Visvesvaraya Technological University

Belgaum, Karnataka-590 018

A Project Report on

"AUTOMATIC FAULT DETECTION AND LOCATION IN POWER TRANSMISSION LINES USING GSM TECHNOLOGY"

Project Report submitted in partial fulfillment of the requirement for the award of the degree of

Bachelor of Engineering

In

Electrical & Electronics Engineering

Submitted by

VIJAYAKUMARA G (1CR17EE417)

ARPITHA B (1CR17EE401) ASHWINI B (1CR15EE015) DHANA SHWETHA P (1CR16EE022)

Under the Guidance of

Ms.Ranjitha R

Assistant professor, Department of Electrical & Electronics Engineering

CMR Institute of Technology

CMR Institute of Technology, Bengaluru-560 037

Department of Electrical & Electronics Engineering 2019-2020

Certificate

Certified that the project work entitled **"AUTOMATIC FAULT DETECTION AND LOCATION IN POWER TRANSMISSION LINES USING GSM TECHNOLOGY"** carried out by Mr.VIJAYAKUMRA G,(1CR17EE417); Ms.ARPITHA B(1CR17EE401); Ms.ASHWINI B,(1CR15EE015); Ms.DHANA SHWETHA P(1CR16EE022) are bonafied students of CMR Institute of Technology, Bengaluru, in partial fulfillment for the award of Bachelor of Engineering in Electrical & Electronics Engineering of the Visvesvaraya Technological University, Belgaum, during the year 2019-2020. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Signature of the Guide **Signature of the Principal**

Signature of the HOD

Ms.Ranjitha R
Assistant professor
EEE Department
CMRIT, Bengaluru

Dr. K. Chitra
Professor & HOD
EEE Department
CMRIT, Bengaluru

Dr. Sanjay Jain
Principal,
CMRIT, Bengaluru

External Viva

Name of the Examiners Signature & Date 1.

2.

AECS Layout, Bengaluru-560 037

DECLARATION

We**, Mr.VIJAYAKUMARA G(1CR17EE417), Ms.ARPITHA B(1C**R**17EE**4**01), Ms.ASHWINI B(1CR15EE015), Ms.DHANA SHWETHA P(1CR16EE022),** hereby declare that thereport entitled **"AUTOMATIC FAULT DETECTION AND LOCATION IN POWER TRANSMISSION LINES USING GSM TECHNOLOGY"** has been carried out by us under the guidance of **RANJITHA R, Assistant professor**, Department of Electrical & Electronics Engineering, CMR Institute of Technology, Bengaluru, in partial fulfillment of the requirement for the degree of **BACHELOR OF ENGINEERING in ELECTRICAL & ELECTRONICS ENGINEERING**, of Visveswaraya Technological University, Belagaum during the academic year 2019-20.The work done in this report is original and it has not been submitted for any other degree in any university.

DHANASHWETHAP(1CR16EE022)

Place: Bengaluru Date:

VIJAYAKUMARA G(1CR17EE417)

ARPITHA B(1CR17EE401) ASHWINI B(1CR15EE015)

Abstract

"Main aim of the project is to design and development of automatic fault detection and location identification in transmission lines and monitoring using internet of Things (IoT)".

In this project we are designing for single phase 230V two transmission lines for the demo Purpose. By creating manual fault. In this project we are using ARM7 microcontroller to

detect the fault .Microcontroller continuously monitoring the fault sense. Once short circuit is found (For demo we are manually creating fault using switch) controller immediately receives the GPS data and sends the location co-ordinates to the server via Wi-Fi Module. Using cloud, we can monitor the transmission line anywhere in the world by checking in the web. These transmission companies manly relies on circuit indicators (FCIs) to assist in locating specific spots within their transmission lines where power fault had occured.

In this paper, a smart GSM based fault detection and location system was used to adequatly and accurately indicate and locate the exact spot where fault had occured. This will ensure a shorter response time for technical crew to rectify these faults and thus help save transformers from damage and disasters. The system uses a current transformer, a voltage transformer, PIC 16F877 Microcontroller, RS-232 connector, and a GSM modem. The system automatically detects faults, analyses and classifies these faults and then, calculates the fault distance from the control room using an impedance based algorithm method. Finally the fault information is transmitted to the control room. In conclusion, the time required to locate a fault is drastically reduced, as the system automatically and accurately provides accurate fault location information.

Acknowledgement

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of people, who are responsible for the completion of the project and who made it possible, because success is outcome of hard work and perseverance, but stead fast of all is encouraging guidance. So with gratitude we acknowledge all those whose guidance and encouragement served us to motivate towards the success of the project work.

We take great pleasure in expressing our sincere thanks to**Dr. Sanjay Jain**, **Principal, CMR Institute of Technology, Bengaluru** for providing an excellent

academic environment in the college and for his continuous motivation towards a dynamic career.We would like to profoundly thank **Dr. B Narasimha Murthy**, Vice principal of CMR Institute of Technology and the whole **Management** for providing such a healthy environment for the successful completion of the project work.

We would like to convey our sincere gratitude to **Dr. K Chitra**, **Head of Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru** for herinvaluable guidance and encouragement and for providing good facilities to carry out this project work.

We would like to express our deep sense of gratitude to **Ranjitha R, Assistant Professor, Electrical and Electronics Engineering, CMR Institute of Technology, Bengaluru** for his/her exemplary guidance, valuable suggestions, expert advice and encouragement to pursue this project work.

We are thankful to all the faculties and laboratory staffs of **Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru** for helping us in all possible manners during the entire period.

Finally, we acknowledge the people who mean a lot to us, our parents,for their inspiration, unconditional love, support, and faith for carrying out this work to the finishing line.We want to give special thanks to all *our friends*who went through hard times together, cheered us on, helped us a lot, and celebrated each accomplishment.

Lastly, to the **Almighty**, for showering His Blessings and to many more, whom we didn't mention here.

CONTENTS

LIST OF FIGURES

Keil ide

Embedded c viii

30 31

Introduction Chapter 1

1. INTRODUCTION:

When a power line is cut off, the sensor will sense the power cut and send a signal to ix the Wi-Fi module that the power line is cut off. The WIFI will send data to AWS cloud and cloud module will send a message to the nearest electricity board regarding the power cut. Simultaneously a buzzer starts buzzing to alert the people and animals around the area about the damage. The current system used in most rural areas is that when the

power line is damaged, the electricity board disconnects the main power supply of that area until the system is back running.

This project is about design and implementation of a mobile embedded system to monitor and record key parameters of a distribution transformer fault status. The idea of on-line monitoring system integrates a wi-fi modem, with a standalone single chip microcontroller. It is installed at the distribution transformer site and the above parameters are recorded using the Analog to Digital Converter (ADC) of the embedded system. The obtained parameters are processed and recorded in the cloud memory. If any abnormality or an emergency situation occurs the system sends Short Message Service (SMS) messages to the mobile phones containing information about the abnormality according to some predefined instructions programmed in the microcontroller. This mobile system will help the transformers to operate smoothly and identify problems before any catastrophic failure occurs.

The components used are smoothly interfaced with each other. The connections are done by the connecting wires. Each component used in the system requires different amount of power supply, hence a distributed power supply is used which very cost efficient and also system efficient in terms of supplying the appropriate power supply to each component in the system and two sensors are used in the system.

1.1 BRIEF BACKGROUND OF THE RESERCH

Globally, there are three phases in electric power supply system. These encompass the generation phase, the transmission phase and the distribution phase. Each of these phases involves certain distinct production processes, work activities and hazards.

➢ **The Generation Phase:** The generating phase begins at the base station where stored energy of gas, oil, coal, nuclear fuel, or falling water is converted to electrical energy.

the generating power voltage from these stations, controlled by Volta River Authority (VRA) is usually from 13.2 kVto 24 kV [1]. This is further stepped up by transformers to higher voltages to transmission by GRIDco systems.

➢ **Transmission Phase:** After generation, transformers at the generation substation then boost up the voltage to high voltages that ranges between 69KV to 330 kV [2] before it is transmitted over great distances across the country by GRIDco using transmission lines (cables). These transmission lines are constructed between transmission substations

that are located at the generating stations and distribution substations The Transmission lines are mainly supported overhead on towers. At the receiving end of the transmission lines substations, these voltages are stepped down to between 34.5 to 138 kV. This power is then transferred to the distribution substation controlled by ECG and NEDco both in the southern and northern part of the country respectively.

➢ **Distribution Phase:** As stated above, the distribution phase (controlled by ECG and NEDco) connects the transmission system of GRIDco to the customer's equipment. The distribution substation reduces the transmitted electrical voltage from 161KV, to 24 kV. A distribution transformer further reduces the voltage to 240V, which is the standard voltage recommended in Ghana. Transmission and distribution substations are installations where the voltage, phase or other characteristics of the electrical energy are changed as part of the final distribution process [3]. Fig 1 depicts the stages and the stakeholders responsible for power generation, transmission and to distribution for consumers.

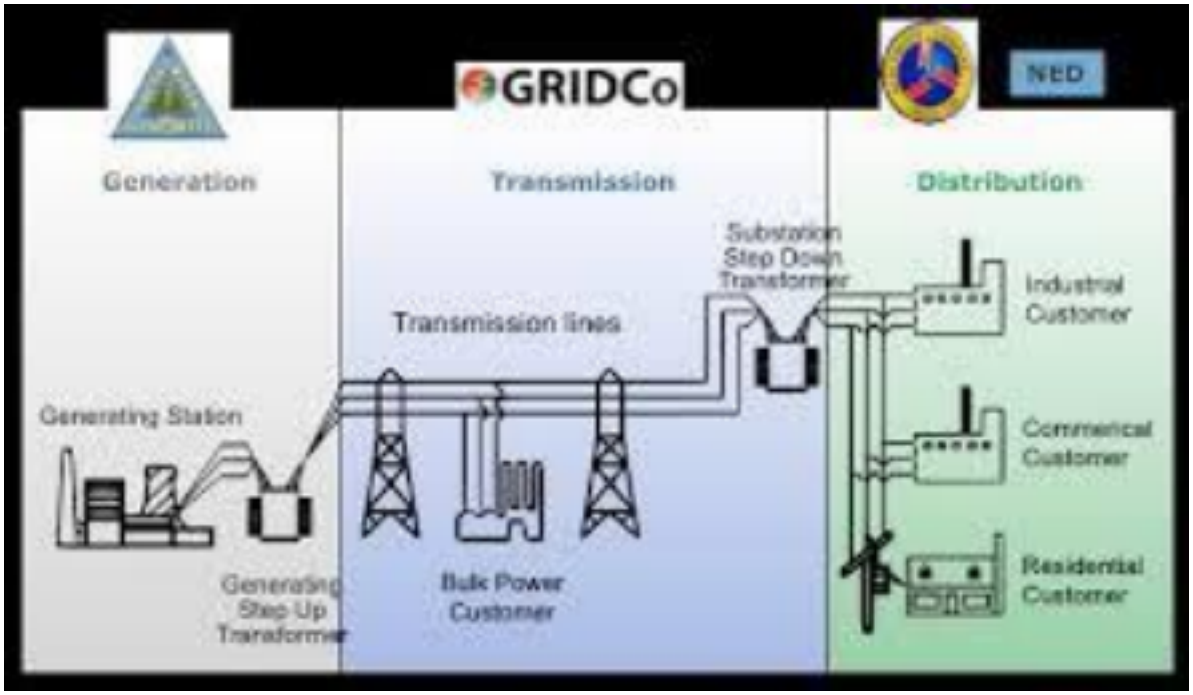

FIG 01: Generation, Transmission and Distribution of Power

➢ **Architecture of the GSM Network:** Global System for Mobile Communications (GSM) is a digital wireless network standard designed by standardization committees from major European telecommunications operators and manufacturers. The GSM standard provides a common set of compatible services and capabilities to all mobile users across Europe and several million customers worldwide

➢ **Common Courses Of Transmmision Line Faults:** There are many courses of fualts in power transmission leading to power outages if not properly managed. Notable among them includes: Faults at the power generation station Damage to power transmission lines (tree falling on lines) Faults at the substations or parts of distribution subsystem Lightening

➢ **Types of transmission line faults:** Power system's faults may be categorized as shunt faults or series faults. The most common type of shunt faults is Single Line-to-ground faults (SLG). This type of fault occurs when one conductor falls to the ground or gets into contacts with the neutral wire. It could also be the result of falling trees in a rainy storm. This type could be represented as shown in Fig

A. Single Line-to-Ground Fault: The most common type of shunt faults is Single Line-to-ground faults (SLG). This type of fault occurs when one conductor falls to the ground or gets into contacts with the neutral wire. It could also be the result of falling

trees in a rainy storm. This type could be represented as shown in Fig 1 below.

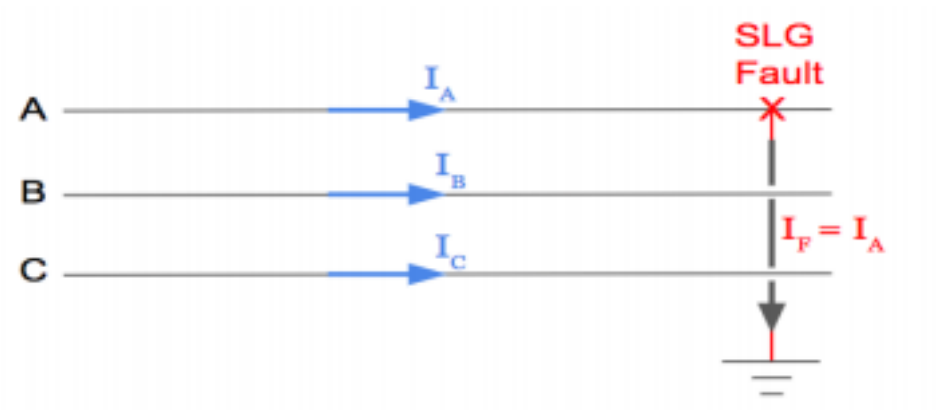

Fig. 2: Single line-to-ground fault

B. Line-to-Line Fault: The second most occurring type of shunt faults is the Line-to Line fault (LL). This is said to occur when two transmission lines are short-circuited. As in the case of a large bird standing on one transmission line and touching the other,
or if a tree branch happens to fall on top of two power transmission lines.

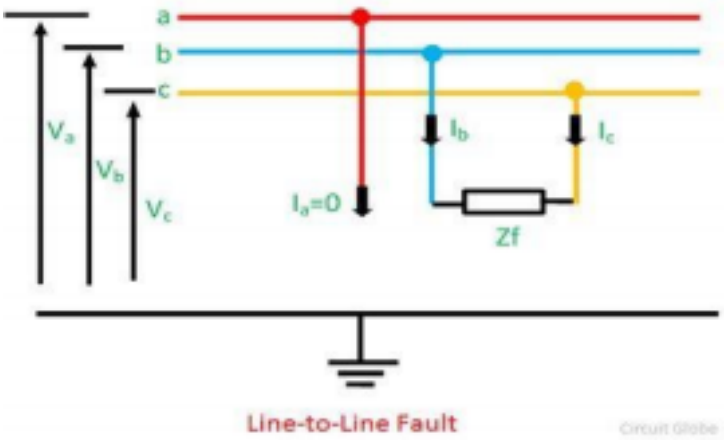

Fig. 3: Line to Line Fault

C. Line-to-Ground Fault: The third type of shunt fault is the Double Line-to-Ground fault (DLG) in figure below. This can be a result of a tree falling on two of the power lines, or other causes.

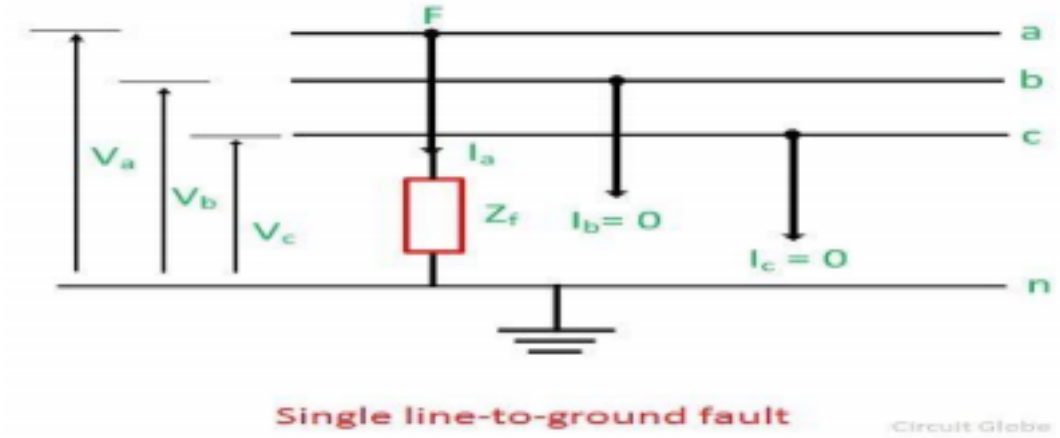

Fig. 4: Line to ground fault

D. Balance Three Phase: the fourth and the real type of fault the balanced three phases, which can occur by a contact between the three power lines in many different forms.

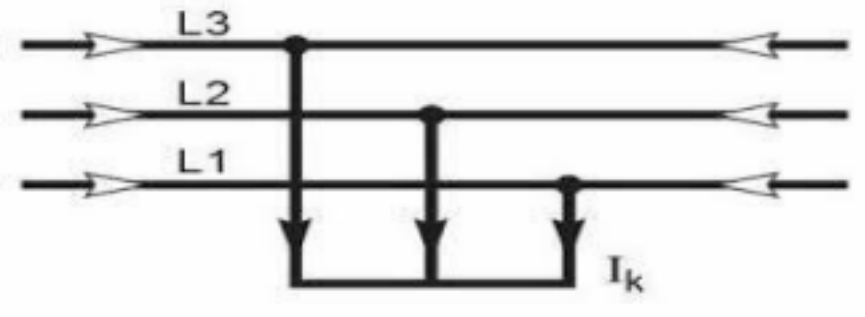

Fig. 5: Balance three phase fault

1.2 OBJECTIVES OF THE THESIS:

- ➢ In this project we are designing for single phase 230v two transmission lines for the demo purpose.By creating manual fault. In this project we are using ARM7 microcontroller to detect the fault. Microcontroller continuously monitoring the fault sense.
- ➢ Once short circuit is found(for demo we are manually creating fault using switch)controller immediately receives the GPS data and sends the location co ordinates to the server via Wi-Fi Module. Using cloud we can monitor the transmission line anywhere in the world by checking in the web.
- ➢ To design an efficient impedance-based and robust automatic fault detection and location system for overhead transmission lines.
- ➢ To reduce response time needed to rectify and save expensive transformers from

damage or theft which usually occurs during longer power outages. ➢ To increase productivity of technical crews since the time needed to locate faults will be minimized.

➢ To ensure stability and reliability of the power supply system in the country to boost economic growth.

1.3 PROBLRM STATEMENT:

Problem Statement To reduce the duration of outages and minimise response time to major faults, and to optimise reliabilty of supply, it is inevitable for power transmission companies such as GRIDco to search for a low-cost communicating device with low power consumption that will relay accurate fault information at real

time back to the control centre. This research work seeks to design an automatic and efficient fault detection and location system for both overhead and underground power transmission network system using both existing fault indicator technology and commercially proven communication technology to quickly and accurately pin point

Faulted sections of a transmission system

Literature review Chapter 2

2.LITERATURE REVIEW:

2.1 Digital Fault Locator for Double End Fed Transmission Lines

Author: Micheletti.R

The paper presents a digital fault locator by dynamic system parameter estimation for a double end fed transmission line. The method uses about 1/6 cycle of recorded fault data and does not require filtering of dc offset and high-frequency components. The system differential equations are based on a lumped parameter line model, Thevenin equivalents at both ends of the line and an unknown fault resistance. The accuracy is demonstrated by a representative set of tests results obtained with computer simulation.

2.2 Fault location in EHV transmission lines using Artificial Neural Networks

Author: TAHAR BOUTHIBA

This paper deals with the application of artificial neural networks (ANNs) to fault detection and location in extra high voltage (EHV) transmission lines for high speed protection using terminal line data. The proposed neural fault detector and locator were trained using various sets of data available from a selected power network model and simulating different fault scenarios (fault types, fault locations, fault resistances and fault inception angles) and different power system data (source capacities, source
Voltages source angles time constants of the sources.

Proposed model with theoretical background Chapter 3

3. Proposed model with theoretical background:

3.1 BLOCK DIAGRAM

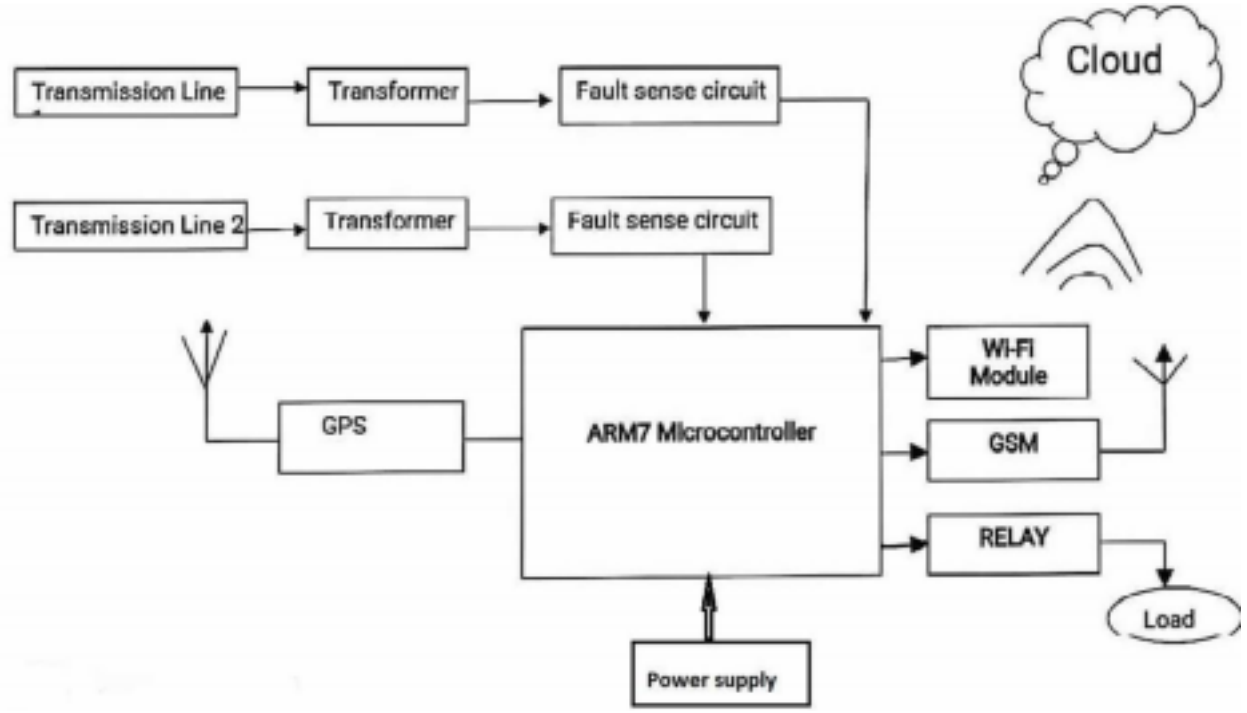

FIG.6 Block diagram

FIG.7 Fault sensing circuit

Proposed model with theoretical background Chapter 3

1. TRANSMISSION LINE: Transmission lines are used to transmit electric power to distant large load centres. These lines are exposed to faults as a result of lightning, short circuits, faulty equipment's, miss-operation, human errors, overload, and aging. In radio-frequency engineering, a transmission line is a specialized cable or other structure designed to conduct alternating current of radio frequency, that is, currents with a frequency high enough that their wave nature must be taken into account. Transmission lines are used for purposes such as connecting radio transmitters and receivers with their

antennas (they are then called feed lines or feeders), distributing cable television signals, trunk lines routing calls between telephone switching centres, computer network connections and high speed computer data buses.

Ordinary electrical cables suffice to carry low frequency alternating current (AC), such as mains power, which reverses direction 100 to 120 times per second, and audio signals. However, they cannot be used to carry currents in the radio frequency range, above about 30 kHz, because the energy tends to radiate off the cable as radio waves, causing power losses. Radio frequency currents also tend to reflect from discontinuities in the cable such as connectors and joints, and travel back down the cable toward the source. These reflections act as bottlenecks, preventing the signal power from reaching the destination. Transmission lines use specialized construction, and impedance matching, to carry electromagnetic signals with minimal reflections and power losses. The distinguishing feature of most transmission lines is that they have uniform cross sectional dimensions along their length, giving them a uniform impedance, called the characteristic impedance, to prevent reflections. Types of transmission line include parallel line (ladder line, twisted pair), coaxial cable, and planar transmission lines such as strip line and micro strip. The higher the frequency of electromagnetic waves moving through a given cable or medium, the shorter the wavelength of the waves. Transmission lines become necessary when the transmitted frequency's wavelength is sufficiently short that the length of the cable becomes a significant part of a wavelength.

At microwave frequencies and above, power losses in transmission lines become excessive, and waveguides are used instead, which function as "pipes" to confine and guide the electromagnetic waves. Some sources define waveguides as a type of transmission line; however, this article will not include them. At even higher

frequencies, in the terahertz, infrared and visible ranges, waveguides in turn become loss, and optical methods, (such as lenses and mirrors), are used to guide electromagnetic waves.

The theory of sound wave propagation is very similar mathematically to that of electromagnetic waves, so techniques from transmission line theory are also used to build structures to conduct acoustic waves; and these are called acoustic transmission lines.

2. TRANSFORMER: A transformer is a passive electrical device that transfers electrical energy from one electrical circuit to another, or multiple circuits. A varying current in any one coil of the transformer produces a varying magnetic flux in the

transformer's core, which induces a varying electromotive force across any other coils wound around the same core. Electrical energy can be transferred between separate coils without a metallic (conductive) connection between the two circuits. Faraday's law of induction, discovered in 1831, describes the induced voltage effect in any coil due to a changing magnetic flux encircled by the coil.

Transformers are most commonly used for increasing low AC voltages at high current (a step-up transformer) or decreasing high AC voltages at low current (a step-down transformer) in electric power applications, and for coupling the stages of signal processing circuits. Transformers can also be used for isolation, where the voltage in equals the voltage out, with separate coils not electrically bonded to one another.

Since the invention of the first constant-potential transformer in 1885, transformers have become essential for the transmission, distribution, and utilization of alternating current electric power. A wide range of transformer designs is encountered in electronic and electric power applications. Transformers range in size from RF transformers less than a cubic centimetre in volume, to units weighing hundreds of tons used to interconnect the powergrid.

Transformers are capable of either increasing or decreasing the voltage and current levels of their supply, without modifying its frequency, or the amount of electrical power being transferred from one winding to another via the magnetic circuit. A single phase voltage transformer basically consists of two electrical coils of wire, one called the “Primary Winding” and another called the “Secondary Winding”. For

this tutorial we will define the “primary” side of the transformer as the side that usually takes power, and the “secondary” as the side that usually delivers power. In a single-phase voltage transformer primary is usually the side with the higher voltage.

FIG:8,

DISTRIBUTION TRANSFORMER

3. FAULT SENSING UNIT: In an electric power system, a fault or fault current is any abnormal electric current. For example, a short circuit is a fault in which current bypasses the normal load. An open-circuit fault occurs if a circuit is interrupted by some failure. In three-phase systems, a fault may involve one or more phases and ground, or may occur only between phases. In a "ground fault" or "earth fault", current flows into the earth. The prospective short-circuit current of a predictable fault can be calculated for most situations. In power systems, protective devices can detect fault conditions and operate circuit breakers and other devices to limit the loss of service due to a failure.

In a polyphase system, a fault may affect all phases equally which is a "symmetrical fault". If only some phases are affected, the resulting "asymmetrical fault" becomes more complicated to analyze. The analysis of these types of faults is often simplified by using methods such as symmetrical components.

There are many courses of faults in power transmission leading to power outages, if not properly managed. Notable among them includes: – Faults at the power generation

station – Damage to power transmission lines (tree falling on lines) – Faults at the substations or parts of distribution subsystem – Lightening Types of transmission line faults: Power system's faults may be categorized as shunt faults or series faults

ARM7 MICRO CONTROLLER: ARM7 is a group of older 32- bit RISC ARM processor cores licensed by ARM Holdings for micro controller use. The ARM7 core family consists of ARM700, ARM710, ARM7DI, ARM710a, ARM720T, ARM740T, ARM710T, ARM7TDMI, ARM7TDMI-S, and ARM7EJ-S.

The ARM7TDMI and ARM7TDMI-S were the most popular cores of the family.

Introduction to arm based LPC 2148 Microcontroller: LPC 2148 microcontroller belongs to ARM7 (Advanced RISC Machine) family, means the ARM is basically an architecture that is used in microcontroller and processors. The word RISC stands for reduced instruction set computer, as its name shows that it is just like a small or mini controller which works on the basis of less instruction as compared to other conventional microcontrollers. This LPC 2148 microcontroller used the 16-bit/32-bit set instruction architecture for real time emulation. It also contains the embedded trace support for combing the microcontroller to high speed flash memory whose ranging between 32KB to 512kB. Its unique accelerator architecture structure and 128kB wide memory enables the code execution at high clock rate.

General features of LPC2148 microcontroller

This ARM microcontroller is best for critical code size applications because it can easily reduce the code size to 30% without reducing the performance. They are easily available in tiny size and consume less power as compared to other microcontrollers. So, due to tiny size and consume less power, these microcontrollers are ideal for that applications where miniaturization is major requirements such as at point of sale and access control etc. It consists of serial communication interface whose ranging from a USB 2,full speed device, multiple UARTs, SPI,SSP to 12C bus and 8kB to, up to 40 kb no chip SRAM, all these features are so much appropriate for communication gateway and protocol converters. Beside this, it also consists of various 32 bit timers,10 bit DAC (Digital to analog converter),10 bit ADC (analog to digital

converter) ,PWM (pulse width modulation) channel,45 fast GPIO lines and level sensitive external interrupts pins make this microcontroller very special for medical system and industrial controls. The general architecture block diagram of this LPC 2148 microcontroller with all their essential parts is shown in figure.

General Architecture Block Diagram of LPC 2148 Microcontroller

Here is the general architecture block diagram of LPC 2148 microcontroller with all their essential parts,

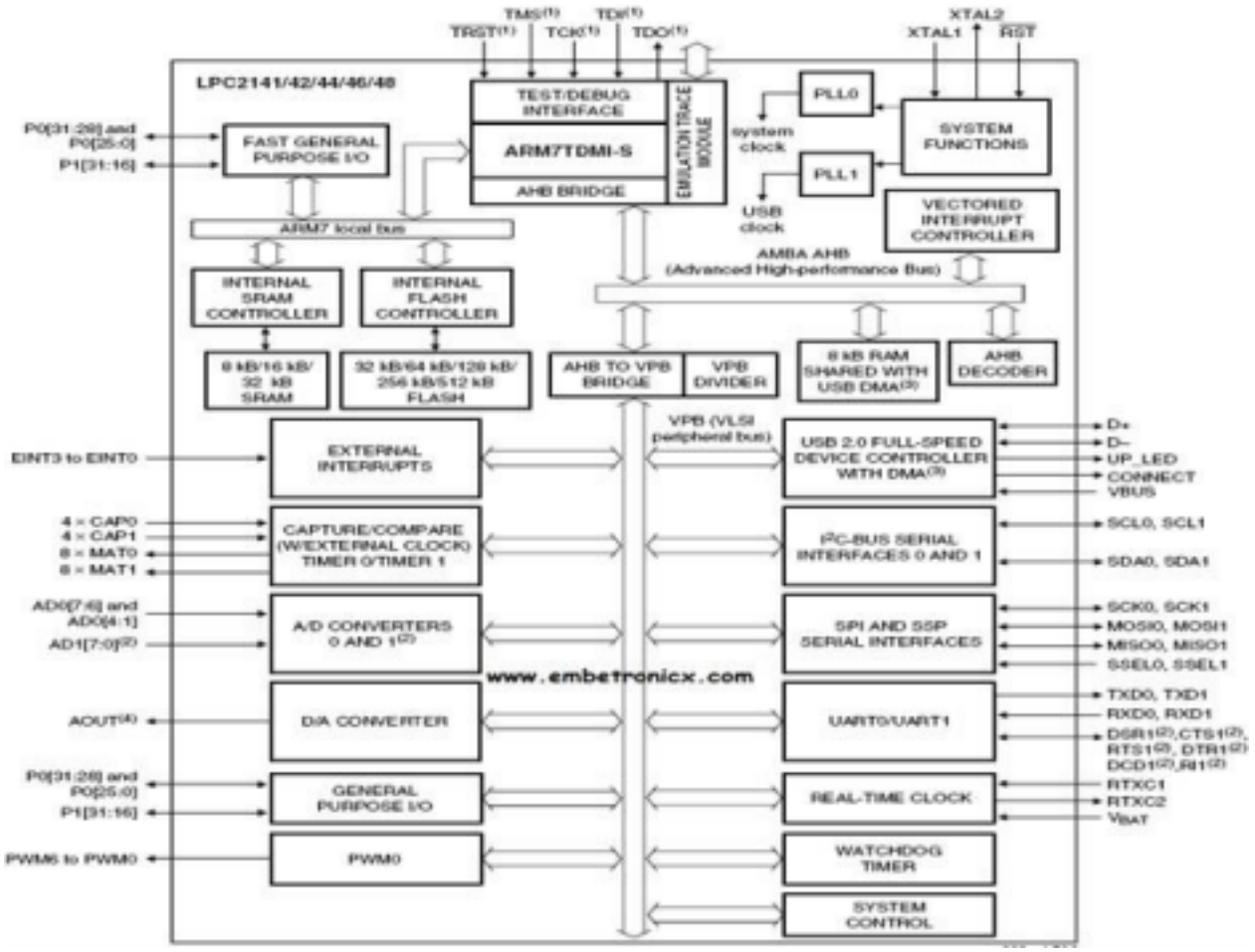

FIG.9

Figure 1 General Architecture Block Diagram of LPC 2148 Microcontroller with all their essential parts.

Proposed model with theoretical background Chapter 3

5. GPS: GPS stands for Global Positioning System by which anyone can always obtain the position information anywhere in the world.

Firstly, the signal of time is sent from a GPS satellite at a given point. Subsequently, the time difference between GPS time and the point of time clock which GPS receiver receives the time signal will be calculated to generate the distance from the receiver to the satellite. The same process will be done with three other available satellites. It is possible

to calculate the position of the GPS receiver from distance from the GPS receiver to three satellites. However, the position generated by means of this method is not accurate, for there is an error in calculated distance between satellites and a GPS receiver, which arises from a time error on the clock incorporated into a GPS receiver. For a satellite, an atomic clock is incorporated to generate on-the-spot time information, but the time generated by clocks incorporated into GPS receivers is not as precise as the time generated by atomic clocks on satellites. Here, the fourth satellite comes to play its role: the distance from the fourth satellite to the receiver can be used to compute the position in relations to the position data generated by distance between three satellites and the receiver, hence reducing the margin of error in position accuracy.

Three-block configuration

GPS consists of the following three segments.

Space segment (GPS satellites)

A number of GPS satellites are deployed on six orbits around the earth at the altitude of approximately 20,000 km (four GPS satellites per one orbit), and move around the earth at 12-hour-intervals.

Control segment (Ground control stations)

Ground control stations play roles of monitoring, controlling and maintaining satellite orbit to make sure that the deviation of the satellites from the orbit as well as GPS timing are within the tolerance level.

User segment (GPS receivers)

User segment (GPS receivers)

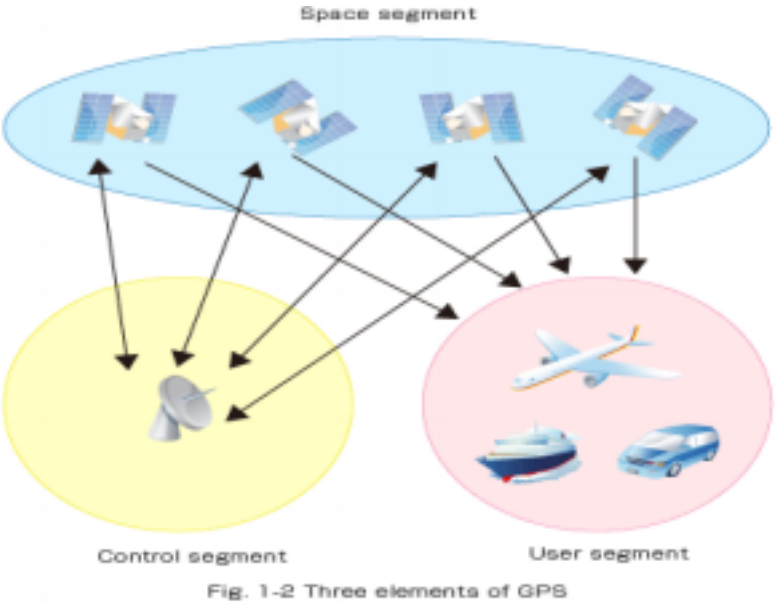

FIG.10 Element of GPS

6. WIFI-MODULE: The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Adriano device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the *Documents* section below you will find many resources to aid you in using the ESP8266, even instructions on how to transforming this module into an IoT (Internet of Things)

FIG.11 WI-FI module

7. GSM :GSM (Global System for Mobile communication) is a digital mobile network that is widely used by mobile phone users in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies: TDMA, GSM and code-division multiple access (CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 megahertz (MHz) or 1,800 MHz frequency band.

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). The mobile device connects to the network via hardware. The subscriber identity module (SIM) card provides the network with identifying information about the mobile user.

The BSS handles traffic between the cell phone and the NSS. It consists of two main components: the base transceiver station (BTS) and the base station controller (BSC). The BTS contains the equipment that communicates with the mobile phones, largely the radio transmitter receivers and antennas, while the BSC, and is the intelligence behind it. The BSC communicates with and controls a group of base transceiver stations

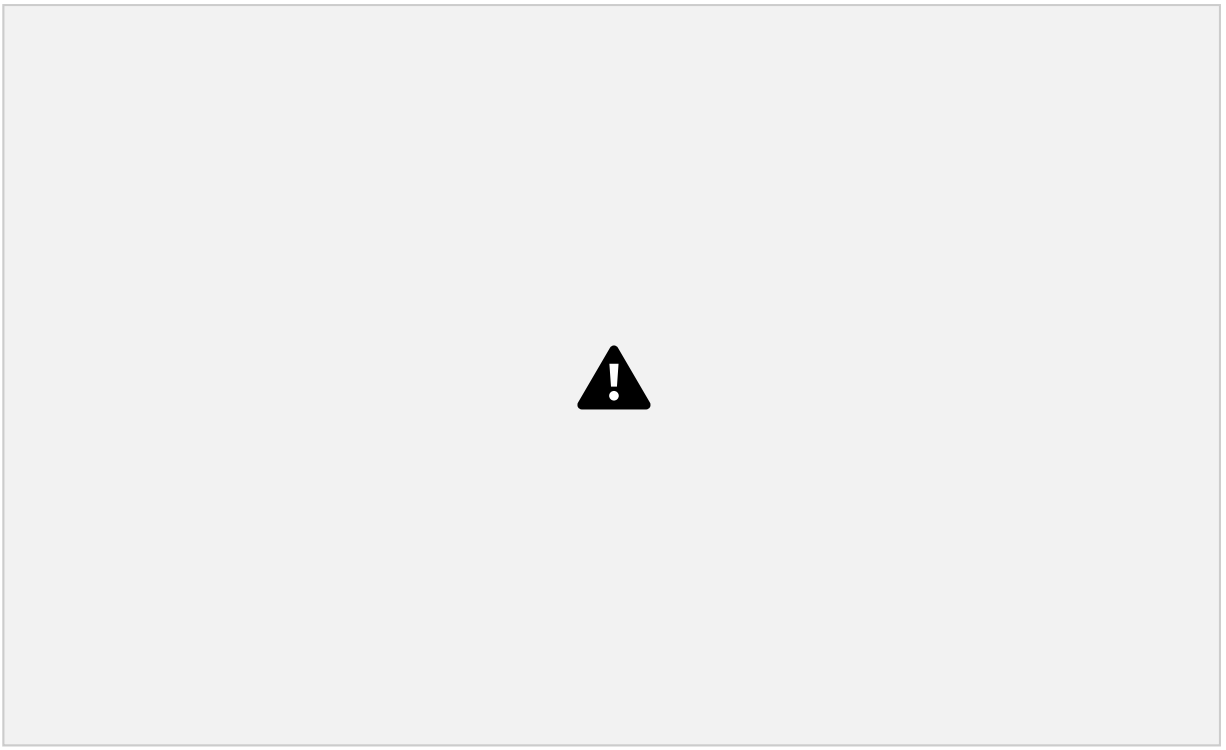

FIG.12 GSM

The NSS portion of the GSM network architecture, often called the core network, tracks the location of callers to enable the delivery of cellular services. Mobile carriers own the NSS. The NSS has a variety of parts, including mobile switching center (MSC) and home location register (HLN). These components perform different functions, such as routing calls and Short Message Service (SMS) and authenticating and storing caller account information via SIM cards.

Since many GSM network operators have roaming agreements with foreign operators, users can often continue to use their phones when they travel to other countries. while experiencing no reductions in service.

A modem (modulator-demodulator) is a device that modulates an analog carrier signal to encode digital information and demodulates such a carrier signal to decode the transmitted information. The goal is to produce a signal that can be transmitted easily and decoded to reproduce the original digital data. The GSM Modem comes with a serial interface through which the modem can be controlled using attention (AT) command interface. An antenna and a power adapter are provided. The basic segregation or working of the modem is as follows: 1. Voice calls 2. Short Message Service (SMS) 3 .GSM Data calls 4.General Packet Radio Services (GPRS).

Proposed model with theoretical background Chapter 3

GSM Programme:

```
void setup()
```

```
{
Serial.begin(9600); //Initialise serial to communicate with GSM Modem }
void loop()
{
delay(10000); //Give enough time for GSM to register on Network
SendSMS(); //Send one SMS
while(1); //Wait forever
}
void SendSMS()
{
Serial.println("AT+CMGF=1"); //To send SMS in Text Mode
delay(1000);
Serial.println("AT+CMGS=\"+9198xxxxxxxx\"\r"); //Change to destination phone
number
delay(1000);
Serial.println("Hello from GSM Modem!"); //the content of the message
delay(200);
Serial.println((char)26); //the stopping character Ctrl+Z
delay(1000);
}
```

8. RELAY: Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized.

When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized. In either case, applying electrical current to the contacts will change their state. Relays are generally used to switch smaller currents in a control circuit and do not usually control power consuming devices except for small motors and Solenoids that

draw low amps. Nonetheless, relays can "control" larger voltages and amperes by having an amplifying effect because a small voltage applied to a relays coil can result in a large voltage being switched contacts. Protective relays can prevent equipment damage by detecting electrical abnormalities, including overcurrent, undercurrent, overloads and reverse currents. In addition, relays are also widely used to switch starting coils, heating

elements, pilot lights and alarms.

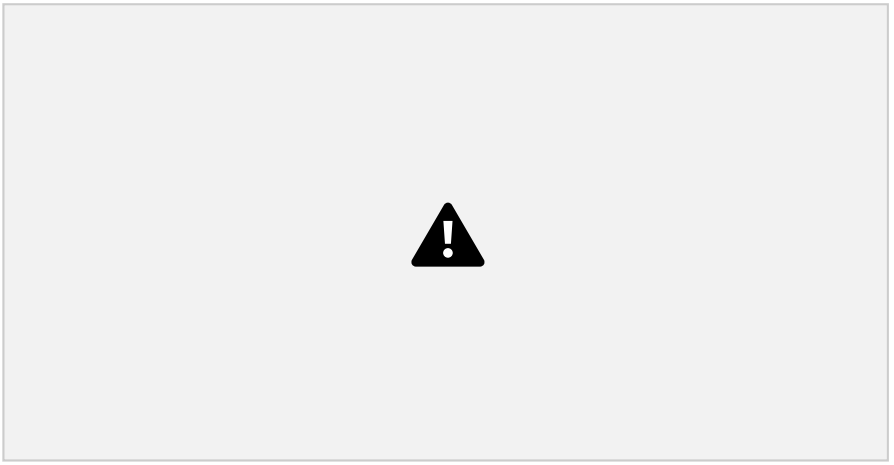

FIG.13 Relay

The fault occurring at what distance and which phase is displayed on a 16X2 LCD interfaced with the microcontroller. If the temperature higher than the threshold value at that time buzzer and LCD will give intimation. Calculated values are sends to the internet with help of IOT.

9. CLOUD COMPUTING:Cloud computing is the on-demand availability of computer system resources, especially data storage (cloud storage) and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the Internet. Large clouds, predominant today, often have functions distributed over multiple locations from central servers. If the connection to the user is relatively close, it may be designated an edge server.

The availability of high-capacity networks, low-cost computers and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture and autonomic and utility computing has led to growth in cloud computing. By 2019, Linux was the most widely used operating system, including in Microsoft's offerings and is thus described as dominant.The Cloud Service Provider

(CSP) will screen, keep up and gather data about the firewalls, intrusion identification or/and counteractive action frameworks and information stream inside the network. Cloud computing poses privacy concerns because the service provider can access the data that is in the cloud at any time. It could accidentally or deliberately alter or delete information.

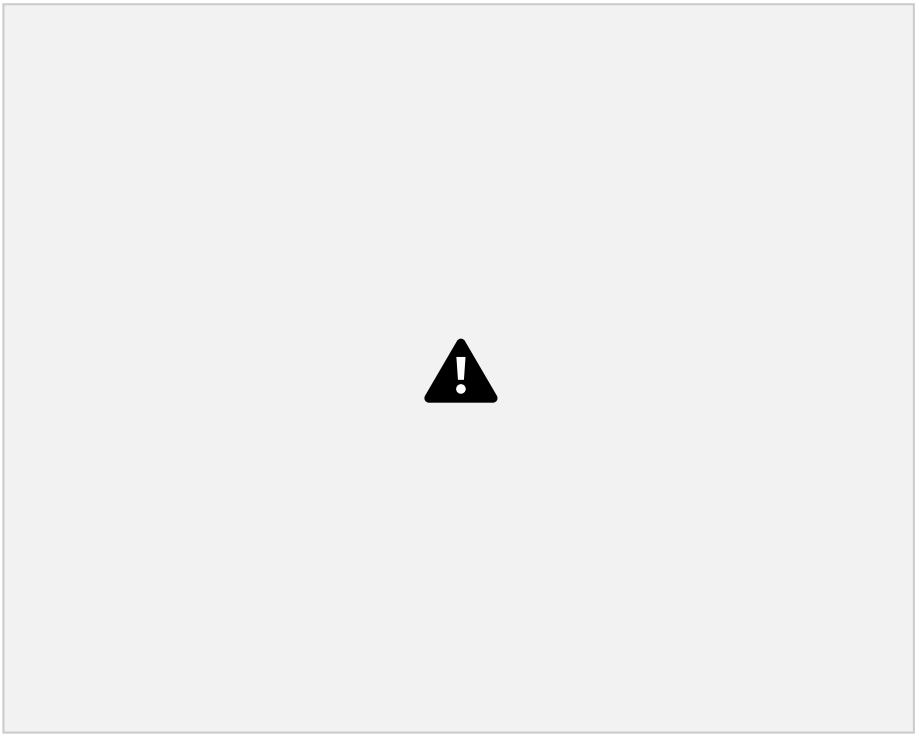

FIG.14 Cloud computing

The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific Application configuration settings.

Design process Chapter 4

4 DESIGN PROCESS:

4.1: METHODOLOGY

This project consists of ARM7 MCU, Relays, transformers, WIFI, LCD, as soon as Connects power supply to the system micro controller, GPS, WIFI, and Display will get initialize.

- ➢ Single phase fault analysis system is built using three single phase transformers input voltage 230 volt and output is 12 volts.
- ➢ Input side we are creating fault for temporary and permanent fault using manual switch.
- ➢ Temporary and permanent fault status can be sent to control station via SMS using Internet of Things (IoT).
- ➢ In case line is short circuit for less than a second then auto reset will occur for load and if line short circuit occurs more than a second load will be permanently OFF.
- ➢ GPS is used to know live location of the fault place so that linemen can go and re-establish the service in faster way.

4.2: OPERATION

The proposed system is intended to automatically detect faults when they occur, analyze the fault to determine the type and then send information based on the fault type and fault location to the control room via GSM. The device location is determined by the SIM card in the modem, each SIM card having a unique identification and hence is used as the device's address. The system senses, analyses and transmits. It does this with the microcontroller which analyses, interprets and sends digital signals to the I/O devices for the system to operate. By programming, the microcontroller is made to perform these functions.

4.2.1: COMMANDS USED

1) AT – This command is used to check communication between the module and the computer. For example,

AT

OK

The command returns a result code OK if the computer (serial port) and module are connected properly.If any of module or SIM is not working, it would return a result code ERROR.

2) +CMGF – This command is used to set the SMS mode. Either text or PDU mode can be selected by
assigning 1 or 0 in the command.
SYNTAX: AT+CMGF=<mode>
0: for PDU mode
1: for text mode

3) +CMGW – This command is used to store message in the SIM. SYNTAX:
AT+CMGW=" Phone number"> Message to be stored Ctrl+z
As one types AT+CMGW and phone number, '>' sign appears on next line where one can type the
message.

4) +CMGS – This command is used to send a SMS message to a phone number.
SYNTAX: AT+CMGS= serial number of message to be send.

5) ATD – This command is used to dial or call a number.
SYNTAX: ATD<Phone number>;(Enter)
For example,
ATD123456789;

6) ATA – This command is used to answer a call. SYNTAX: ATA(Enter)

Design process Chapter 4

4.3: LCD PROGRAMME

```
#include "lpc21xx.h“
 void delay(void);
/ /#define PULSE1()
((IOSET0 = BUZ),
delay(),
(IOCLR0 = BUZ),
delay());
#define RELAY(1<<10)
 int main(void)
  {
```

```
 IODIR0 |= RELAY;
 while(1)
 {
IOSET0 = RELAY;
delay();
 IOCLR0 = RELAY;
 delay();
 }
 }
void delay()
{
int i,j;
for(i=0;i<100000;i++)
{ for(j=0;j<50;j++)
{ continue;
 }}}
```

4.4: TIMING PROGRAMME

```
#include "LPC214x.H" /* LPC21xx definitions */ //#include
"type.h"
//
```



```
#define TEST_LED (1 << 10)
 Void delay(void)
{
 /* My PCLK of Timer0 is 18Mhz */
 T0PR = 8888; // Prescale Register = 9999
 T0MR0 = 900; // Match Register = 900
 T0MCR = 0x00000004; // Stop on MR0: the TC and PC will be stopped // and  TCR[0]
will be set to 0 if MR0 matches the TC.
 T0TCR = 0x02; // Counter Reset
 T0TCR = 0x01; // Counter Enable
 while(T0TC != T0MR0);
}
int main(void)
```

```
{
 IODIR0 |= TEST_LED; // 1 for Output
while(1)
 {
 IOSET0 = TEST_LED;
 delay();
 IOCLR0 = TEST_LED;
 delay();
 }
 }
```

4.5: LED PROGRAMME

```
#include "lpc21xx.h"
void delay(void);

//#define PULSE1()
((IOSET0 = BUZ),
```



```
delay(),
(IOCLR0 = BUZ),
delay());
#define RELAY(1<<10)

int main(void)
{
IODIR0 |= RELAY;
while(1)
{
IOSET0 = RELAY;
delay();
IOCLR0 = RELAY;
delay();
}
```

```
}
void delay()
{
int i,j;
for(i=0;i<100000;i++)
{
for(j=0;j<50;j++)
{
continue;
}}}
```


Design process Chapter 4

4.6 SWITCH PROGRAMME

```
#include <LPC214x.H>
/* LPC214x definitions */
typedef unsigned char uc;

////////////////////////////////input pin from left obstacle
#define SWITCH_1 (1 << 15)
#define SWITCH_PIN1 IO0PIN
#define SWITCH_DIR1 IO0DIR

#define SWITCH_2 (1 << 16)
#define SWITCH_PIN2 IO0PIN
#define SWITCH_DIR2 IO0DIR

#define BUZZER (1 <<10)
#define BUZZER_DIR IO0DIR
#define BUZZER_SET IO0SET
```

```
#define BUZZER_CLR IO0CLR

typedef unsigned char uc;
uc read_switch1(void);

void delay(int count);
int main (void)
{
BUZZER_DIR |= BUZZER;
while (1)
{
if(!(SWITCH_PIN2 & SWITCH_2)) {
BUZZER_SET = BUZZER;
}
else
{
```



```
BUZZER_CLR = BUZZER;
}
}
}
uc read_switch1(void)
{
return (SWITCH_PIN1 & SWITCH_1) ? 1:0;
}
```

4.6: HARDWARE USED:

1. Internet of things (IOT)

The Internet of Things is simply defines "A network of Internet connected object able to collect and transfer data.

The Internet of Things, or IoT, refers to the billions of physical devices around the world that are now connected to the internet, all collecting and sharing data. Thanks to the arrival of

super-cheap computer chips and the ubiquity of wireless networks, it's possible to turn anything, from something as small as a pill to something as big as an aero plane, into a part of the IoT. Connecting up all these different objects and adding sensors to them adds a level of digital intelligence to devices that would be otherwise dumb, enabling them to communicate real-time data without involving a human being. The Internet of Things is making the fabric of the world around us smarter and more responsive, merging the digital and physical universes.

the ability to sending data over a network without requiring human-to-human or human-to-computer interaction. The Internet Of Things is simply defines "A network of Internet connected object able to collect and transfer data ". IOT is the concept of connecting any device with an ON and OFF switch to the internet and then give a appropriate output.

Design process Chapter 4

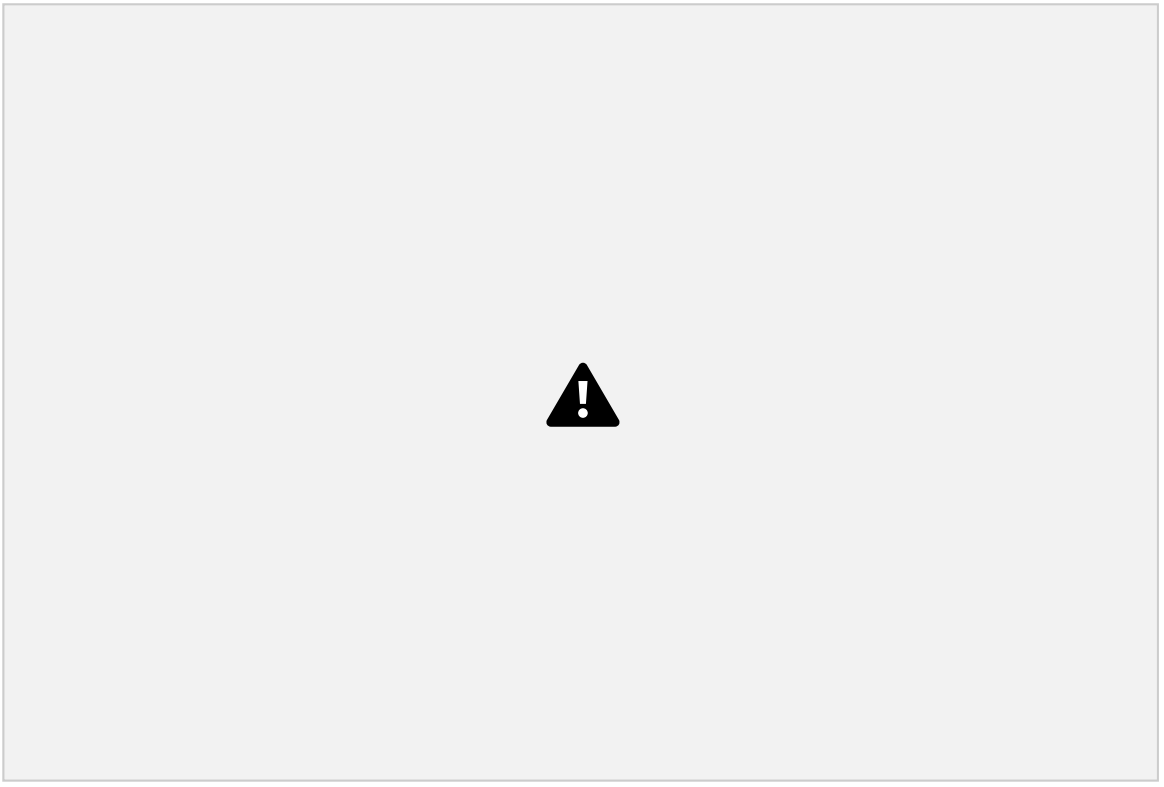

Fig15: IOT

2. The GSM Modem:

A modem (modulator-demodulator) is a device that modulates an analog carrier signal to encode digital information and demodulates such a carrier signal to decode the transmitted information.

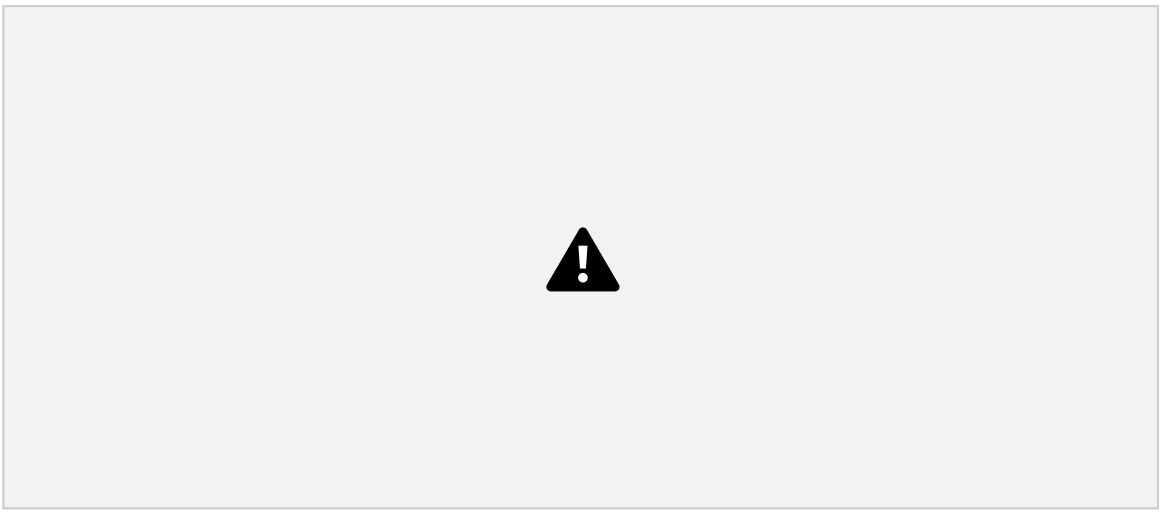

Fig: 16 Gsm modem

Design process Chapter 4

GSM (Global System for Mobile communication) is a digital mobile network that is widely used by mobile phone users in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies: TDMA, GSM and code-division multiple access (CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 megahertz (MHz) or 1,800 MHz frequency band.

3. GPS:

Is a satellite-based Navigation system in which two more signals, received from satellites, are used to determine the receiver's position on the globe? The Global Positioning System (GPS) is a navigation system using satellites, a receiver and algorithms to synchronize location, velocity and time data for air, sea and land travel.

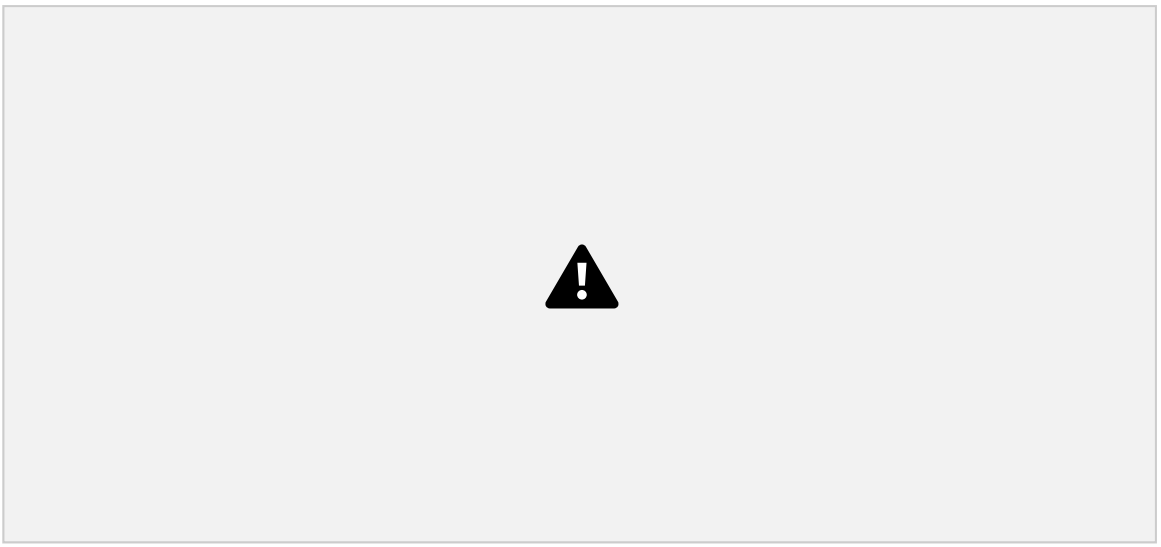

Fig:17 Gps

Design process Chapter 4

4.7: SOFTWARE USED:

1. KEIL IDE

Keil MDK is the complete software development environment for a wide range of Arm Cortex-M based microcontroller devices. MDK includes the µVision IDE and debugger, Arm C/C++ compiler, and essential middleware components. ULINK debug adapters allow you to program, debug, and analyse your embedded applications.

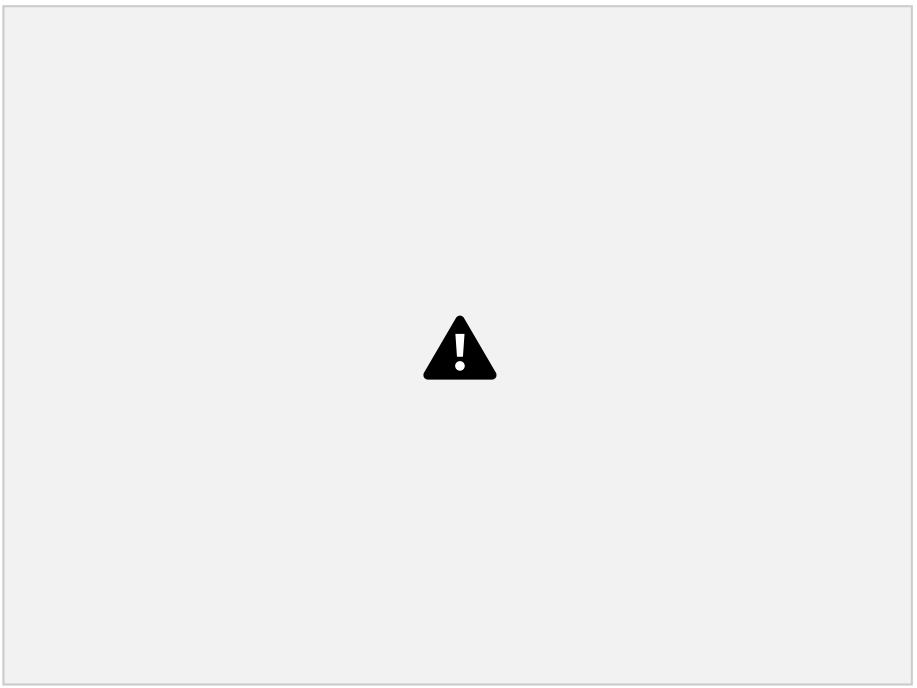

Fig:18 keil ide

2. Embedded C

C language is a software designed with different keywords, data types, variables, constants, etc. Embedded C is a generic term given to a programming language written in C, which is associated with particular hardware architecture. Embedded C is an extension to the C language with some additional header files.

Design process Chapter 4

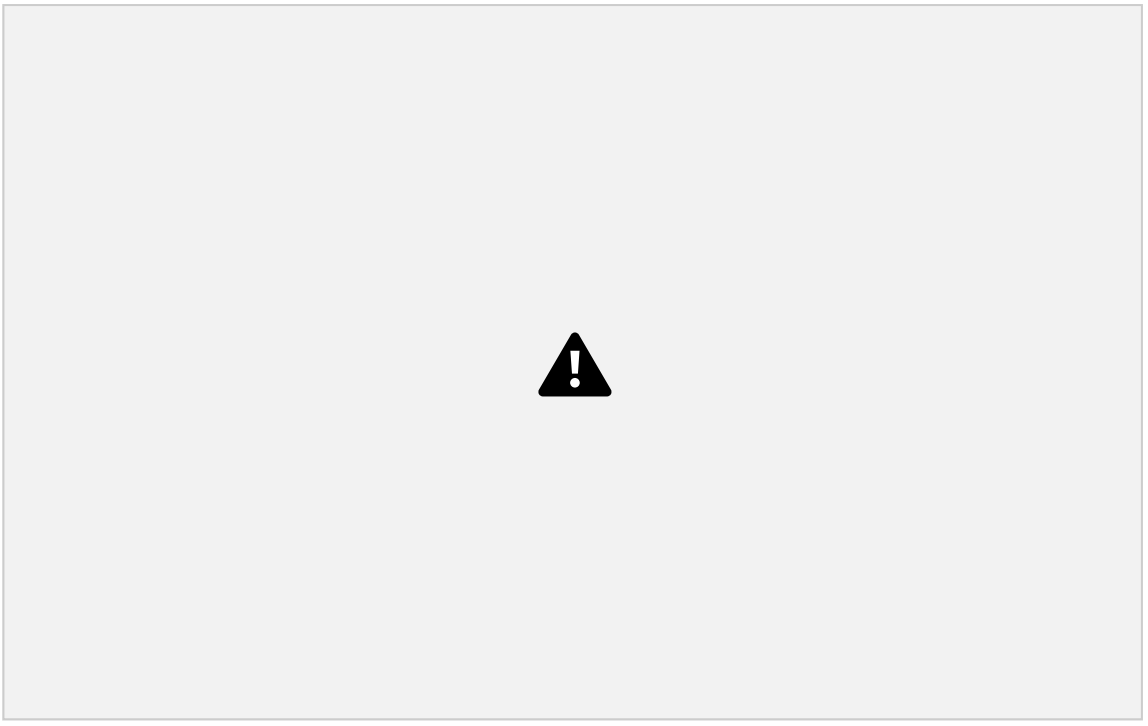

Fig:19 Embedded C

5. Results and Discussions:

The three terminal is connected to the switch when one switch is one and remaining two switches are closed then the output shown is display is terminal Y and B has been faulted (Supposed terminal is R,Y,B and terminal R is connected to supply i.e. switch is ON and other switch which is connected between terminal Y and B is OFF hence its shows the fault.)

The analysis of fault detection and location system of transmission line. Whether it is any type of fault that can be detected and located. When fault get occurs on the transmission line the signal is send to the control room or mobile phone through a GSM modem. The message receive on the mobile that is the fault between pole 1 and 2 and the fault which is symmetrical or unsymmetrical like L-G, L-L, L-L-G, L-L-L, L-L-L-G. The signal that appears on the control room or mobile phone is the L*G or

Any other type of fault occurred on transmission line.

6. Advantages and Applications:

6.1 ADVANTAGES

➢ 1.Easy for lineman to identify the fault location .

➢ 2.It will be helpful in faster restore the services in village as well in city. ➢ 3.Maintain reports of fault with location using internt of things. ➢ 4.Less number of components and manual observations.

➢ 5.It is economically reliable low cost.

➢ 6.Devices enable by wireless communication.

6.2 APPLICATIONS

➢ Can be used and installed near all the transformers to mointer the transmission lines.

➢ Helpful to mointer single phase and three phase transmission line .

➢ Advantage sensing and communication technologies IOT.

➢ Used in transmission line.

➢ Used in distribution line.

7. Conclusions and Future Directions:

7.1 Conclusions

- ➢ The model is design in such a way to solve the problems faced by consumer in transmission line By using this method, we can easily detect the fault and resolve it.
- ➢ It will also allow operators such as GRIDco to correctly detect and locate faulted segments on their transmission lines and, therefore, minimise power desruptions to distribution substations and help save expensive tranformers.
- ➢ The method proposed now provides us a cheap and highly reliable way to locate the faults in the three phase transmission lines and also supports data storage. Hence this method can be implemented to detect the faults and retrieve the corresponding data anytime.

7.2 Future Directions

This work is limited to the design of an efficient system that will detect and locate line to line and line to ground faults in overhead and underground transmission lines which will automatically indicate to the control room the exact spot of the Transmission line where a fault had occurred.

References Chapter 8

8 REFERENCES:

- ➢ M. M. Saha, J. Iżykowski, and E. Rosolowski, Fault Location on Power Networks. New York: Springer, 2010.

- M. T. Sant and Y. G. Paithankar, “Online digital fault locator for overhead transmission line,” Proc. Inst. Elect. Eng., vol. 126, no. 11, pp. 1181–1185, 1979.
- T. Takagi, Y. Yamakoshi, M. Yamaura, R. Kondow, and T. Matsushima,“Development of a new type fault locator using the one-terminal voltage and current data,” IEEE Trans. Power App. Syst.,vol. PAS-101, no. 8, pp. 2892–2898, 1982.
- Wiszniewski, “Accurate fault impedance locating algorithm,” Inst.Elect. Eng., Gen. Transm. Distrib., vol. 130, no. 6, pp. 311–314,
- L. Eriksson, M. Saha, and G. D. Rockefeller, “An accurate fault locator with compensation for apparent reactance in the fault resistance resulting from remore-end infeed,” IEEE Trans. Power App. Syst., vol.PAS-104, no. 2, pp. 423–436, 1985.
- M. S. Sachdev and R. Agarwal, “A technique for estimating transmission line fault locations from digital impedance relay measurements,”IEEE Trans. Power Del., vol. 3, no. 1, pp. 121–129, 1988
- Johns and S. Jamali, “Accurate fault location technique for power transmission lines,” Inst. Elect. Eng., Gen. Transm. Distrib., vol. 137, no. 6, pp. 395– 402, 1990.
- Transmission Line Fault Detection Using Android Application Via Bluetooth By MD AsaduzzamanNur, Jahidul Islam, Md. Golam Mostofa & Moshiul Alam Chowdhury.