IOT Based Three Phase Power Failure Monitoring with GSM



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Declaration

It is declared hereby that this thesis paper or any part of it has not been submitted to anywhere else for the award of any degree.

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CERTIFICATION

This is to certify that this project entitled “IOT Based Three Phase Power Failure Monitoring with GSM” is done by the following students under my direct supervision This project work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering, Sonargaon University (SU) in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering.

Supervisor

……

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Dedicated to

OUR BELOVED PARENTS
&
HONOURABLE TEACHERS

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LIST OF ABBREVIATIONS

EB	Electricity Board
WNS	Wireless sensor network
SMS	Short Message Service
GSM	Global System for Mobile
AC	Alternating current
CT	Current Transformer
OCPD	Over current protection devices
NO	Normally Open
NC	Normally Closed
LCD	Liquid Crystal Device

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ABSTRACT

The three-phase fault detection and protection system was designed to distinguish the type of fault that occurs in the power system, improved by the combination of Arduino and the current sensor. Any kind of electrical substation that provides electricity to users such as industrial or residential may have some faults that may be temporary or permanent. Nonetheless, due to problems such as the process, it takes longer to identify the form of fault and also involves manual reset of the fault to make the current protection system not effective in the supply of energy to the user. In this issue, we should build an outline to have a built-in intelligence to detect the incidence of transmission line error. A far-reaching monitoring and control system is developed to ensure a secure distribution operation and reduce the occurrence of accidents. This paper proposes Fault Detection, Identification and Auto Closed from Fault in Power Transmission Lines based on Arduino UNO, Current sensor and Relay hardware that helps to significantly reduce human effort reduces times and operates securely and skillfully without human interference.

CHAPTER 1

INTRODUCTION

1.1 Introduction

In recent months, electrical unexpected bad events have increased to the line man, while the electrical lines are repairing because the electrical substation and the maintenance team have no contact between them. Distribution system errors are much higher than transmission side losses, and distribution side failure is also more common. The survey shows that 80% of the service interruptions of the customer were attributed to distribution network failures. This plan offers a solution to this issue to ensure the safety of the lineman. For a safe operation of the power system, the identification and location of power line faults is very important. The command (ON / OFF) of the power lines rests with Line Man in this proposed system. The work is so organized that the electric power supply is ON / OFF by maintenance staff or line man. Now if there is a malfunction in electricity, the power supply is turned off and the electricity is fixed easily and, after the electricity supply to a specific line is switched on. [1] Special protection systems to improve accuracy and reliability by using contact schemes. There are several examples of fault over loading solid faults (i.e. Single line to ground, Double line to ground, Line to line, Triple line to ground, Three phase short circuit Faults), Overvoltage & Under voltage fault.

The problem of error detection in the transmission line and the automated alert to Electricity Board (EB) is dealt with at the EB most errors detection and warning in the distribution line. The line man will then remove the power supply from the transmission line. This plan significantly reduces resources, saves time and runs effectively without human interference.

1.2 Problem Statement

In doing this project, we have encountered various problems such as voltage sensing problems, current sensing problems, right values, coding, problem with 1Arduino and more. The project of detecting fault & defending will be unmatched even after specific obstacles. Even if it does, it will still have to upgrade the instrument and technology.

1.3 Objectives

The ability of a transmission and distribution line can also be used for multiple purposes to protect and follow a sense object to design a low-cost device for general purposes.

I. To reduce the outage time due to faults and provide higher level of service continuity to the customers.
II. To analyze how three-phase circuit faults could be recognized.
III. To study how protected transmission and distribution line.
IV. To help humans.
V. To maintain system stability.
VI. Disables the total system using an automated process.

1.4 Applications of this project.

- It can be use industry for the protected their machines.
- Use in Sub-station.
- Use in transmission and distribution line fault detection.
- Protected three phase induction motor.

1.5 Literature Reviews

In regard to the distribution system, the most essential part of the transmission lines is the transfer of power from the generating station to the load centers. In Bangladesh power system generating voltage 6.6kv/11kv/13.6kv, transmitting voltage 66kv/132kv/230kv/400kv but distributing voltage 11kv/400v/230v.Therefore, it's very important to the power system engineers have been objects for detecting and detecting faults since the development of the distribution and transmission system.

1.6 Research Methodology.

Taking into account two things unique to this project, the approach was adopted. The project module is broken down into multiple sections. Each module is divided by itself. The current sensor, voltage measurement, high voltage failure, low voltage failure, overload defect, short circuit defect and unbalance fault identification are carried out step by step from the start of the voltage sensor. In this design, relays and sensors work easily. Fault identification is

analyzed using these relays and sensors and an MCU is used to obtain three-phase circuit instructions based on the analysis obtained. It is a processor for transmitting digital signals and receiving analog signals. The object of this project is that if there is no damage to the circuit in case the relays flow because of failure (low voltage, high voltage, overload and unbalance) for any reason. And we put in place the foundation of the project after all the effort.

1.7 Project Outline

This project is organized as follows:

In Chapter 1, we briefly discuss this project and the importance of this project in our daily lives.

In Chapter 2 we analyze our project with Block Diagram, Schematic Diagram and parts elements that we need to construct this project.

In Chapter 3, we will give a brief overview of all the hardware parts that we use in this project

In Chapter 4, we provide the result, output and advantage of our project.

In Chapter 5, we provide the consolation, disadvantage, future scope and some recommends.

CHAPTER 2
ANALYSIS OF THIS SYSTEM COMPONENT

2.1 Introduction

In this chapter we discussed various components that will be required to detect and protect three phase circuit faults.

2.2 Block diagram & How to work this project

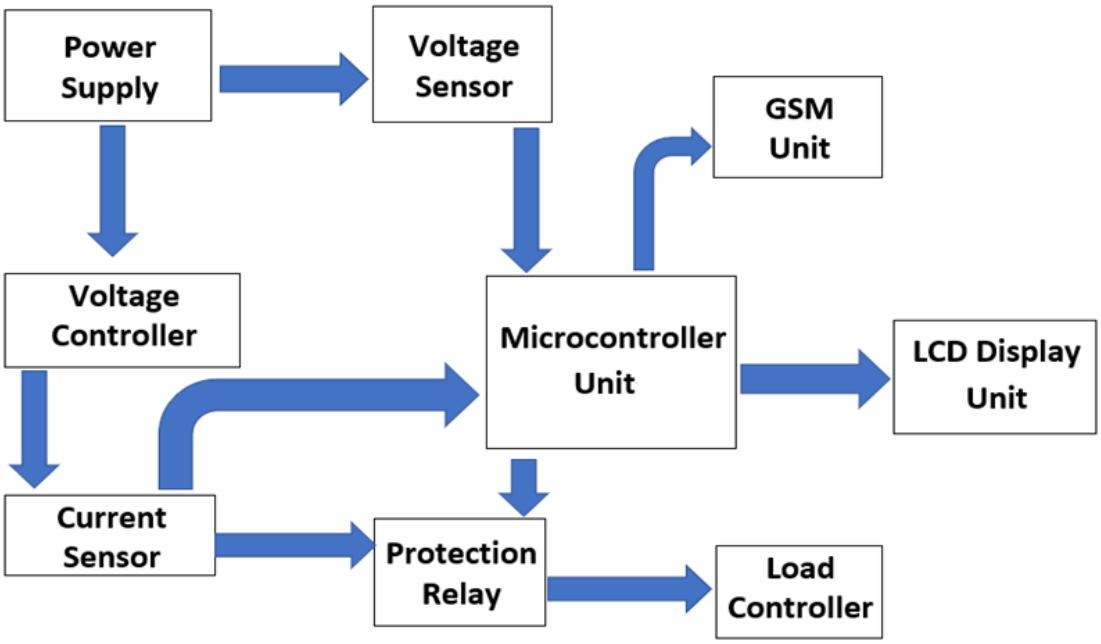


Fig. 2.1 Block diagram of this project

In this task, we measured the current using the current sensor. Before, let's assume we get line power on every device The Arduino sends out a signal at the same time, the s relay goes on, the voltage in the line starts flowing, the loads are moving. The current sensor checks the current on the line and provides Arduino with the analog signal which is provided in

Adriano's digital language. The arduino then shows the voltage on the display and senses the current sensor on the line by an additional 1 amp, and sends a signal to the Arduino relay. Now the relay receives the signal and tipping the relay so that the line has no problem.

2.3 Current Sensor

AC (Alternating current) current will measurement used by the current sensor. In these part discuses about how to measure AC current using by the current transformer/CT.

Current sensors measure the levels of AC and/or DC current. These sensors measure current and provide a kind of output that is consistent with the measured current. When choosing a current sensor, the most important point to make is whether AC and/or DC current must be measured. Another essential feature is if the sensor has to be attached to the circuit or if it operates by clamping the wire to be calculated. [15]

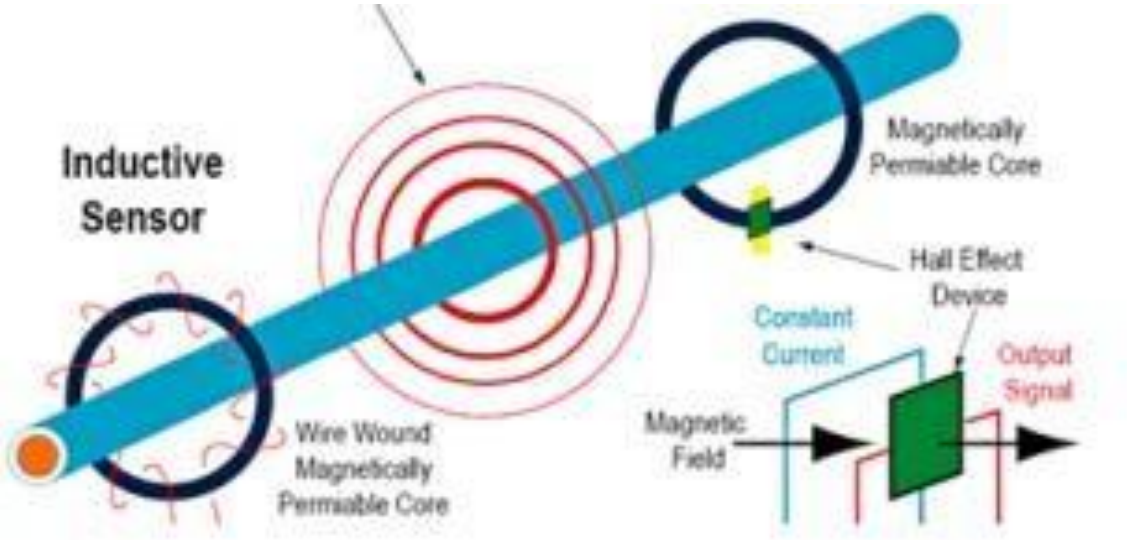


Fig. 2.2 Working principle of current sensor

2.4 Over current/Over load

Over current or large amounts of current in an electrical power system is a situation where there is a greater than intended electrical current through a conductor, resulting in excessive heat generation and the risk of fire or equipment damage. Over current causes include short circuits, excessive load, incorrect layout, or ground defect.

For example, with an additional load, a 10-amp branch circuit is modified, the load current increases to 13 amps, this must be a circuit overload.

Over current protection (OCP) controls are frequently used to control the risks by fuses, circuit breakers and current limiters. An over current may be caused by a circuit overload, a

short circuit, a ground fault, or an arc fault. Circuit breakers and fuses protect the circuit from over damage. [4]

2.5 Short Circuit

A short circuit failure happens when an isolation failure occurs between phase conductors or between phase conductors and earth or both. An isolation failure results in the creation of a short circuit path that creates short circuit conditions in the circuit. [5]

2.5.1 Type of short circuit fault:

I. Single conductor to earth fault (L-to-G)
II. Conductor to conductor fault (L-to-L)
III. Double conductor to earth fault (L-L-to G)
IV. Three conductor fault (L-L-L)

Table 2.1 Fault of Transmission line

Type of Fault	Symbol	%Occurrences	Severity
Line to Ground	L-G	75-80%	Very less severe
Line to Line	L-L	10-15%	Less severe
Double line to ground	L-L-G	5-10%	Severe
Three phase	L-L-L	2-5%	Very severe

2.6 Project Overview

This project, a short circuit kept from a dangerous situation, gives us excessive overload. We mean how to use all devices from the dangerous effects during the transit to the government. Over current protection devices (OCDP) are intended to protect against the potentially harmful impacts of over currents, such as overload current or short-circuit current, which creates a current of failure. Damage to machinery, personal injury, and even death may result from incorrect use of the voltage rating, current rating, or malfunction rating of a system. Something as simple as a circuit breaker will defend against such harm, but if a fuse or circuit breaker does not have an appropriate voltage rating, it can break or burst when trying to stop fault currents beyond their disrupting ratings. Grounding defends against inadequate over current or failure of the OCPD. These systems are structured for the safety of machinery, assets and individuals. [10]

2.7 Component

Three phase fault detection and protection has the following components:

1. MCU Module
2. Current sensor
3. Relay module
4. 16×2 LCD
5. Resistor
6. Power Supply 220V Ac to 12V Dc
7. Diode
8. Blubs 5w/21w 12v
9. Wire
10. Tools needed

2.8 Node MCU

NodeMcu is a microcontroller device which attached with a Wi-Fi module. Also NodeMCU is a development board specially targeted for IoT based Applications. It includes Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.



Figure 2.3: Node MCU

Node MCU Specifications & Features

i. Microcontroller: Tensilica 32 bit.
ii. Voltage: 3.3V
iii. Input Voltage: 7-12V
iv. Digital I/O Pins: 16
v. Analog Pins : 1
vi. UART: 1
vii. SPI: 1
viii. I2C: 1
ix. Flash Memory: 4 MB
x. Static RAM: 64 KB
xi. Clock Speed: 80 MHz
xii. USB-TTL Communication for programming
xiii. Antenna
xiv. Small Size

2.8.1 Current Sensor

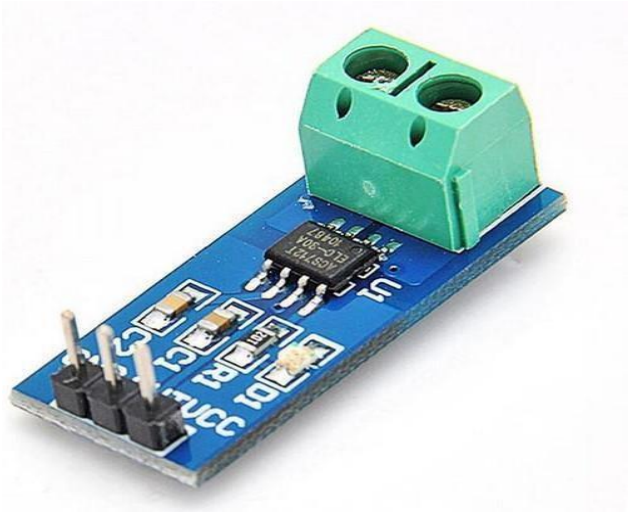


Fig. 2.4 ACS712 Current Sensor

2.8.2 Pin configuration

I. **VCC**: Input voltage is +5V for typical applications.
II. **Output**: Outputs Analog voltage proportional to current.
III. **Ground**: Connected to ground of circuit
IV. **Wire In**: The wire through current has to be measured is connected here AC 220volt supply.
V. **Wire Out**: It power supplies the series AC with the sensor output and receives 220 volts

2.8.2.1Specification

VI. Measures both AC and DC current.
VII. Available as unit 5A, 20A and 30A.
VIII. Provides load isolation.
IX. Easily integrated with MCU, since the analog voltage variable is output.

2.8.2.2 Relay module

It is a LOW Level 5V single-channel relay control panel and the channel requires 15-20mA for operate circuit Can be used for monitoring different big current appliances and equipment. The AC 250V 10A is fitted with high-current relays. It has a standard functionality, which can be directly controlled by a microcontroller.

2.8.3 GSM Unit

The GSM network has four separate parts that work together to function as a whole: the mobile device itself, the base station subsystem (BSS), the network switching subsystem (NSS) and the operation and support subsystem (OSS).



Fig. 2.5 GSM Module

2.8.3.1 Specifications

The 1-channel relay unit specifications are as follows.

2.8.3.1.1 Secure good. The lower current can be regulated by the higher power system and high voltage device

2.8.3.1.2 1-channel high-voltage output unit to satisfy single-channel power criteria.

2.8.3.1.3 Large range of voltage controlled.

2.8.3.1.4 Capable of regulating high current of 240V, 10A.

2.8.3.1.5 A contact normally open (NO) and a contact normally closed (NC). [6]

2.8.3.216×2 LCD Display

All around us we consider Led screens. The use of some kind of time display is done by computers, calculators, TV sets, mobile phones and digital watches. An LCD is an electronic display device that produces a visible image using fluid crystal. The 16×2 LCD display is a very simple unit that is widely used in DIYs and circuits. The sixteen to two is translated in two of these lines into sixteen characters per line. Every character in this LCD is shown in a matrix of 5 pixels.

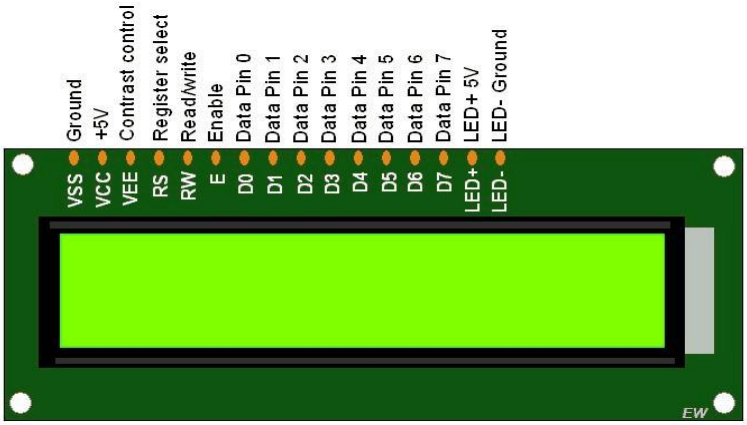


Fig. 2.7 16×2 LCD Display

2.8.4.1 FEATURES

2.8.4.1.1 20×4 dots.

2.8.4.1.2 Built in control.

III. +5v supply.

IV. Backlight LED

2.8.4.2 Applications

2.8.4.2.1 Monitor to control.

2.8.4.2.2 The technology is called liquid crystal.

2.8.4.2.3 This is the input that captures digital data and displays it on the output display.

2.8.4.2.4 This is an electrical connection that is dependent on the fluorine device. [7]

2.8.5 Resistor

A resistor is a passive electrical element with two terminals that implements electrical resistance as a circuit element. Resists are used in electronic circuits for reducing current flow, setting signal level, dividing voltages, biasing active elements, and terminating, among other uses, Transmission lines. High energy resistors can be utilized as a component of motor controls or as a test charge for generators, which can dissipate most watts of power as heat. [11]

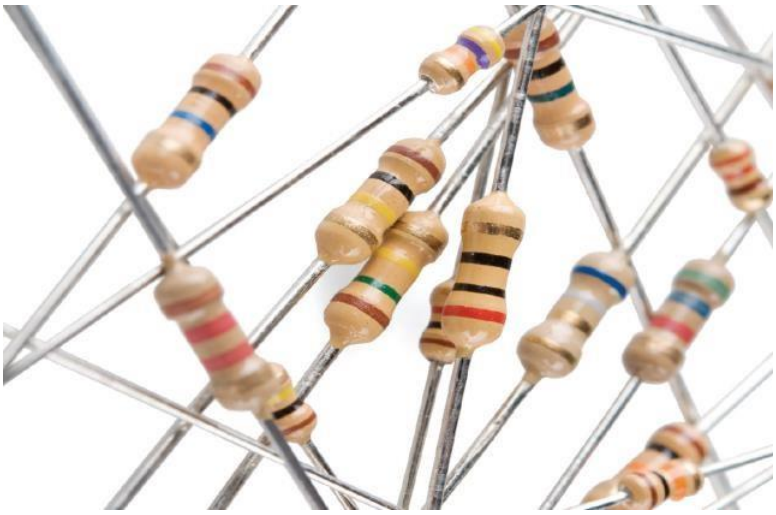
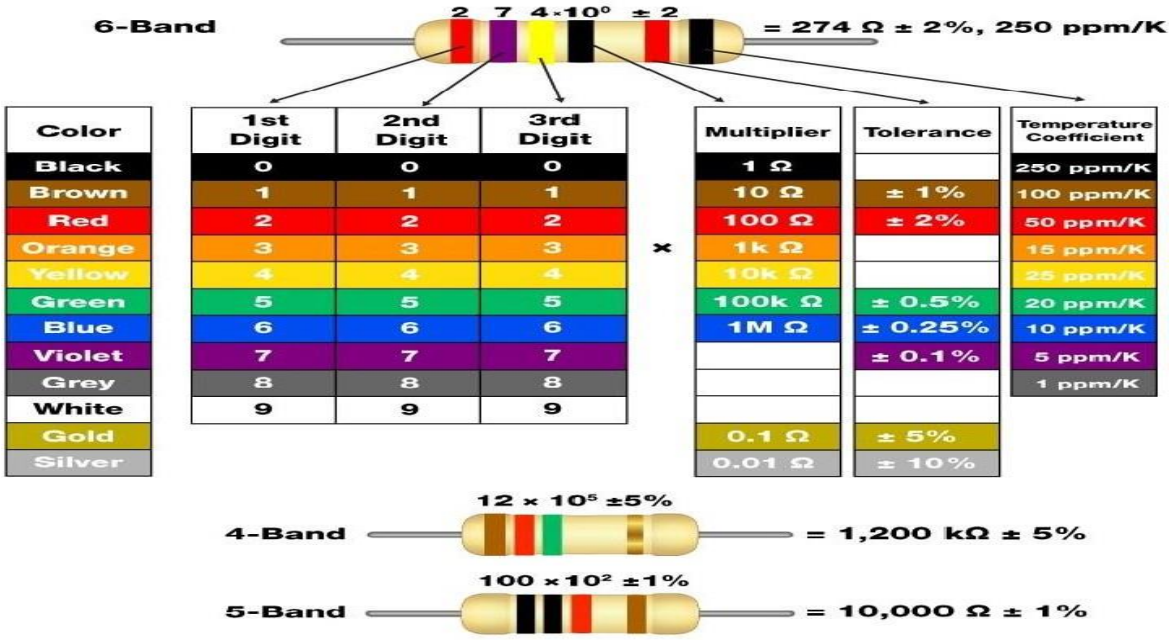


Fig. 2.8 Resistor

2.8.5.1 Resistor Color band

Show in the Table of resister color band

Table 2.2 Resistor color band Table



2.8.6 Voltage sensor

The voltage divider is used as a voltage sensor by the voltage divider law. A voltage detector may assess the voltage supply and calculate it. The AC or DC voltage rate can be calculated. Two kinds of capacitive and resistive voltage sensors are usable. Three resistors, capacitor and diode are used in this project for the voltage sensor using divider rule. There are two

adjacent resistors and one is in sequence. The Arduino is transmitted to this voltage sensor as 3V=250V.

2.8.7
Features of o-9V 300mA Transformer:

2.8.7.1.1 Iron core type.

2.8.7.1.2 Current gain is 300mA.

2.8.7.1
Application of o-9V 300mA Transformer:

2.8.7.1.3 Works as High Current Gain.

2.8.7.1.4 This transformer basically transfers 220V ac to 0-9V.

2.8.7.1.5 It has two windings

2.8.8 Diode

The diode is a two-terminal electronic element which conducts current mainly in one direction (asymmetric conductivity); it has a small (ideally zero) resistance in one direction and a strong (ideally infinite) resistance in the other. A diode vacuum tube or a thermionic

diode is a two-electrode vacuum tube, a heated cathode, and an electron fluid plate, from cathode to plate. [12]

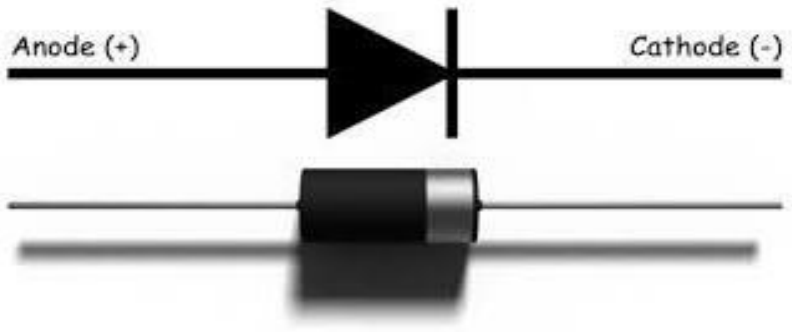


Fig. 2.10 Diode & symbol

2.8.9 Regulator

The regulation regulator controls voltage and from the law of Ohm we know that when resistance is fixed the voltage is proportional to current. In this project regulating unit, voltage can be regulated to produce high voltage, low voltage, unbalanced and overload conditions.

2.8.10 Jumper wire

Wires are used to connect every device. It also connected with every electrical circuit. Wire is a conductor that connects one electric circuit with another or one device with another.

2.8.11 Adaptor

Adaptors are used for converting AC to DC voltage for required value. In this project We can us 220V Ac to 12V Adaptor.



Fig. 2.15 12V DC Adaptor

2.8.12 Tools needed



Fig. 2.16 Needed tools

I. Solder Iron
II. Solder Roxon
III. Solder Lead
IV. Glue-Gun
V. Anti-cutter
VI. Cutting Plus
VII. Digital Multi-Meter
VIII. Screw Driver
IX. Wire Stripper

2.9 Summary

In this chapter we can discuses about all component of the Three Phase Power failure Monitoring. We will finish the project by using all these components properly and maintaining the fault. In this chapter we actually discuss in detail the description and the work of each hardware used.

CHAPTER 3

HARDWARE DEVELOPMENT

3.1 Introduction

This chapter describes the methods used to solve algorithms for three phase fault detection. The main topics discussed in this chapter are how this project flow software. Discusses how our project works.

3.2 Project Flowchart

In shown as the flowchart diagram,

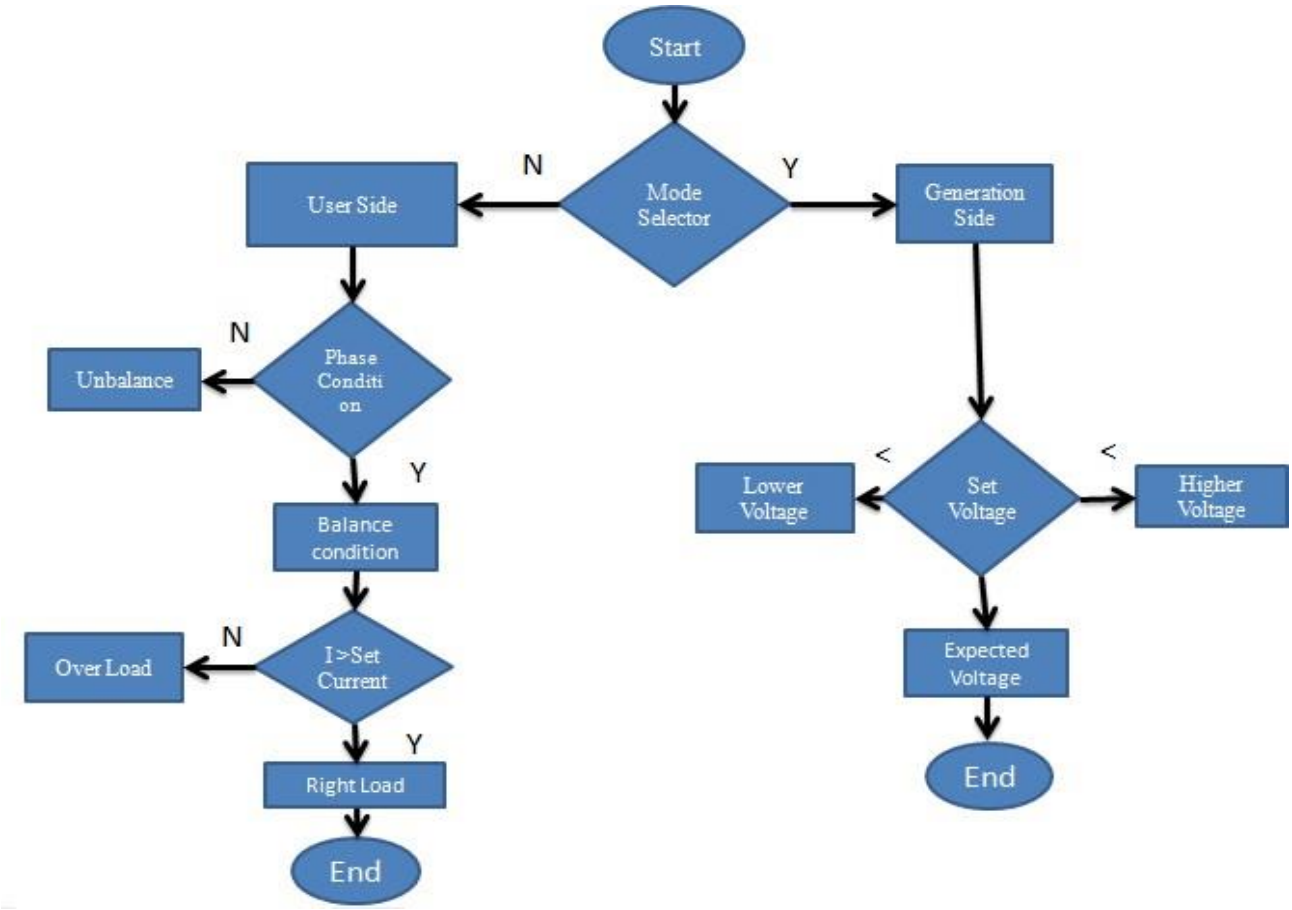


Fig. 3.1 Flowchart of this project

3.3 Algorithm of the Three Phase fault detection device

Step 1: Start

Step 2: Mode selector condition Yes

Step 3: Generation side

Step 4: Measured the voltage

Step 5: Condition Lower voltage<Set voltage<Higher voltage

Step 6: Arduino Read the value

Step 7: If condition lower voltage

Step 8: Relay condition open and displays lower voltage and alarm

Step 9: If condition higher voltage

Step 10: Relay condition open and displays high voltage and alarm

Step 11: If condition set voltage

Step 12: Relay condition close and display system ok

New step: supply to the load

Step 13: Mode selector condition No

Step 14: Distribution side

Step 15: Measured the current from the current sensor

Step 16: Condition phase current deference phase condition>15, phase condition<15

Step 17: Arduino Read the value

Step 18: If phase condition>15

Step 19: Relay condition close and alarming and display unbalance phase

Step 20: If phase condition<15

Step 21: Relay condition close and display system ok.

Step 22: Condition If I>Set current

Step 23: Arduino Read the value

Step 25: Relay condition open and alarming and displays overload

Step 26 If I</=set voltage

Step 27: Relay condition close and displays system ok

Step 28: End

3.4 Hardware Connection picture

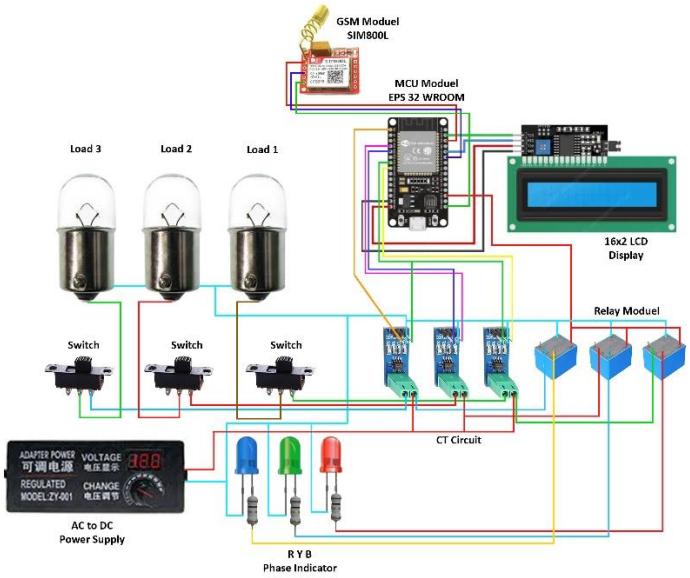


Fig.3.2 Circuit diagram of this project

3.4.1 Description of Hardware Connection

All type of connection of this project Show down:

- At first AC connection in a Transformer.
- Transformer converts 220V AC to 12V DC.
- Transformer 12V DC connecting a rectifier circuit and convert 12V AC to 12V DC.
- Then 12V DC connected to the Arduino internal power supply panel.
- Relay, Current sensor, Display driver all ground and VCC are connected to the Arduino ground and VCC pin.
- Relay in pin connected in dc 12v line.
- All current sensor series connected Output pin from Relay ON.
- Current sensor-1 (R) Input is connecting to the Arduino Analog pin A0.
- Current sensor-2 (Y) Input is connecting to the Arduino Analog pin A1.
- Current sensor-3 (B) Input is connecting to the Arduino Analog pin A2.
- Voltage sensor IN pin is connecting to the Arduino Analog pin A3.

- Displays pin number 1, 5 and 16 are shorted.
- A 10k variable resistance is connected to displays 1, 2 and 3 no pin.
- 220 ohms resistance is connected between displays 2 and 15 no pin.
- Displays pin no 2 is connected to Arduino's 5V pin.
- Displays pin no 1 is connected to Arduino's GND pin.
- Displays 4 and 6 no pin is connected to Arduino's digital output pin 7 and 6.
- Displays D4-D7 pin connected to Arduino's Digital output pin 5-2 respectively.
- A buzzer is connected between Arduino's digital output pin 11 and GND.
- A mode switch is connected between Arduino's digital pin 8 and GND.
- The cable from the current sensor is connected to the dimmer regulator's input cable.
- For current reduction and loading, the load from dimmer regulator output is connected.

3.5 Summary

The following chapter describes the equipment used during the Three Phase transmission line fault of this project laze. All the equipment included in this plan is fully designed and operational and should operate well for fault protection. In this chapter we try discussing the details of the hardware characterization used its work.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

The main part of the power system is the transmission line. The biggest amount of power transmission lines. The power needs and their allegiance has been dramatically increased during the modern world, with electricity transferred from the source area into the distribution system as the main role of the transmission line. The collision between output limits and massive demands on reducing power failures have increased. Therefore, this project is very helpful for day to day life.

4.2 Result

This plan is designed to protect the fault in the transmission line. Defect lines on the transmission line, such as overload, over currant flow, short circuit fault, etc. By transforming the analog signal into a digital signal, the amount of current flow that we make through the current sensor in this project is transferred to an Arduino processor. The Arduino processor then completes the process and transmits the high digital signal to the relay. Then the relay connects via the signal to the relay. The Arduino will then give the digital signal to the Display driver, so we can see how amount of current flow through the transmission line. If over current flow through the transmission line then Arduino transferred low signal to the Relay. Arduino transfer a signal through the display, then we can see who fault is organized as like as overload, over current unbalance etc. Arduino and Relay connection is off mode

Relay operate and disconnected the circuit. Then transmission line has no current or no voltage. In the distribution line we therefore find the load on each load. All of this work done through the Arduino program.

4.2.1 Generation Side:

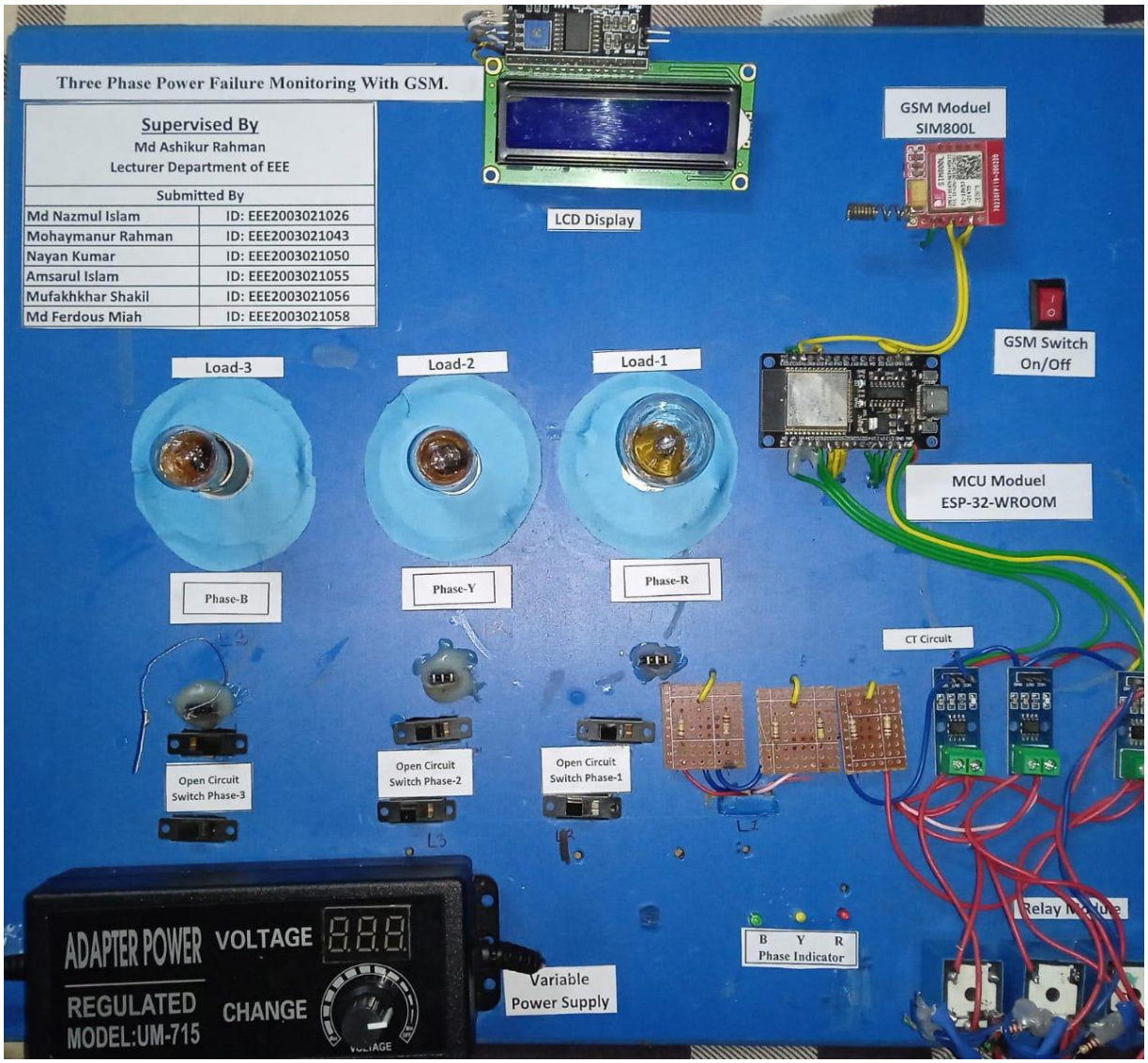


Fig. 4.1 Final project

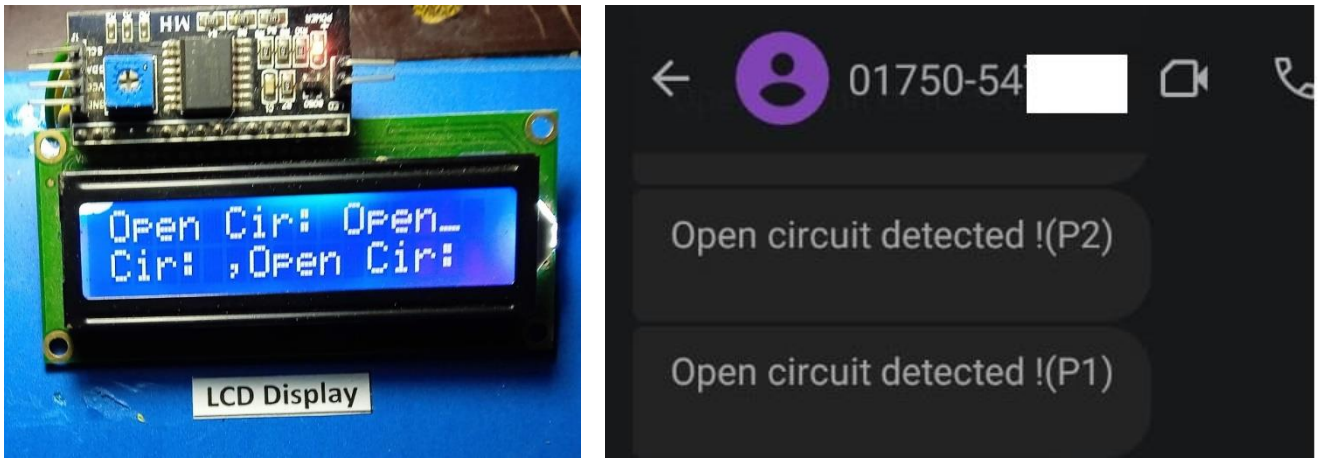


Fig 4.2 Open circuit

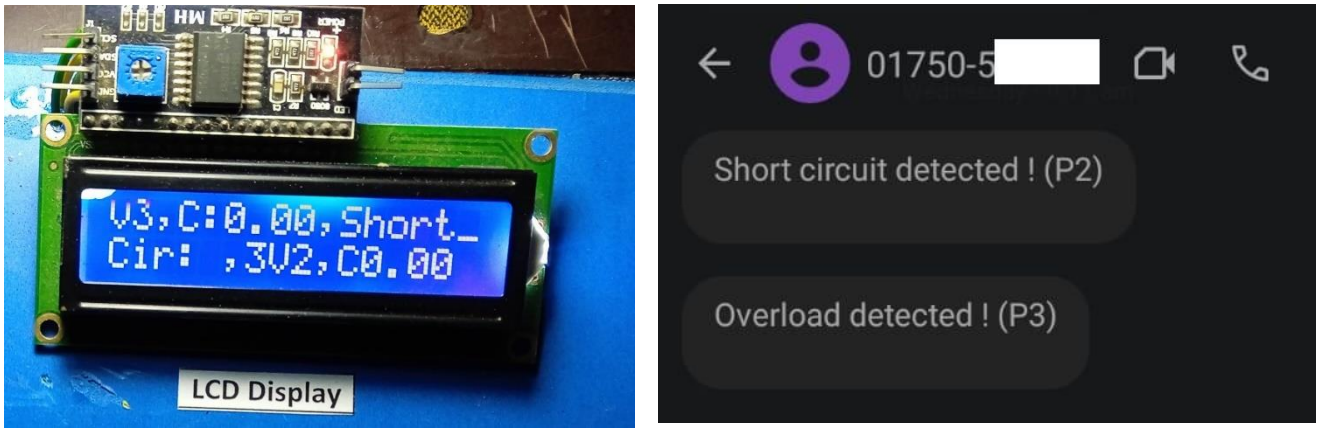


Fig 4.3 Short circuit

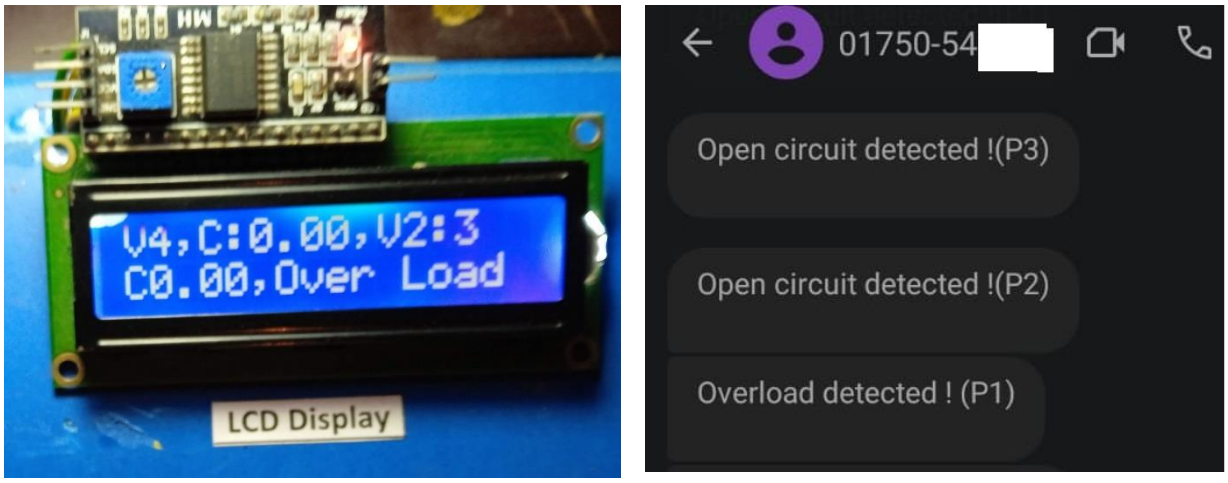


Fig 4.4 Over Load

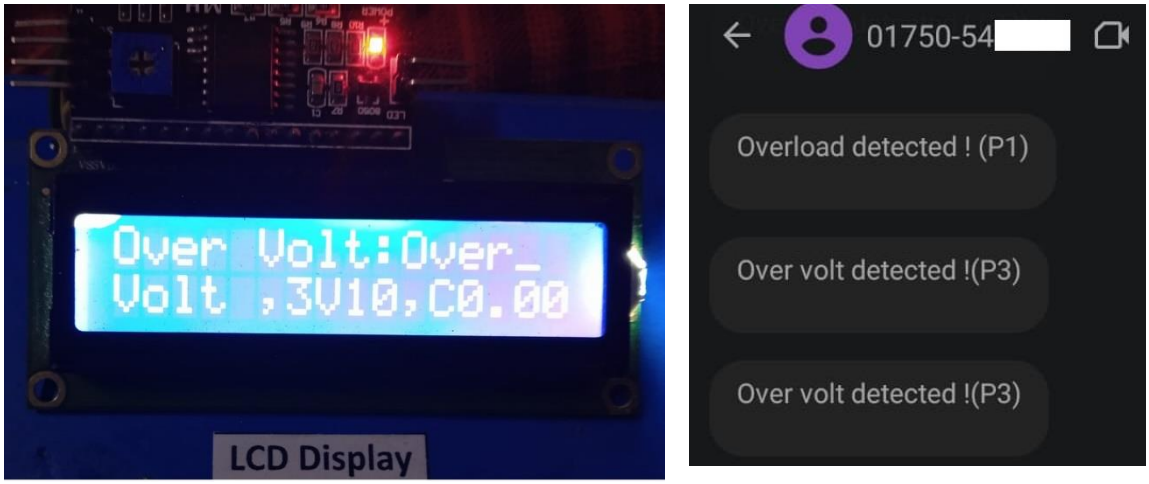


Fig. 4.5 Over voltage

4.3 Cost Analyses

Serial No	Name	Quantity	Price (BTD)
1	MCU ESP32-WROOM	1	650
2	Current Sensor (ACS712)	3	900
3	Relay module 5v	3	150
4	LCD Display Unite 16x2	1	850
5	Diode 4007	4	20
6	Power Supply 220AC to 12V DC	1	1000
7	Wire		100
8	Resistor 10k	5	30
9	Switch	7	70
10	Bulbs	4	100
11	LED 1.5v R Y B	3	30
12	Others		500
		Total	4400

Table 4.1 Cost analysis of this project

4.4 Advantage of the project

i. Remove the damage of the transmission line.
ii. In this project we have create a fault detection transmission line, it detected fault of the transmission line.
iii. It's save our transmission and distribution line equipment.
iv. With the relay in this plan the defective circuit is removed before the system is broken. The Arduino processor recognizes digital signals for all kinds of situations.
v. It has simple circuit diagram to implement the project.
vi. Low cost of this project.
vii. Operation and control is very easy.
viii. Any kind of fault detected this project and we can see who fault organized in the transmission line.
ix. Compared with the current system, the coverage area is increasing.
x. Less part number and manual control. [8]

4.5 Summary

The independent object defect is ready to be executed following completion of all goods pursuant to this chapter. This chapter was mainly challenged by creating an algorithm that works on this transmission line. Thus, the main aim of the chapter was the algorithm and diagram of the conjunction.

CHAPTER 5
CONCLUSION

5.1 Conclusion

Many voltage and current signal fluctuations are induced by defects of power transmission networks. Stopping the power supply will cause faults in power transmission lines. Thanks to the continuous and precise location information of the device, the time taken to locate the fault is significantly reduced. This means that the skilled crew responds less to repair such faults and thus save transformers from failure and catastrophe. This term enables us to classify the fraud present and process interrupting in the transmission line with the system parameters to be collected and modified. The fault warning software is easily detected and repaired by the line control staff.

5.2 Limitation of the project

We realize that the project requires components and that the relay has been rotated to avoid the excess current from passing through the existing detector. Since we have collaborated with the regulator to through the existing through this venture. If we were to use this plan within the borough area, we would be hesitant to use specific signals, substations.

5.3 Future Scopes

In this project, a wireless sensor can be used to detect faults that include phase-to-phase, short-circuit and, in particular, ground-to-ground faults in the power line for better reliability and best operation of the system. The proposed power line is divided into WNS (wireless sensor network) nodes that could detect fault in the power line, display to the operator and send SMS through the GSM modem to the service engineer. This idea successfully studies the asymmetrical faults that occur in the power line.

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APPENDIX

Code:

Three phase fault detection of transmission line code as shown:

```
#include <LiquidCrystal.h>
LiquidCrystal lcd (7, 6, 5, 4, 3, 2);
#define acsL712 A0 // Left side load R
#define acsR712 A1  // Right side load  B
#define acsM712 A2  // Mdidle load  Y
int relay=A4;
int mode=8,s;
int sound = 11;
int volt=0;
int v[10]={};
int error=15;  // Phase load difference set
int max_i=33; // Over load set
String m = "System OK";
int m2;
long lastsample = 0;
long samplesumR = 0;
long samplesumM = 0;
long samplesumL = 0;
int sampleCountL = 0;
int sampleCountM = 0;
int sampleCountR = 0;
float vpc = 4.8828125;

void setup()
{
  Serial.begin(115200);
  pinMode(A4,OUTPUT);
  digitalWrite(relay,HIGH);
  pinMode(mode,OUTPUT);
  digitalWrite(mode,HIGH);
  pinMode(sound,OUTPUT);
  //digitalWrite(sound,HIGH);
  lcd.begin(16, 2);

}
```

```
void loop() {
  s = digitalRead(mode);
while(s==0)
{
  if (millis() > lastsample + 1) {
    //take sample.
    samplesumR += sq(analogRead(acsR712) - 492); // Line B
    sampleCountR++;

    samplesumM += sq(analogRead(acsM712) - 495); // Line Y
    sampleCountM++;
    samplesumL += sq(analogRead(acsL712) - 490); // Line R
    sampleCountL++;
    lastsample = millis ();
  }
  if (sampleCountM == 1000)
  {
    //averaging stuff
    float meanR = samplesumR / sampleCountR;
    float meanL = samplesumL / sampleCountL;
    float meanM = samplesumM / sampleCountM;
    float valueR = sqrt(meanR);
    float valueL = sqrt(meanL);
    float valueM = sqrt(meanM);
    float mvR = valueR * vpc;
    float mvL = valueL * vpc;
    float mvM = valueM * vpc;
    float amperageR = mvR / 185;  //66 for 30A  185 for 20A  185 for 5A
    float amperageL = mvL / 185;
    float amperageM = mvM / 185;

 if(mvL>max_i){m="Over Load
R";Serial.println(m);digitalWrite(relay,LOW);disp();alarm(1,1);while(1);}
else if(mvM>max_i+1){m="Over Load
Y";Serial.println(m);digitalWrite(relay,LOW);alarm(1,1);disp();while(1);}
else if(mvR>max_i){m="Over Load
B";Serial.println(m);digitalWrite(relay,LOW);alarm(1,1);disp();while(1);}

 else if((mvL-mvM)>error){m="RY Unbalance";Serial.println(m);alarm(1,0);} // L==R,
M=Y, R=B
 else if((mvM-mvL)>error){m="YR Unbalance";Serial.println(m);alarm(1,0);}

 else if((mvM-mvR)>error){m="YB Unbalance";Serial.println(m);alarm(1,0);}
 else if((mvR-mvM)>error){m="BY Unbalance";Serial.println(m);alarm(1,0);}
```

```
 else if((mvL-mvR)>error){m="RB Unbalance";Serial.println(m);alarm(1,0);}
 else if((mvR-mvL)>error){m="BR Unbalance";Serial.println(m);alarm(1,0);}
 else {m="System OK";Serial.println(m);digitalWrite(relay,HIGH);alarm(0,0);}

   s = digitalRead(mode);
   Serial.println(s);
   Serial.print("R_load="); // Most Left
   Serial.println(mvL);
   Serial.print("Y_load="); // Midle
   Serial.println(mvM);
   Serial.print("B_load="); // Most Right
   Serial.println(mvR);
   Serial.println(".......... ");
   disp();
   supply_voltage();
   //Serial.println("The final RMS Amperage is: " + String(amperage) + " Appox WATTAGE
is: " + String(amperage * 240) + ".");

   samplesumR = 0;
   samplesumL = 0;
   samplesumM = 0;
   sampleCountR = 0;
   sampleCountL = 0;
   sampleCountM = 0;
}
}
supply_voltage();
disp();
}
void supply_voltage()
{
  while(s==1)
  {
 for(int i=0;i<10;i++){v[i]=analogRead(A3);delay(20);Serial.println(i);}
 volt =(v[0]+v[1]+v[2]+v[3]+v[4]+v[5]+v[6]+v[7]+v[8]+v[9])/10;
 int voltage = map(volt, 550,850,60,300);
 m2=voltage;
Serial.println(voltage);
if( voltage>30 && voltage<150){m="Lower
voltage";Serial.println(m);digitalWrite(relay,LOW);alarm(1,0);}
else if(voltage>160 && voltage<240){m="System
OK";Serial.println(m);digitalWrite(relay,HIGH);}
else if(voltage>250){m="Higher voltage";Serial.println(m);digitalWrite(relay,LOW);disp();
```

```
alarm(1,1);while(1);}

s = digitalRead(mode);
Serial.println(s);
disp();
 }
}
void disp()
{
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print(m);
  if(m2>30 && m2<300)
  {
  lcd.setCursor(0,1);
  lcd.print(m2);
  lcd.setCursor(3,1);
  lcd.print("V");
}
  delay(30);
}

void alarm(int s, int t)
{
digitalWrite(sound,s);
delay(200);
digitalWrite(sound,t);
}
```