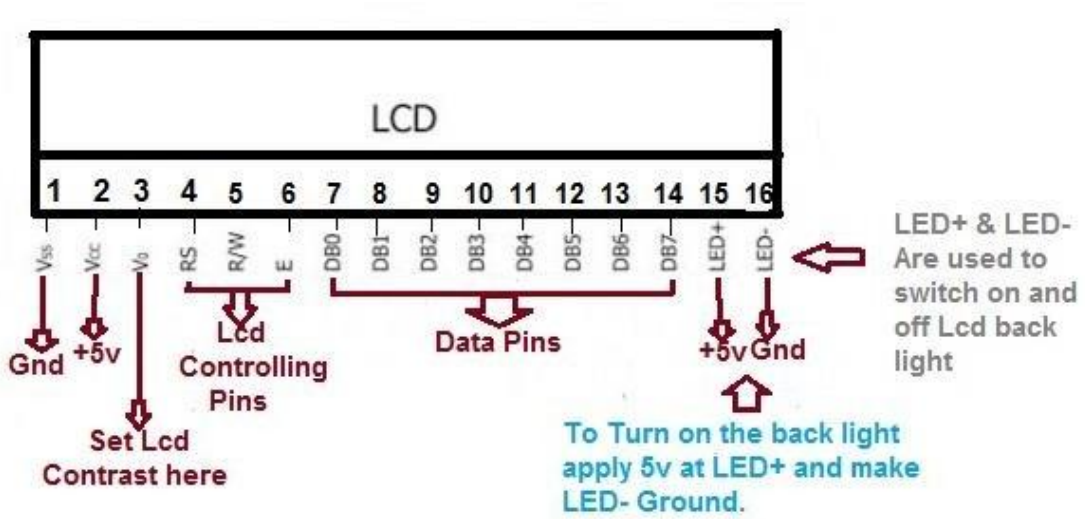
The ESP8266 Wi-Fi Module is a self-contained System-on-a-Chip (SOC) and is integrated for TCP/IP protocol stack. Its purpose is to enable any microcontroller to connect to a Wi-Fi network. With the ESP8266, you canoffload all Wi-Fi networking tasks from anotherapplication processor or even host an application directly. Each ESP8266 module comes pre-programmedwith an AT command set firmware, making it easy to connect to your Arduino project and achieve Wi-Fifunctionality similar to a Wi-Fi Shield. The ESP8266 module is highly cost-effective and has a growing community of users. The onboard processing and storage power of this module enable smooth integrationwith sensors and other devices specific to the application. It offers a hassle-free development process with minimal upfront effort and imposes low loading during runtime. With its high level of on-chip integration, the module eliminates the need for additional circuitry, while its compact front-end moduletakes up minimal space on the PCB.



Wi-Fi Module

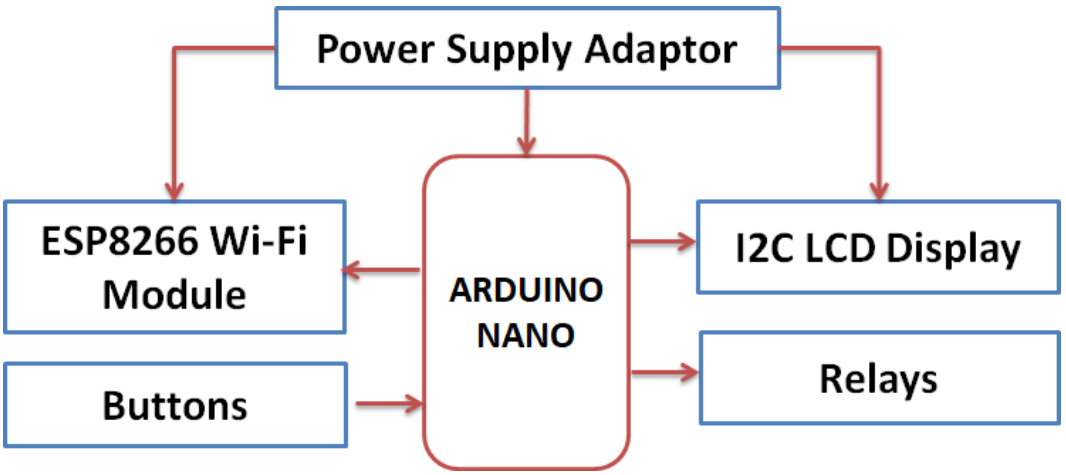
VI. LCD

LCD, short for liquid crystal display, is an electronic display module widely utilized in various circuits and devices such as mobile phones, calculators, computers, TVs, and other electronics.It is particularly suitable for applications involvingseven-segment and multi-segment light-emitting LEDs. The adoption of LCD modules offers several advantages, including affordability, ease ofprogramming, the ability to display custom characters and animations, and a wide range of applications. One commonly used LCD module inDIY projects and circuits is the 162 LCD display, which consists of two lines with 16 characters per line. Each character in this LCD is composed of a 5 by 7-pixel matrix. Character LCDs come in different sizes such as 8x1, 8x2, 10x2, 16x1, 16x2, 20x2, 20x4, 24x2, 30x2, 32x2, and 40x2.



LCD

VII. Block Diagram



VIII. WORKING PRINCIPLE

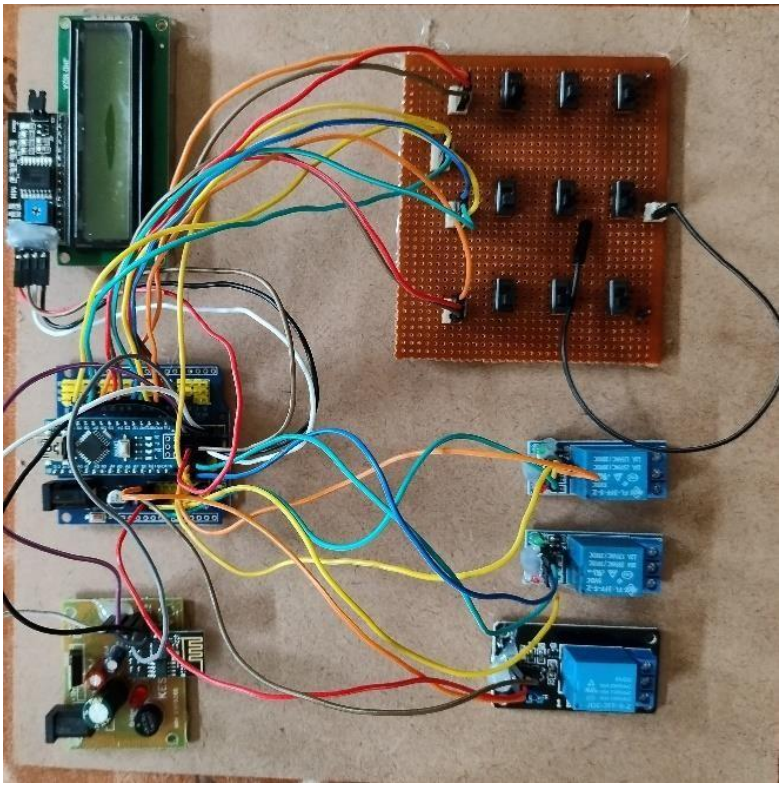
Arduino is the heart of this project. It takes input from the fault switches that are given to the digital pins of the Arduino. The relays operate according to the output given by the Arduino based on the input of fault switches. The information about the faults is displayed on the LCD screen accordingly [4]. Further, the information is also updated on the server and is updated on the webpage. In this prototype, we considered three lines namely the red line, green line, and yellow line. For each line, there are three slide switches at three points considering the distance as 2Km, 4Km, and 6Km respectively. For the short circuit fault, we considered a separate point at the end of the line.

For the red line, the output from the fault switches is connected to digital pins 2, 3, and 4 in the Arduino Nano representing 2, 4, 6 Km respectively. Similarly, for the green lines 5, 6, and 7 digital pins, and for the yellow lines 8, 9, and 10 digital pins are connected. For the short circuit fault, the signal from the fault switches is given to the Arduino Nano digital pins 11 and 12. The power supply is given to the Arduino Nano by connecting the USB cable that supplies 5V to the Arduino Nano and thus the Arduino Nano supplies power to the other components. To provide power to the ESP8266 Wi-Fi module, the 5V pin of the Arduino Nano is connected to the corresponding 5V pin on the Wi-Fi module. Additionally, the ground pin of the Arduino is connected to the ground pin on the Wi-Fi module. This establishes the power connection between the Arduino Nano and the ESP8266 module. The Rx and TX pins on both the Arduino board and the Wi-Fi module are connected which helps in transmitting and receiving the signals from Arduino to the Wi-Fi module and vice versa [5]. The 5V pin of the Arduino is connected to the 5V pin on the I2C LCD and the ground pin of the Arduino Nano is connected to the ground pin on the I2C LCD which supplies power to the LCD. The SCL and SDA pins on both Arduino and I2C LCD are connected to each other which helps in transmitting the data and clock signal.

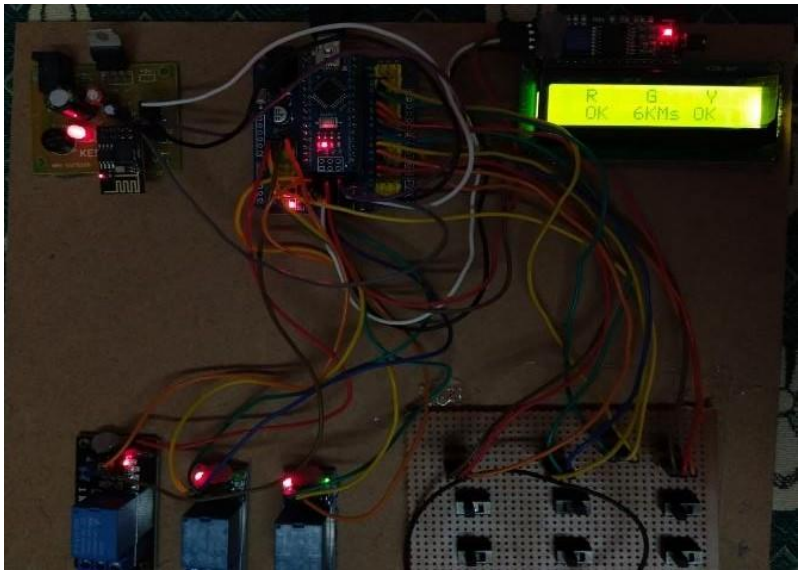
IX. SOFTWARE USED

Software: Embedded C Programming Language, PHP Embedded C is the extension variant of the C language. This programming language is independent of hardware. The code is written the Arduino IDE platform.

At its core, PHP is a server-side scripting language that is seamlessly embedded within HTML. It empowers web developers to interact with databases and generate dynamic content for websites. The enduring popularity of PHP in the realm of web development can be attributed to its straightforwardness, rapid execution, and adaptability.




grts.in/iotprojects/Arduin
3
IoT based Underground Cable Fault Detection System using Arduino
Red Line
OK
Green Line
6KM
Yellow Line
OK


R G Y
OK 6KMs OK

Conclusions:

This is a suggested model for microcontroller-based fault detection in underground cables. DC power is divided into four categories. This is an idea for a microcontroller-based fault locator for underground cables. A DC power supply, wires, controllers, and displays make up its four sections. The bridge-rectifier converts ac to dc, the rectifier reduces 230V of ac supply, and the regulator maintains a constant dc voltage in the DC power supply section. The cable portion can be distinguished using switches and a collection of resistors. The current-detecting section of the cable, represented as a group of resistors and switches, is used as the fault maker to determine the defect at each point. This component determines the change in current by detecting the voltage drop [6]. The display component has an LCD screen that is coupled to a microprocessor, which, in the event of a failure, shows the length of the cable at each phase as well as its condition. The projected project has a few benefits, including reduced maintenance, lower tree-trimming costs, and lower storm restoration costs. Another plus is that you will be more dependable when it comes to severe weather. Every time the source of the wi-fi network changes, adjustments in the code are needed, which might be challenging.

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