UNDERGROUND CABLE FAULT DETECTION USING ARDUINO

A minor project report,
submitted in partial fulfillment of the requirement for the award of
B.Tech. degree in computer science and engineering

by

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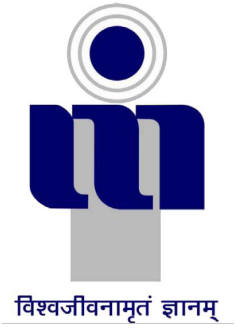

ABV INDIAN INSTITUTE OF INFORMATION TECHNOLOGY AND MANAGEMENT
GWALIOR-474 015

2019

CANDIDATES DECLARATION

We hereby certify that the work, which is being presented in the report, entitled **Underground cable fault detection using Arduino**, in partial fulfillment of the requirement for the award of the Degree of **Bachelor of Technology** and submitted to the institution is an authentic record of our own work carried out during the period *May 2019* to *August 2019* under the supervision of **Prof. Joydip Dhar** and **Dr. Saumya Bhadauria**. We also cited the reference about the text(s)/figure(s)/table(s) from where they have been taken.

Date: Signatures of the Candidates

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Date: Signatures of the Research Supervisors

ABSTRACT

Underground cables are used in power system generation to distribution nowadays. In case of underground cables, sometimes fault occurs which is difficult to detect. The objective of this project is to detect the underground cable faults and abnormalities with the help of an Arduino and GSM module. We will be having several phases representing different underground connections and will have several switches in each phase representing the distance of the fault from the base station. We will manually generate the fault by pushing the switches. This will lead to the change in current and voltage values across the resistors, these changes are fed to the Arduino through relays. Arduino process these values and will calculate the distance at which the fault has occurred and display this value on the LCD display interfaced with it. With the help of GSM module we will be getting the messages to our phones about the situation of fault.

Keywords: Arduino, GSM module, Relays, fault.

ACKNOWLEDGEMENTS

We are highly indebted to **Prof. Joydip Dhar** and **Dr. Saumya Bhadauria**, and are obliged for giving us the autonomy of functioning and experimenting with ideas. We would like to take this opportunity to express our profound gratitude to them not only for their academic guidance but also for their personal interest in our project and constant support coupled with confidence boosting and motivating sessions which proved very fruitful and were instrumental in infusing self-assurance and trust within us. The nurturing and blossoming of the present work is mainly due to their valuable guidance, suggestions, astute judgment, constructive criticism and an eye for perfection. Our mentor always answered myriad of our doubts with smiling graciousness and prodigious patience, never letting us feel that we are novices by always lending an ear to our views, appreciating and improving them and by giving us a free hand in our project. It's only because of their overwhelming interest and helpful attitude, the present work has attained the stage it has.

Finally, we are grateful to our Institution and colleagues whose constant encouragement served to renew our spirit, refocus our attention and energy and helped us in carrying out this work.

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TABLE OF CONTENTS

LIST OF FIGURES

ABBREVIATIONS

GSM	Global System for Mobile communication
LCD	Liquid Crystal Display
CRT	Cathode Ray Tube
PCB	Printed Circuit Board
TDMA	Time Division Multiple Access
DC	Direct Current
LED	Light Emitting Diode
NF	No Fault
SMS	Short Message Service
AC	Alternating current

CHAPTER 1

Introduction

In many urban areas and nowadays even in rural areas, underground cabling has become very common. This is to ensure the safety of the cables from rainfall, snow, thunder, light etc. Overhead cables are easily prone to these types of problems. Many types of cables are laid underground like electricity cables, telephone cables, and other signal cables. Faults in these underground cables occur mainly because of construction work or some extreme weather conditions. It is difficult to know the exact location of the fault and it becomes difficult to find out that cable and fix the fault. If a fault occurs in the cables, the whole area is needed to dig out to detect and fix it [1,2,3]. This may take a lot of time and other cables may also get affected due to which we will face problem using appliances at our homes for a long time. It will consume time and efforts unnecessarily and due to this we will face problems using the appliances. Therefore, it becomes necessary to know the exact location of the faults in the cables to avoid unnecessary digging that may affect other cables in that area [5,7,8].
There are two types of faults which can occur in underground cables. These are open circuit faults and short circuit faults [1,2].
In open circuit faults, there is an open circuit in the conductor. These faults occur due to mechanical stress and may lead to breaking of cable conductors [1,2].
Short circuit faults occur due to improper insulation of the cables or when two or more conductors of same cable touches each other and come in contact with each other [1,2].

1.1 Main features

1.Distance of the fault from the base station and the type of phase which has fault will be displayed on the LCD display.
2.A message will be sent to the mobile about the fault location of the cable using GSM module.
3.LED light turns on corresponding to the phase which has fault.

CHAPTER 2

Literature Survey

Different literature that we have studied for the purpose of making of the project tells us about the different components that we have used and their importance. And how to connect the components so that we can connect to get the desired results [1,2,3]. We are operating push buttons to generate fault manually and resistors as cables [1,2,5,7,8]. We also get the idea of improvements in those projects [1,3]. We came to know the background and the importance of this project [1,2,3,5,7,8]. As many underground cables are difficult to fix when any kind of fault occurs in them, we need to know about the position of the fault in those cables so that fixing can become easy [10, 11]. We were able to understand the advantages of this project which are:

1. Less maintenance
2. Higher efficiency
3. Less fault occur in underground cables
4. We can detect any types of faults like resistive faults, sheath faults, cable cuts, etc [1,10,11].

CHAPTER 3

Requirements Analysis and Specification

3.1 Tools Description

3.1.1 Arduino Nano

The Arduino Nano is a microcontroller board based on the ATmega328. It has wide range of applications because of its small size and flexibility. It has 22 input/output pins in total in which 14 pins are digital pins and 8 analogue pins. It has a crystal oscillator of 16MHz. ItâĂŹs operating voltage varies from 5V to 12V [12].

3.1.2 GSM module

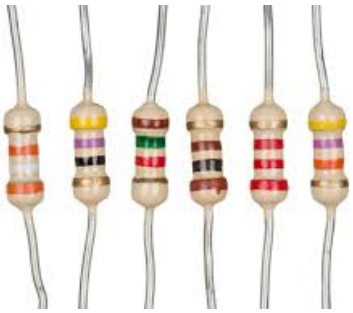
GSM stands for Global System for Mobile communications. GSM is a cellular network and is used to connect cellphones by searching for cells near it. It is widely used for communication purposes. It uses time division multiple access (TDMA) technique for communication purposes [13].

3.1.3 PCB board

Printed Circuit Boards (PCBs) are the boards that are used both as a physical support piece and as the wiring area for the surface-mounted and socketed components. PCBs have copper tracks to connect the holes where the various components are located. They are specially designed for each and every circuit and build construction very easy [21].

3.1.4 Resistors

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses [1].



3.1.5 LCD display

LCD (Liquid Crystal Display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technolo-

gies, LCDs allow displays to be much thinner that cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it [1,2].

3.1.6 Relays

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal [14].

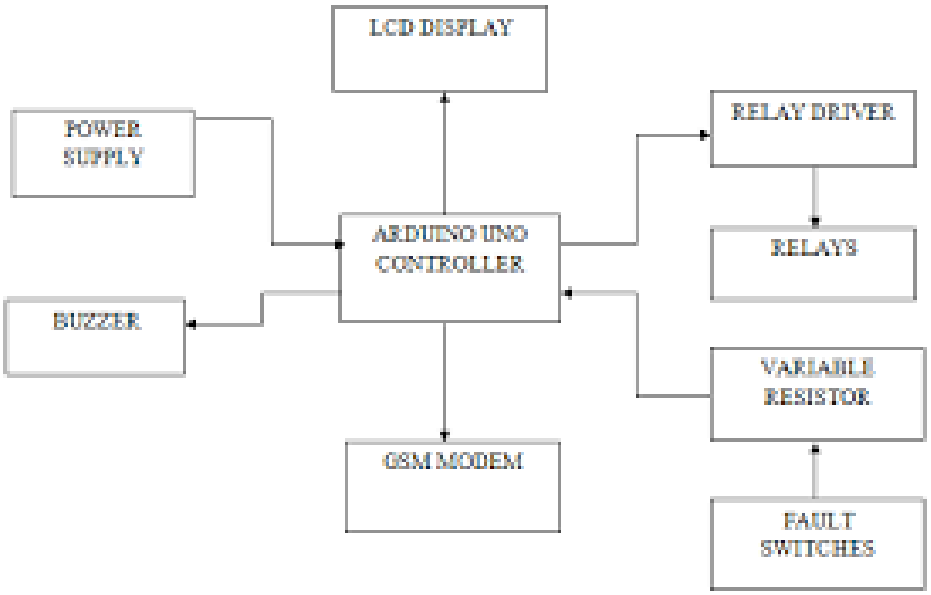
3.1.7 Push buttons

A push-button (also spelled push button) or simply button is a simple switch mechanism for controlling some aspect of machine or a process [2,3].

CHAPTER 4

System Design, Project Description and Methodology

4.1 System Design



BLOCK DIAGRAM OF THE CIRCUIT

We are using arduino nano to control the circuitary as the main programming to drive the project is done in arduino. Power supply of 5V through 6V adapter. Push buttons as fault switches and relays to connect the fault switch circuit to arduino and GSM module which will send the messages to the phone. LCD display is connected to arduino which will display the fault situations.Resistors here are acting as wires [1,2,3].

4.2 Methodology

Our main objective in this project is to detect the faults of underground cables and their fault position from the base station using an Arduino and GSM module. The circuit consists of Arduino, GSM module, resistance measurement circuit and LCD display. We manually introduce faults in the circuit using fault switches. We have arranged these switches in 3 rows having 4 switches each. The 3 rows represent 3 different phases. The main component of the fault detection in the underground cable is the low value of resistance [1]. The key idea in the working of this project is ohms law. When we apply a DC voltage at the feeder end based on the fault position in the cable, the value of current varies [1,2]. When a short circuit fault occurs, the changed voltage value across the resistor is measured and fed to the Arduino which has in-built analog to digital converter. Arduino, then calculate the fault in terms of distance from the base station [1,2,3,4,19]. This value for all the three phases is then displayed at the LCD display interfaced to the Arduino and a message will be sent to the mobile phone using GSM module. Set of resistors represent the length of the cable. We can introduce faults manually by using fault switches and then can determine the fault distance [1,7,8,17,22].

4.3 Project description

In this project, we are detecting faults in different phases of the underground laid cables. We are creating the faults with the help of push buttons. Pressing the push buttons will create the change in current and this will activate the relays through which arduino and GSM circuit will get activated and the corresponding fault distance will be displayed on the LCD and GSM will send the message about the fault to our phone.

CHAPTER 5

Implementation Results

As the result, we are getting the distance of the fault from the base station for a particular phase and message is sent to the phone about the situation. LED corresponding to the phase gets turned on and remain on for sometime. The circuit works correctly.

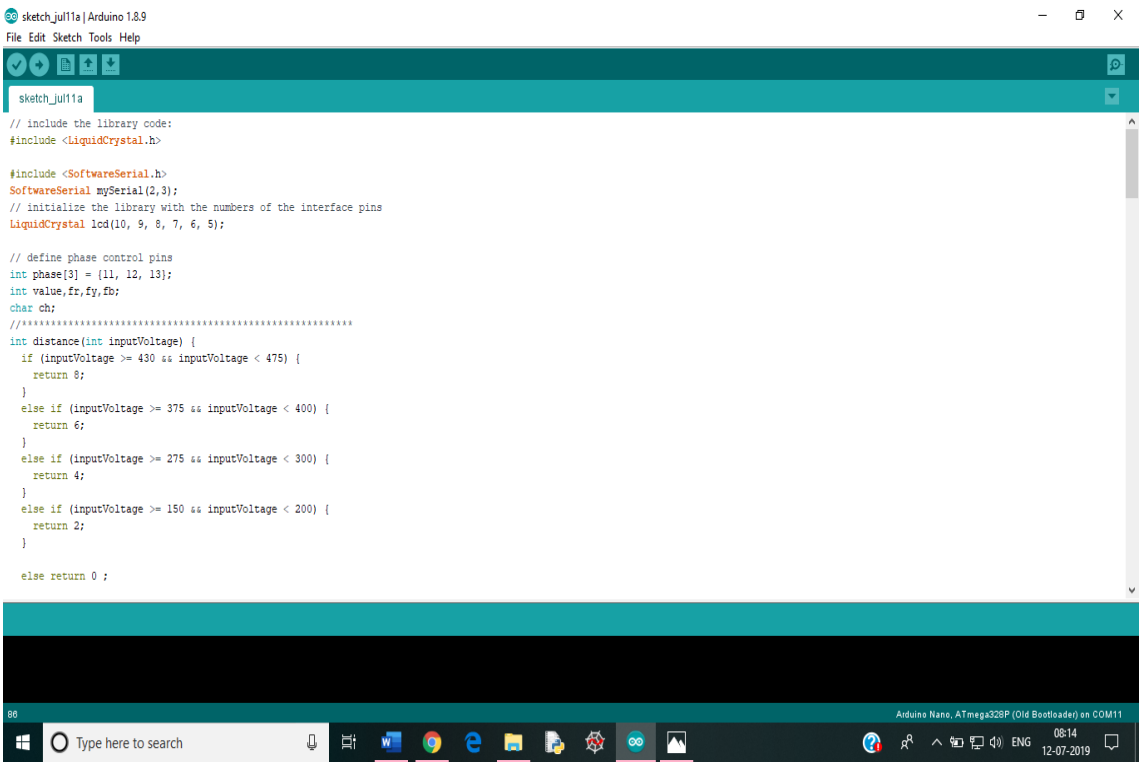
5.1 Test Cases and Test Results

We test our circuit by introducing faults by pushing the push buttons. It will create a fault in the circuit and then a signal will be sent to the Arduino using relays. Arduino is connected to our PC where we have written the code in the Arduino software. The code will run on the Arduino and according to the created fault it will send a signal to the LCD display and GSM module. The LCD Display will then display the fault location and the phase in which the fault has occurred. The GSM module will send the message to the mobile phone regarding the information about the fault. We will create faults in the different phases likewise for different fault locations and test them if they are displaying the information in the LCD Display and mobile phones.

CHAPTER 6

Screenshots of Project with Descriptions

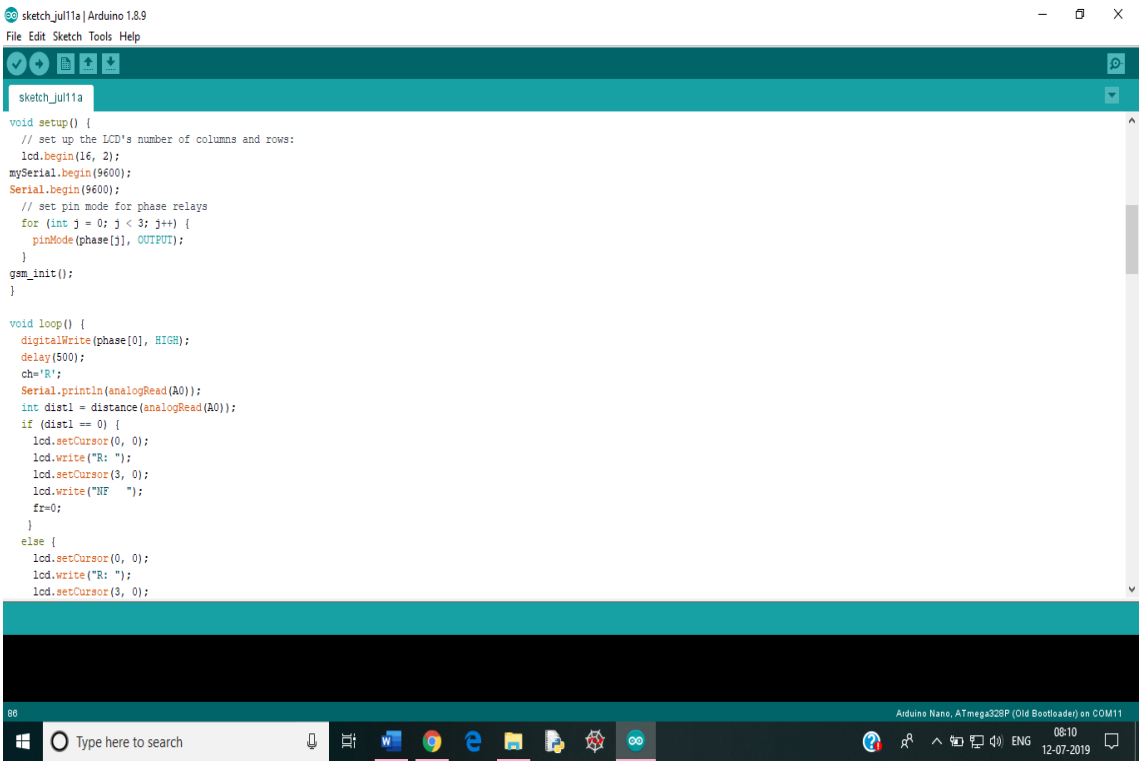
6.1



Screenshot of code of initialization of variables

This is the driving program of our project. Here we have initialized variables and have set the initial distance values according to the voltage across the cables (here resistors). Distance value will be 0 at analogue input of greater than 475 and less than 150.

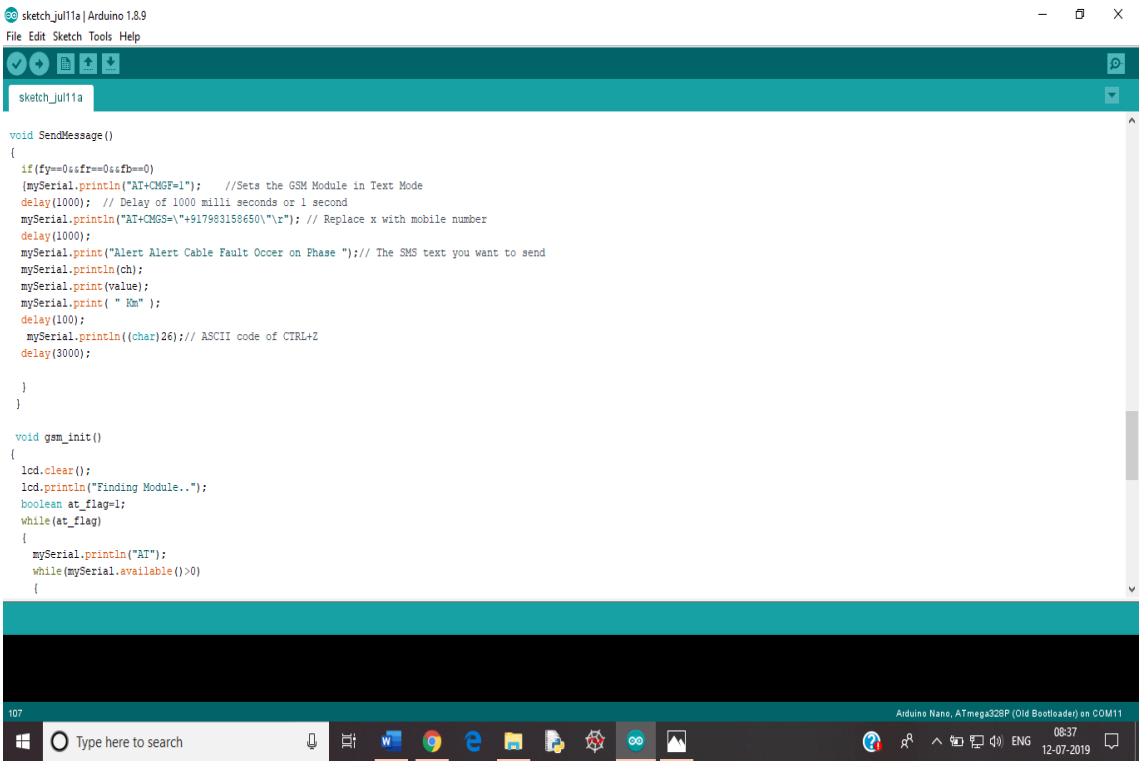
6.2



Screenshot of code for LCD display

Here we are initializing our LCD display, taking the input from arduino, and printing the results on the LCD screen. Any of the button pressed will lead to an analogue input to arduino and according to that input distance is being calculated as above. If distance is 0 means no fault generated so it will print no fault (NF) and if the value is not 0, it will print the corresponding distance of the fault in the phase.

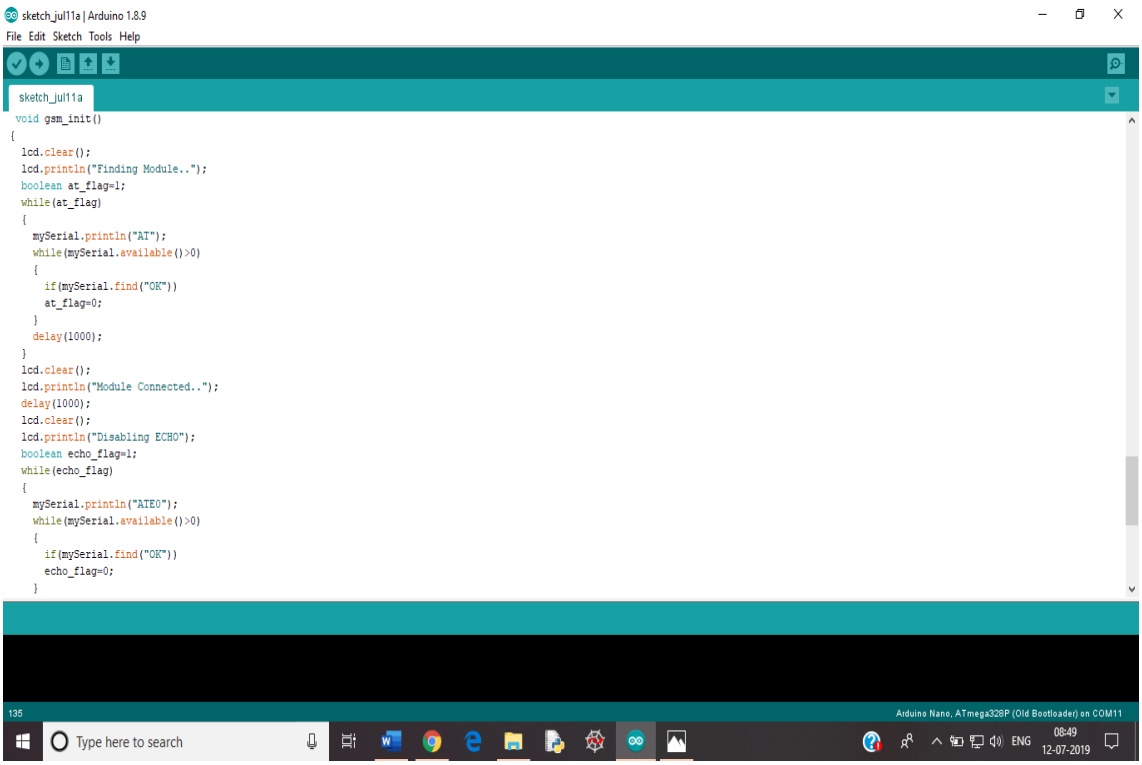
6.3



Screenshot of code of message sending module

In this part of the code, sending message module is set, in which GSM is set into the text mode and whenever the fault corresponding to a particular phase is 0 flag values(fr/fy/fb) are 0 and thus when the fault is generated, LCD prints the fault and this module is called which will send the message to our phone(on the given phone number), after that flag values become 1, and no further continuous message for the same thing will be send.

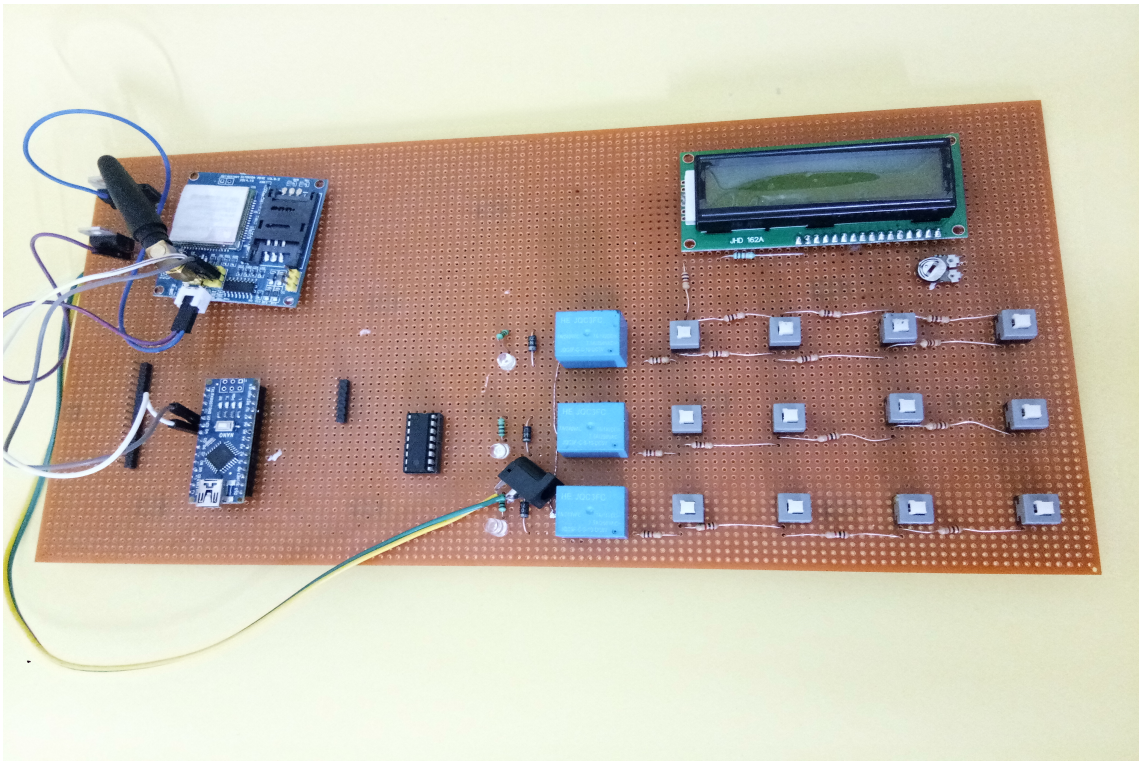
6.4



Screenshot of code of GSM activation

This is the main part of message sending. We are activating the GSM. Arduino will find the GSM module first, if found it will display module connected. Then it will find the network of the sim so that we can connect and send the messages through that sim. When network will be found it will display network found and will send the message.

6.5



Hardware circuitary of the project

This is how our hardware circuitary of the project looks like. It has all the above mentioned components like arduino nano, relays, GSM module, switches, resistors, LCD display.

CHAPTER 7

Conclusion and Future Scope

7.1 Conclusion

In this project, underground cable fault detection using arduino is done and we getting SMS alert for the faults. The distance of the fault corresponding to the faulty phase is displayed on LCD and in SMS also. Different values of resistors can be used to simulate various fault conditions. When the fault switch is pushed, the phase corresponding to that switch is called faulty phase. So these can be located easily.

7.2 Future Scope

In this project we have detected the short circuit fault. We can also detect the open circuit faults using capacitor and measuring impedence of the AC circuit [1].

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