REWA ENGINEERING COLLEGE, REWA (M.P.)

A Major Project Report On

'UNDERGROUND CABLE FAULT DETECTION USING ARDUINO'

SESSION-2018-22

SUBMITTED TO

PROF. A.B. SARKAR

(HOD)

DEPT. OF ELECTRICAL ENGINEERING

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Declaration

We hereby declare that project report which is being presented in this dissertation entitled 'UNDERGROUND CABLE FAULT DETECTION USING ARDUINO' in partial fulfillment of requirement of degree 'BACHELOR OF TECHNOLOGY' in 'ELECTRICAL ENGINEERING' is an original piece of practical work carried out by our group.We further declare that the information collected is genuine and we have not submitted this project report to any other university for award.

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Session: 2018-2022

CERTIFICATE

This is to certify that the project report entitled 'UNDERGROUND CABLE FAULT DETECTION USING ARDUINO' is submitted as per the requirement of RGPV syllabus of Bachelor of Technology in "Electrical Engineering" at REWA ENGINEERING COLLEGE, REWA(M.P.) is a record of their own work submitted under our guidance and supervision.To the best of our knowledge the matter presented in this report has not been submitted for the award of any other degree or certificate.

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Acknowledgement

In the accomplishment of this project successfully many people have test on upon as they are placing and the heart placed support this time we are utilizing to thank all the people who have been concerned with the project. The pleasure that follows the successful completion of the project would remain incomplete without a word of gratitude for the people and without whose cooperation the achievement would remain distant dream. It is not a mere formality to place a record the tireless effort ceaseless cooperation constant guidance and encouragement of the people closely associated withe the project but a distant necessity for the authenticity and the readability of the project.

The management theories learnt in a year are brought into practice we have tried to make the best of their opportunity. The work bears the print of many persons under whom we did this project. We are thankful to PROF. A.B. SARKAR(HOD,EE)for their scholarly guidance advice and encouragement. Finally we are indebted to our family, friends and those people who have helped us in completing this project. At last but not least we would like to thank our classmates who have helped us a lot.

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Content

INTRODUCTION

In this project we proposed a fault localization model for the underground cable lines with Arduino. The purpose of this paper is to determine the distance from the base station's underground cable fault in kilometres. In this project we used a simple concept of ohms low. When a fault occurs in the system the distance located on liquid crystal display (LCD). Until the last decade, cables were designed to be placed above the head and, at present, there is no underground cable that is higher than the previous method. adverse weather conditions such as storms, snow, torrential rains and pollution does not affect on underground lines But when a fault occurs in underground lines it is difficult to locate the fault in underground cable. We will find the exact location of the fault. Now the world has become digitized so, the project is to detect exact location of the fault in digital form. Underground cabling system is a more common practice in many urban areas. Although the fault occurs for some reason, at that time, the repair process for this particular cable is difficult because of not knowing the exact location of the cable breakdown.

Components Details -

1 PCB Board 18 cm×30 cm

2 Arduino Uno

3 12 V 5 Pin Relay×3

4 4007 Diode×3

5 16 Pin IC Base

6 ULN 2003 IC

7 Slide Switch ×12

8 1 K variable resistor

9 100R resistor ×16

10 12V Buzzer

11 Blue LED, Yellow LED, Red LED

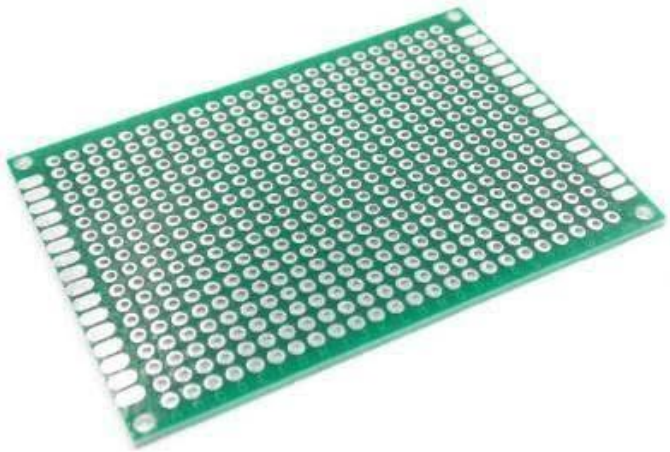
12 Male and Female Header

13 12 V 2Amp Power Adapter

Component details

A. PCB BOARD

A printed circuit board(PCB) is a laminated sandwich structure of conductive and insulating layers. PCBs have two complementary functions. The first is to affix electronics components in designated locations on the outer layer by means of soldering. The second is to provide reliable electrical connections (and also reliable open circuits) between the component's terminals in a controlled manner often referred to as PCB design. Each of the conductive layers is designed with an artwork pattern of conductors (similar to wires on a flat surface) that provides electrical connections on that conductive layer. Another manufacturing process adds vias, plated-through holes that allow interconnections between layers.



B. ARDUINO Uno

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic

resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

“Uno” means one in Italian and was chosen to mark the release of Arduino Software(IDE) 1.0. The Uno board and version 1.0 of Arduino Software(IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is first in a series of USB Arduino boards, and the reference model for the Arduino platform ; for an extensive list of current, past or outdated boards see the Arduino index of boards.

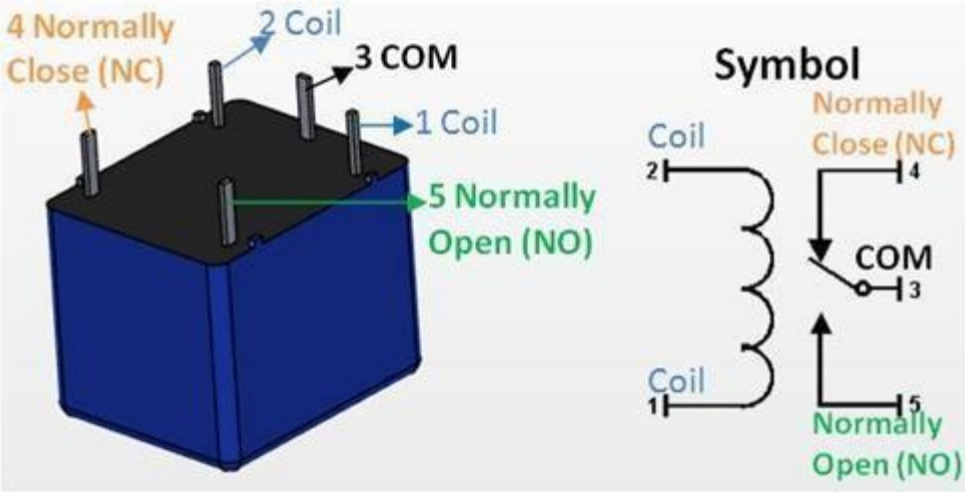
C. 16×2 LCD DISPLAY

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of

applications like various circuits and device like mobile phones , calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

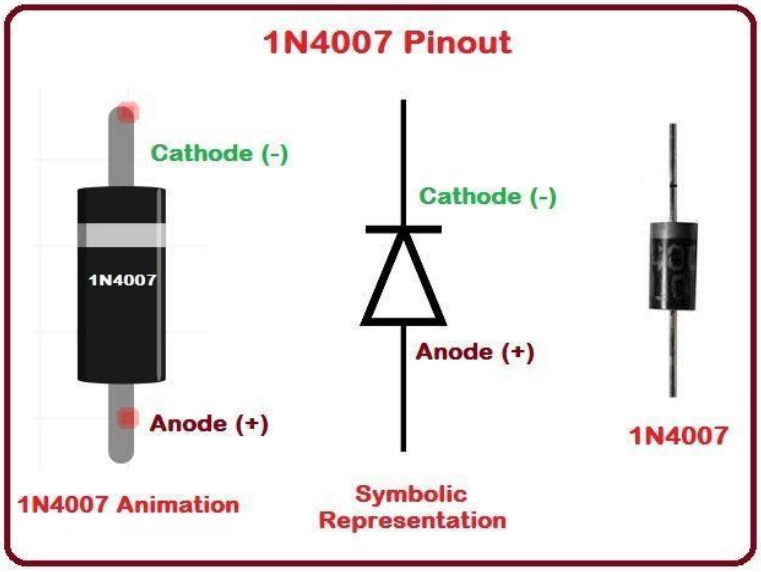
D. 5 Pin Relay

A Relay is an electronically operated switch. They commonly use an electromagnet(coil) to operate their internal mechanical switching mechanism(contacts). When a Relay contact is open, this will switch power ON for a circuit when the coil is activated.



E. 1N 4007 Diode

1N 4007 belongs to the silicon family of 1N 400X series. It is a general-purpose rectifying Diode that serves its purpose of converting alternating current signals(AC) to direct current signals(DC) in electronic products.1N means single junction semiconductor. Since the Diode is made by two dissimilar P and N semiconductor types, a junction is formed between them. N stands for semiconductor Diode and 4007 is the identification number of that particular Diode.



F. 16 Pin IC Base

16 Pin IC socket Base adaptor is a 16 pin IC holder, which can be soldered directly onto the PCB. The IC can be removed from this socket when required.

G. ULN 2003 IC

Typical usage of the ULN 2003 A is in driver circuits for relays, lamp and LED displays, stepper motors, logic buffers and line drivers.

ULN 2003 IC is a 16 pin IC which has seven darlington pairs inside, where each can drive loads upto 50V and 500 mA. This is because when the input Pin of the IC gets high the respective output Pin will get connected to ground. So when the negative terminal of LED is grounded it completes the circuit and thus glows.

H. SLIDE SWITCH

Slide Switches are an electromechanical device used to control current flow in a circuit path. Devices in this family are actuated by sliding a mechanical switch. The characteristics are circuit, contact timing, switch function, current rating, voltage rating(AC or DC), and actuator type.

I. Variable Resistor

A variable resistor is a resistor of which the electronic resistance value can be adjusted. A variable resistor is in essence an electro-mechanical transducer and normally works by sliding a contact(wiper) over a resistive element.

J. Resistor

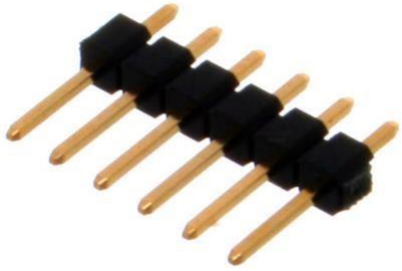
A device that has electrical resistance and that is used in an electronic circuit for protection, operation, or current control. Here we are using 100 R 16 resistor.

K. Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric(piezo for short). Typical values of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

L. Pin Header

Pin Header is a type of electrical connector. These connectors are widely used in electronic or instrumentation of PCB (printed circuit board). It functions as bridge between two PCBs which were blocked, and used to take current or signal transmission.



Arduino Based Underground Transmission Cable Fault Location System

The transmission line fault location requires intense human effort and resources. Typically this process is time consuming and while digging the cable there is a risk of damaging the insulation. This paper provides a simple and safe alternative by automating the process of fault detection and location. The project uses the simple concept of OHMs law where a low DC voltage is supplied at the feeder end through a series resistor.

The current would vary depending upon length of fault of the cable in case there is a short circuit of LL or 3L or LG etc. The series resistor voltage drop changes accordingly which detects the exact location of the fault for process of repairing that particular cable. The proposed

system finds the exact location of the fault. This system uses an Arduino microcontroller kit and a rectified power supply. Here the current sensing circuits made with a combination of resistors are interfaced to Arduino microcontroller kit to help of the internal ADC device for providing digital data to microcontroller representing cable length in kilometres.

The fault creation is made by the set of switches. The relays are controlled by the relay driver. A 16×2 LCD display connected to the microcontroller to display the information. In case of short circuit, the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data to a programmed microcontroller kit that further displays exact fault location from base station in kilometres. The project in future can be implemented by using capacitor in an AC circuit to measure the impedance which can even locate the open circuited cable.Presented underground cable fault detector using GSM.

The main aim of the project is to detect and locate the fault in underground cable. In the urban areas, the electrical runs in underground instead of overhead lines. Whenever the fault occur the repairing process becomes difficult. It is very difficult to identify the exact location of the fault in underground power cable line. This project will ensure a shorter response time for technical crew to rectify these faults. Fault occur due to short circuit fault, low voltage fault, high voltage fault. Previously proposed technique is used to identify short circuit fault only. This project is used to detect not only short circuit fault but also detect low voltage fault, high voltage fault. The system developed here works on the basis of Ohms law. The proposed technique is used not only for identification but also it is used to send the detail information about the fault to the authority using GSM and also it cut the power supply on that particular location for the security

of the people. It also used to display the type of the fault in LCD display. Whenever a fault occurs in a cable the buzzer produces the sound to alert and to take an immediate action.

PROCEDURE

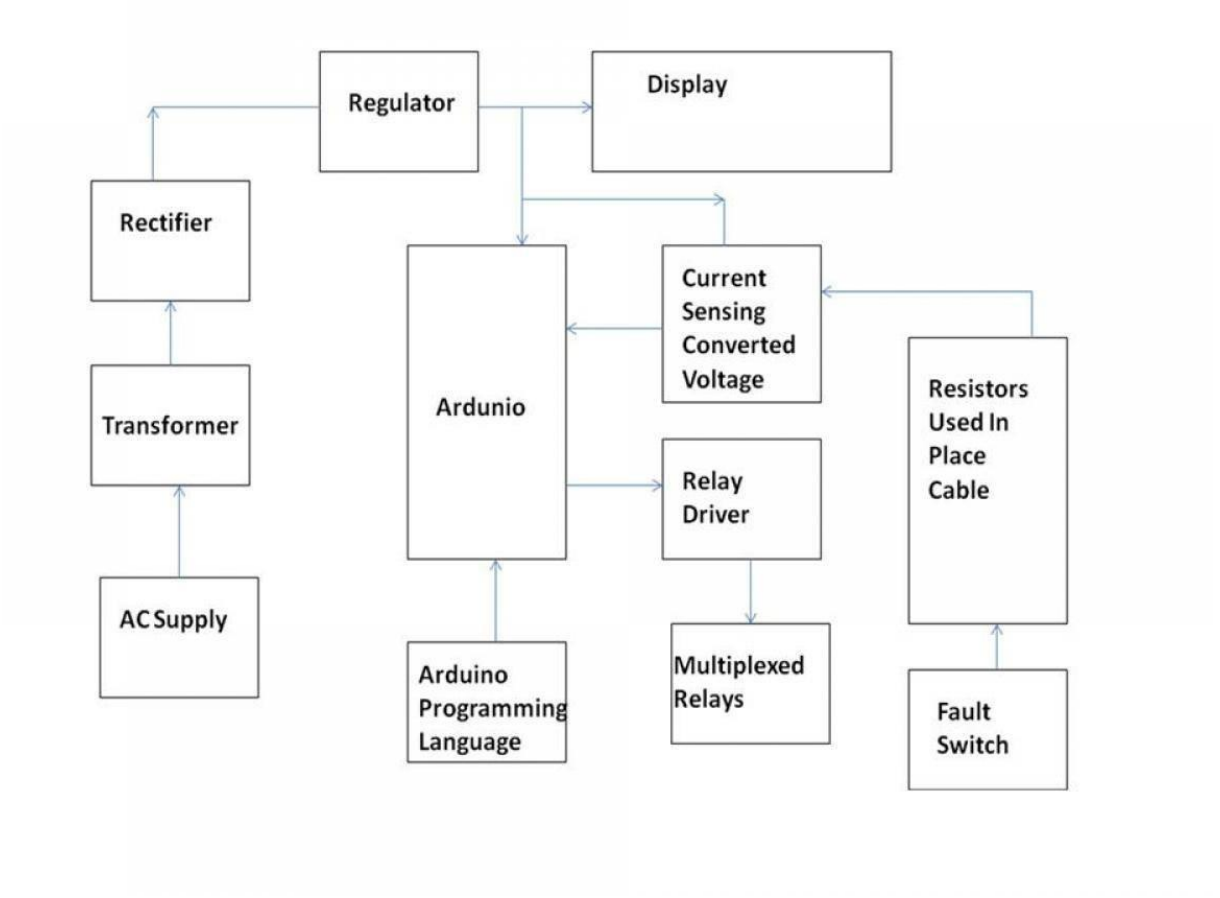
The circuit consists of power supply, 4 line display, arduino and resistance measurement circuit. To induce faults manually in the kit, fault switches are used. About 12 fault switches are used which are arranged in three rows with each row having 4 switches. The 3 rows represent the 3 phases manually R, Y & B. The fault switches have 2 positions- no fault position(NF) and fault position(F). Main component of the underground cable fault detection circuit is low value resistance measurement. It is constructed using a constant current source of 100mAmps. It can measure very low value resistances as the cables have around 0.01 ohm/meter resistance.For 10 meter cable resistance becomes 0.1 Ohm. This circuit can measure resistance upto 50 Ohm. Maximum cable length it can check upto 4 kilometres.

1. So starting from the reference point 3 sets of resistances are placed in series. These 3 sets of resistances represent the three phases and three neutral. Short circuit fault, Symmetrical and unsymmetrical faults can be determined by this method. This project uses three sets of resistances in series, one for each phase.
2. Each series resistor represent the resistance of underground cable for a particular and so here 4 resistance in series represent 1-3 kms. Value of each resistance is 10K.
3. One relays for each phase R,Y & B as three relays are used and the common points of the relays are grounded and the NO points are connected to inputs of R17,R21 and R25 and being the three phase

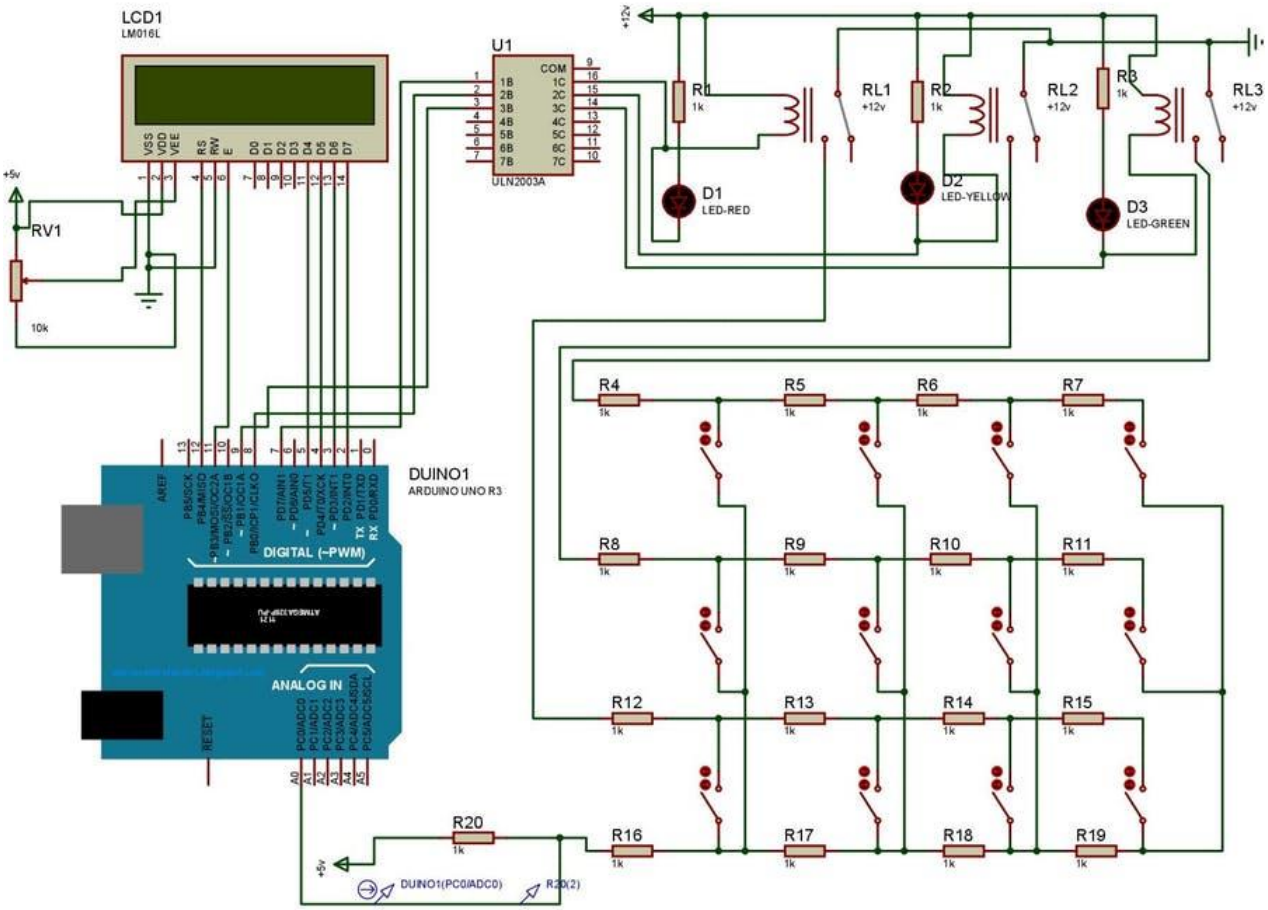
cable input. As supply needed for the relays is higher than that of the arduino, Relay driver is used to boost the supply and provide it to the relays.

4. When fault is induced by operating any of the 12 switches (to F position), they impose conditions like LG,LL,LLG fault as per the switch operation. As a result of the fault, there is a change in voltage value. This voltage value measured across the resistance is fed to the ADC of the Arduino. Using this value, the arduino computes the distance. Finally the distance of the fault from the base station is displayed in kilometre.

Block Diagram



CIRCUIT DIAGRAM



TOPIC- UNDERGROUND CABLE FAULT DETECTION USING ARDUINO

PROGRAMMING

```
// include the library code:
#include <LiquidCrystal.h>


// initialize the library with the numbers of the interface pins const
int rs = 12, en = 11, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
// define phase control pins int
phase[3] = {7, 8, 9};


//*********************************************************
int distance(int inputVoltage) {   if (inputVoltage
>= 890 && inputVoltage < 920) {     return 8;
 }
 else if (inputVoltage >= 850 && inputVoltage < 890) {
return 6;
 }
 else if (inputVoltage >= 750 && inputVoltage < 850) {
   return 4;
 }
 else if (inputVoltage >= 600 && inputVoltage < 750) {
return 2;
 }


 else return 0 ;


}
//*********************************************************
```

```
void setup() {
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);


  // set pin mode for phase relays
  for (int j = 0; j < 3; j++) {
    pinMode(phase[j], OUTPUT);
  }


}


void loop() {     digitalWrite(phase[0],
HIGH);       delay(500);       int dist1 =
distance(analogRead(A0));  if (dist1 ==
0)    {                  lcd.setCursor(0,    0);
lcd.write("R: ");      lcd.setCursor(3, 0);
lcd.write("NF   ");
  }
  else {
lcd.setCursor(0, 0);
lcd.write("R: ");
lcd.setCursor(3, 0);
lcd.print(dist1);
lcd.setCursor(4, 0);
lcd.write(" KM");
```

```
 }
 digitalWrite(phase[0], LOW);
 //================================================
 digitalWrite(phase[1],              HIGH);
delay(500);                int      dist2      =
distance(analogRead(A0));   if (dist2 ==
0)    {                    lcd.setCursor(8,    0);
lcd.write("Y: ");     lcd.setCursor(11, 0);
lcd.write("NF   ");
 }
 else {
lcd.setCursor(8, 0);
lcd.write("Y: ");
lcd.setCursor(11, 0);
lcd.print(dist2);
lcd.setCursor(12, 0);
lcd.write(" KM");
 }
 digitalWrite(phase[1], LOW);
 //================================================
 digitalWrite(phase[2], HIGH);
delay(500);   int dist3 =
distance(analogRead(A0));   if (dist3
== 0) {

   lcd.setCursor(0, 1);
lcd.write("B:          ");
lcd.setCursor(3,     1);
lcd.write("NF   ");
```

```
  }
  else {
lcd.setCursor(0, 1);
lcd.write("B: ");
lcd.setCursor(3, 1);
lcd.print(dist3);
lcd.setCursor(4, 1);
lcd.write(" KM");
  }
  digitalWrite(phase[2], LOW);
}
```

Advantages

- Less maintenance.
- It has higher efficiency.
- Less fault occur in underground cable. This method is applicable to all types of cable ranging from 1kv to 500kv.
- It can detect other types of cable fault such as Short circuit fault , cable cuts.
- Resistive fault, Sheath faults, Water trees, Partial discharges.

Conclusion

This project is intended to detect the exact location of the circuit fault in the underground cables from the feeder and in km by using an arduino microcontroller. The arduino microcontroller works based on the output of cable resistance. Relay helps to separate the faulty line from healthy line.