A Project report on

“UNDERGROUND CABLE FAULT DISTANCE CONVEYED OVER INTERNET”

Submitted by

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Under the guidance of

PROF. ANISH SALVI

in the partial fulfillment of the requirements of the degree of

B. Tech (Electrical Engineering)

of

Dr. Babasaheb Ambedkar Technological University, Lonere

ELECTRICAL ENGINEERING DEPARTMENT

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for the academic year 2017-18

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CERTIFICATE

This is to certify that the project entitled "**Underground Cable Fault Distance Conveyed Over Internet**" submitted by

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We are pleased to present this project report entitles "**UNDERGROUND CABLE FAULT DISTANCE CONVEYED OVER INTERNET".** We would like to express our sincere gratitude and like to mention that this work would not have been possible without time to time guidance provided by our facilitator **Prof. Anish Salvi .** We have been greatly benefited by his valuable suggestions, constant encouragement, moral boasting support & patience throughout his work. He has given his full effort in guiding the team in achieving the goal as well as his encouragement to maintain our progress in track. From the very onset he has taken a keen interest in the development of our project and we are very grateful for his time, efforts and timely suggestions.

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ABSTRACT

This report proposes fault location model for underground power cable using microcontroller. The aim of this project is to determine the distance of underground cable fault from base station in kilometers. This project uses the simple concept of ohm's law. When any fault like short circuit occurs, voltage drop will vary depending on the length of fault in cable, since the current varies. A set of resistors are therefore used to represent the cable and a dc voltage is fed at one end and the fault is detected by detecting the change in voltage using an analog to voltage converter and a microcontroller is used to make the necessary calculations so that the fault distance is displayed on the LCD display. The modern method of effective cable-fault location is to establish an approximate fault locality and then to accurately confirm the fault position. The main causes of failure are analysed and, since the majority of cable faults occur on the electricity-supply distribution systems, the scope is limited to the location of faults on h.v. and m.v. cables and associated pilot cables.

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LIST OF ABBREVIATION

IOT	Internet Of Things
ADC	Analog To Digital Converter
LCD	Liquid Crystal Display
DPST	Double Pole Single Throw
LED	Lighting Emitting Diode
ROM	Read Only Memory
IFTTT	If Then This That
WiFi	Wireless Fidelity
SRAM	Static Random Access Memory
EPROM	Erasable Programmable Read Only Memory
ESCP	Expressif system Smart Connectivity Platform
SOC	System On Chip

TIME BAR CHART

Phase I:

Sr No	Work	July	August	September	October	November	December
1	Topic Selection						
2	Litreture Review						
3	Detailed work						
4	Design						
5	Simulation						
6	Analysis & Report						
7	Submission						

Phase II:

Sr. No.	WORK	JANUARY	FEBRUARY	MARCH	APRIL
1.	Literature study of UGC fault detection technique				
2.	Simulation of Arduino UNO R3 and ESP 8266				
3.	PCB mounting				
4.	Testing of hardware				
5.	Report writing and submission				

CHAPTER 1

INTRODUCTION

1.1 PROJECT REVIEW

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 analyse. The analysis of these types of faults is often simplified by using methods such as symmetrical components. The design of systems to detect and interrupt power system faults is the main objective of power-system protection.

1.2 Objective

1.To detect fault location in underground cable system .

2.To restore the faulty condition to normal working condition within shorter time duration.

3.Using Internet Of Things (IOT) this method becomes more advanced.

1.3 Need for a modern technique:

Cable-fault-location techniques have been developed over a long period, and today quite sophisticated methods and aids are available for locating faults in underground cables, ranging from bridge methods to the pulse-reflection technique. All have been tried and proved successful in minimising both the cost of repairs and traffic congestion, and have enabled supplies to be restored with the minimum of delay. Since faults and cable systems differ widely in their characteristics, only careful application of the various procedures, using the many types of equipment available, can ensure satisfactory results in accurately locating cable breakdowns. The

choice of location method will usually depend on the particular field engineer's experience, until such a time as a single method for dealing with all fault conditions has been proved reliable by actual field work.

Formerly, cable faults were detected by 'classical' methods with the aid of measuring bridges, burn-out transformers and 'purpose built' auxiliary equipment. Location often took several hours, possibly running into days, and was not always successful. Furthermore, these methods required knowledge of accurate cable records, not merely the length, route and size of cables, which are important, but also details regarding the type of cable for capacitance bridge tests, because of older cables and the introduction of screened cables into distribution systems having belted cable runs.

The modern method of effective cable-fault location is to establish an approximate fault locality and then to accurately confirm the fault position. The main causes of failure are analysed and, since the majority of cable faults occur on the electricity-supply distribution systems, the scope is limited to the location of faults on h.v. and m.v. cables and associated pilot cables. Present equipment limitations mean that a complete fault-location system is achieved only by combining different equipment and different methods. However, until a reliable universal fault locator has been developed, cable-fault location will remain an art rather than a science, particularly in the field of m.v./l.v. cable faults. Future developments are suggested for locating faults on m.v. networks which generally present a special problem.

In this Project, the objective is to determine the distance of underground cable fault from base station in kilometers. The underground cable system is a common practice followed in many urban areas. While a fault occurs for some reason, at that time the repairing process related to that particular cable is difficult due to not knowing the exact location of the cable fault. The proposed system is to find the exact location of the fault. The project uses the standard concept of Ohms law i.e., when a low DC voltage is applied at the feeder end through a series resistor (Cable lines), then current would vary depending upon the location of fault in the cable. In case there is a short circuit (Line to Ground), the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data which the programmed microcontroller of arduino family would display in kilometers. The project is assembled with a set of resistors representing cable length in KM’s and fault creation is made by a set of switches at every known KM to cross check

the accuracy of the same. The fault occurring at a particular distance and the respective phase is displayed on a LCD interfaced to the microcontroller.

Further this project can be enhanced by using capacitor in an ac circuit to measure the impedance which can even locate the open circuited cable, unlike the short circuited fault only using resistors in DC circuit as followed in the above proposed project.

CHAPTER 2

TYPES OF FAULT

2.1 Symmetric Fault

A symmetric or balanced fault affects each of the three phases equally. In transmission line faults, roughly 5% are symmetric. This is in contrast to an asymmetrical fault, where the three phases are not affected equally.[5]

2.2 Asymmetric Fault

An asymmetric or unbalanced fault does not affect each of the three phases equally. Common types of asymmetric faults, and their causes:

2.2.1 Line-to-Line: a short circuit between lines, caused by ionization of air, or when lines come into physical contact, for example due to a broken insulator. In transmission line faults, roughly 5% - 10% are asymmetric line-to-line faults.

2.2.2 Line-to-Ground: a short circuit between one line and ground, very often caused by physical contact, for example due to lightning or other storm damage. In transmission line faults, roughly 65% - 70% are asymmetric line-to-ground faults.

2.2.3 Double line-to-ground: two lines come into contact with the ground (and each other), also commonly due to storm damage. In transmission line faults, roughly 15% - 20% are asymmetric double line-to-ground.

2.3 Ground Fault

A ground fault (earth fault) is any failure that allows unintended connection of power circuit conductors with the earth. Such faults can cause objectionable circulating currents, or may energize the housings of equipment at a dangerous voltage. Some special power distribution systems may be designed to tolerate a single ground fault and continue in operation. Wiring codes may require an insulation monitoring device to give an alarm in such a case, so the cause of the ground fault can be identified and remedied. If a second ground fault develops in such a system, it can result in overcurrent or failure of components. Even in systems that are normally connected to ground to

limit overvoltages, some applications require a Ground Fault Interrupter or similar device to detect faults to ground.[5]

2.4 Arcing Fault

Where the system voltage is high enough, an electric arc may form between power system conductors and ground. Such an arc can have a relatively high impedance (compared to the normal operating levels of the system) and can be difficult to detect by simple overcurrent protection. For example, an arc of several hundred amperes on a circuit normally carrying a thousand amperes may not trip overcurrent circuit breakers but can do enormous damage to bus bars or cables before it becomes a complete short circuit. Utility, industrial, and commercial power systems have additional protection devices to detect relatively small but undesired currents escaping to ground. In residential wiring, electrical regulations may now require Arc-fault circuit interrupters on building wiring circuits, to detect small arcs before they cause damage or a fire.

2.5 Principal Fault Types:

By nature of electrical systems, at the basic level, electrical faults can be categorized as:

2.5.1 Open Circuit Faults:

This fault occurs when a failure happens in the conduction path of electricity.Besides this, there could be combination (Simultaneous) fault situations as well and equipment level winding faults. We will not look in to them in detail over here.

2.5.2 Short-Circuit Faults:

This is caused when there is a failure of insulation causing a short-circuit condition. This is by far the most common cause of failure.Since Short-Circuit Faults are the most common causes of faults in Electrical distribution systems, let us study them in detail:

A short circuit fault occurs when there is an insulation failure between phase conductors or between phase conductor(s) and earth or both. An insulation failure results into formation of a short-circuit path that triggers a short-circuit conditions in the circuit (i.e. abnormally high current situations followed by visible effects like arcing, flashing). Figure 2.1 below depicts a three phase-to-earth balanced fault condition.[4]

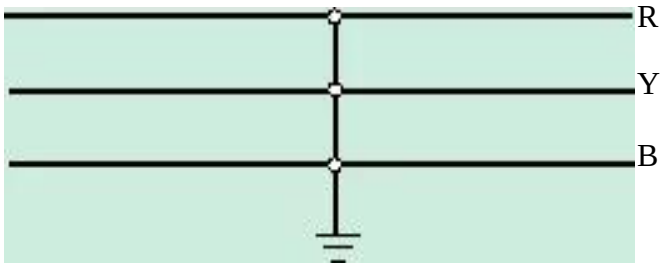

Fig 2.1: Three Phase-to-Earth Balanced Fault Condition

2.6 Causes for Cable Failures

Some of the major causes for cable failures are:

- Ageing
- Wrong selection or application
- Mechanical failures
- Corrosion of sheath
- Moisture in the insulation
- Heating of cable
- Fire and lightning surges
- Electrical puncture
- Mechanical failures

2.6.1 Mechanical Failures:

Mechanical failures can be due to breaks and defects of sheath material, mechanical punctures by people or machines, or cracks due to sharp bending or vibration.

Whenever mechanical damage occurs in the cable sheath, the entrance of moisture will produce slow deterioration of insulation material, resulting in eventual failure of the cable. It is important therefore to take every precaution that either direct or indirect mechanical damage be eliminated or minimized by correct selection, installation, and maintenance of cable systems.

2.6.2Corrosion of sheath:

Sheath corrosion can occur due to the following factors:

- Dissimilar soil effects
- Galvanic action
- Acidity and alkali in conduits
- Chemical contamination in the soil

Corrosion of sheath will eventually allow moisture to penetrate into the insulation system and cause an eventual failure. Sheath corrosion can be minimized by correct application of cathodic protection, application of insulating paints, providing adequate drainage, and removing the source of chemical contamination.

2.6.3 Moisture in the insulation:

Because of mechanical damage or for other reasons, entrance of moisture into the insulation system will deteriorate the cable, and all precautions to prevent such entrance should be taken. Damage due to moisture can be indicated by the following:

- Bleached or soggy aper
- Resistance to tearing of tapes
- Stain on the inside surface of the sheath
- Visible water
- Whitish powder on aluminum conductor
- Heating of cables

2.6.4 Heating of the Cable:

As discussed before increased heat rise in the cable results in insulation degradation. Heat can be due to overloading, high ambient temperatures, insufficient ventilation, manual heating due to cables being installed too close to each other, or external sources of heat. Care must be taken not to exceed the temperature rise of the cable insulation system. This can be done by first identifying the various environmental and operating factors that will determine the correct selection of the

cable insulation and conductor size. Once correct selection and installation are made, routine maintenance and inspection of cable will ensure safe and long operating life of the cable.

2.6.5 Electrical puncture:

Once the insulation is weakened owing to any of the reasons already analyzed, it may fail electrically. That is to say that the insulation system cannot confine the flow of electrical current to the conductor inside the insulation system. Failure may be line-to-ground or three line-to-ground or line-to-line faults. If failure is a short-circuit due to defective conductors, it will be detected by the circuit protective device. Some of the not-so-easy-to detect electrical failures can be indicated by the following:

- Bulging of the sheath
- Tree design marking
- Polymerized compound
- Lack of compound in the insulation

CHAPTER 3

CONSTRUCTION OF UNDERGROUND CABLES

An underground cable essentially consists of one or more conductors covered with suitable insulation and surrounded by a protecting cover. Although several types of cables are available, the type of cable to be used will depend upon the working voltage and service requirements. In general, a cable must fulfil the following necessary requirements: The conductor used in cables should be tinned stranded copper or aluminum of high conductivity. Stranding is done so that conductor may become flexible and carry more current. The conductor size should be such that the cable carries the desired load current without overheating and causes voltage drop within permissible limits. The cable must have proper thickness of insulation in order to give high degree of safety and reliability at the voltage for which it is designed. The cable must be provided with suitable mechanical protection so that it may withstand the rough use in laying it. The materials used in the manufacture of cables should be such that there is complete chemical and physical stability throughout.

Figure shows the general construction of a 3-conductor cable. The various parts are :

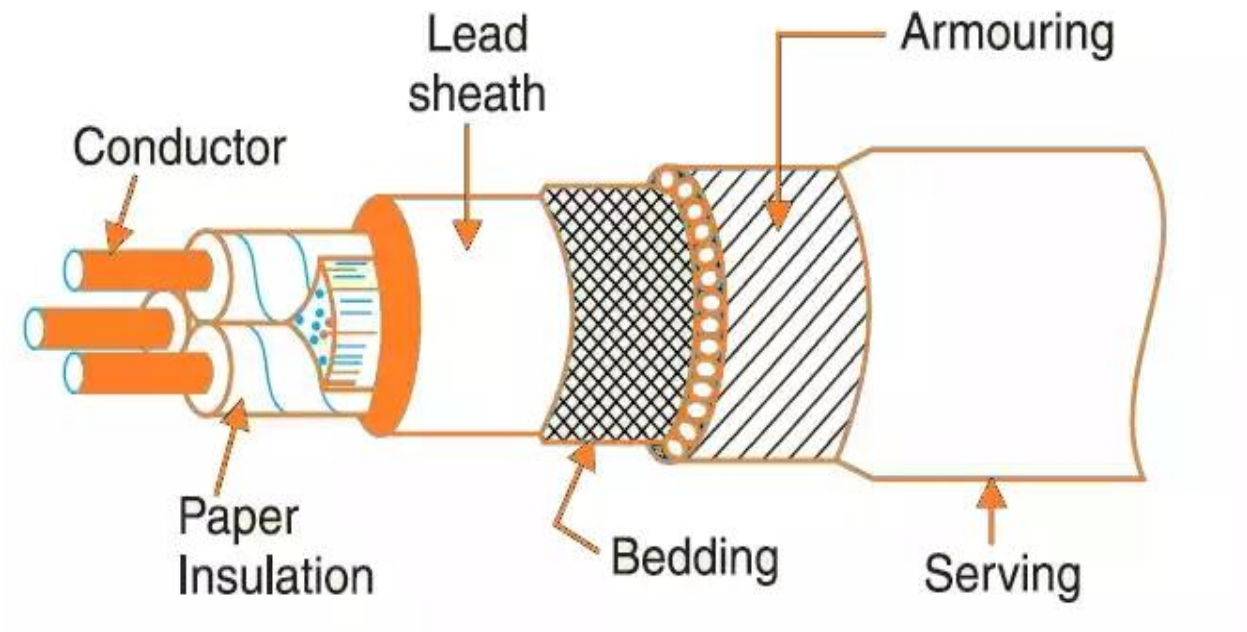

Fig 3.1: Underground Cable

Cores or Conductors:

A cable may have one or more than one core (conductor) depending upon the type of service for which it is intended. For instance, the 3-conductor cable shown in Figure is used for 3-phase service. The conductors are made of tinned copper or aluminum and are usually stranded in order to provide flexibility to the cable.

Insulation:

Each core or conductor is provided with a suitable thickness of insulation, the thickness of layer depending upon the voltage to be withstood by the cable. The commonly used materials for insulation are impregnated paper, varnished cambric or rubber mineral compound.

Metallic sheath:

In order to protect the cable from moisture, gases or other damaging liquids (acids or alkalies) in the soil and atmosphere, a metallic sheath of lead or aluminum is provided over the insulation as shown in Figure.

Bedding:

Over the metallic sheath is applied a layer of bedding which consists of a fibrous material like jute or hessian tape. The purpose of bedding is to protect the metallic sheath against corrosion and from mechanical injury due to armouring.

Armouring:

Over the bedding armouring is provided which consist of one or two layers of galvanised steel wire or steel tape. Its purpose is to protect the cable from mechanical injuries while laying it or handling it. Armouring may not be done in the case of some cables.

Serving:

In order to protect armouring from atmospheric conditions, a layer of fibrous material like jute similar to bedding is provided over the armouring. This is known as serving. Armouring and serving are only applied to the cables for the protection of conductor insulation and to protect metallic sheath from mechanical injury.

CHAPTER 4

LITERATURE REVIEW

4.1 Construction Of Prototype And Its Relation To Real Life Applications

The model is built as a prototype of a cable, which is having a fixed amount of resistance for all 3 of its phases. For the representation of the cable resistance; the pair of resistors are used. These resistors are arranged in series connection to each other and forming the 3 different lines. The resistance of a cable for a particular length is fixed and hence the resistances also are of fixed values. For the fault occurring condition such as short circuit in the cable ; 9 different DPST switches are used to create short circuit from lined to ground.

3 LED's are used to give the indication for faulty & emergency condition for particular phase using specific colour. Each resistor have specific value and and divided into 3 parts for each phase and hence consisting 9 resistor designated for 1km each. Faulty condition is shown by using the switch to short the specific part of the line. The part which is being short circuited have a specific length designated which is ultimately shown on the LCD display. In practical situation the short circuit can occur in between the phase and grounded armour and hence the total resistance of the of the cable can be calculated according to its length and then the resistance of the cable is divided for specific length accordingly. The arduino which is continuously recording the analogues value of resistance and voltage will note down the change in its initial value and proceed according to its further algorithm. [2]

4.2 Operating Principle

Ohm's Law Method

In this method simple OHM's law is used to locate the short circuit fault. A DC voltage is applied at the feeder end through a series resistor, depending upon the length of fault of the cable current varies. The voltage drop across the series resistor changes accordingly, this voltage drop is used in determination of fault location. This method is assembled with a set of resistors representing cable length in KMs and fault creation is made by a set of switches at every known KM to cross check the accuracy of the same. The voltage drop across the

feeder resistor is given to an ADC which develops a precise digital data which the programmed microcontroller would display the same in Kilo meters.

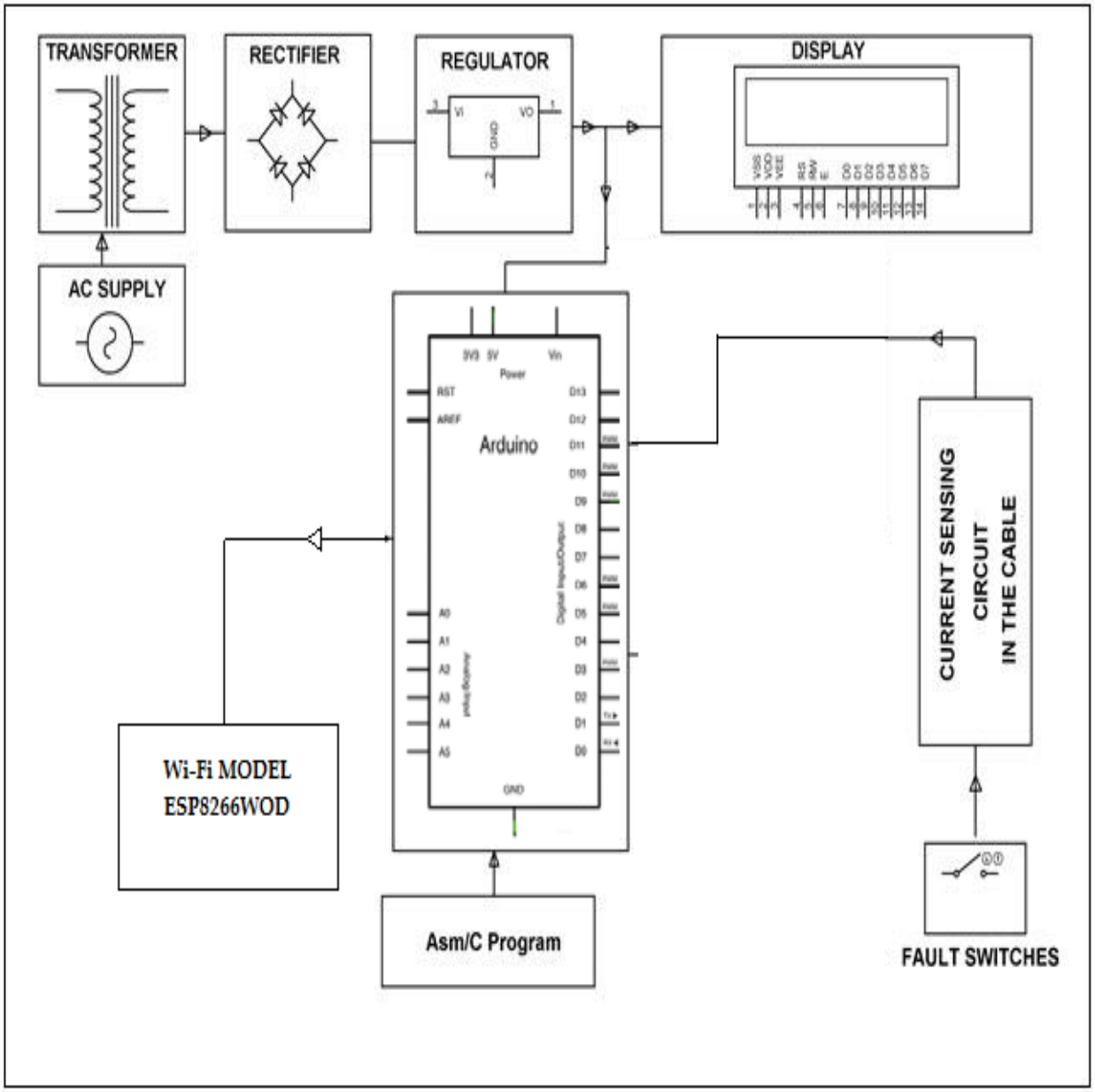

Fig.4.1 Block Diagram Of Circuit

The fault occurring at what distance and which phase is displayed on a 16X2 LCD interfaced with the microcontroller. In this method we use a microcontroller ATMega8 which is of 8-bit. The program is burned into ROM of microcontroller written in either Embedded C or assembly language. The power supply consists of a step down transformer

230/12V, which steps down the voltage to 12V AC. This is converted to DC using a Bridge rectifier. [2]

The ripples are removed using a capacitive filter and it is then regulated to +5V using a voltage regulator 7805 which is required for the operation of the microcontroller and other components The power supply circuit which is used to run the set up consists of step down transformer which is 230 V step-down to 12 V. In this circuitDB107 is used to form bridge rectifier which delivers pulsating dc voltage & then fed to capacitor filter the output voltage from rectifier is fed to filter to eliminate any a. c. components present even after rectification. The filtered DC voltage is given to regulator to produce 12 V constant DC voltages.

4.3 OPERATION OF CIRCUIT

4.3.1 Pre fault condition working

Initially, The 230V, 50Hz supply is given to the transformer or supply can also be given through the Wi-Fi module. When everything is working alright; the Arduino chip is continuously reading the analog values received from external circuit. The particular range of analog values are already set in the arduino program (for example:-If everything is working fine then arduino will read the high value like >=1000 & if the fault is occurred at some distance then this analog value will changes according the value of voltage it senses and become less according to the distance at which fault is occurring like for 1km -values will be 700-400,for fault at 2km-values will be 250-70 hence likewise for each Km and for each of the 3 phases.)

The LCD will display the (R-OK, B-OK and G-OK) for the 3 phase system as every condition is fine. The Wi-Fi module will be getting the internet access from the hotspot provided by the local provider such as mobile, Router etc. which is already configured and set in program itself.

There are three different colour LED’s representing 3 different phases. These 3 LED will glow simultaneously if the condition is normal or fine and turn OFF if the fault is occurred in the particular phase & according to the severity of the faulty condition.

4.3.2 Post fault Condition Working

Once after the fault has occurred at some distance then the analog value which is the representative of voltage senses by arduino will changes accordingly and become less according to the distance at which fault is occurring like for 1km -values will be 700-400,for fault at 2km-values will be 250-70 hence likewise for each Km and for each of the 3 phases. According to the program installed arduino will further progress in the algorithm and it will

1) Give the signal to the LCD display for the displaying of the distance at which the fault is occurred
2) Give the signal to turn OFF the particular LED representing specific phase on which fault is occurred (Multiple LED can be turned OFF simultaneously according to the faulty condition or the severity of fault).
3) Give the signal to the WiFi module to start the algorithm over internet.

The wifi module will trigger the algorithm over internet. It will pin the sequence which is present in the database in the website (undergroundfault.000webhostapp.com).This website contain total 9 php files which will be triggered according to the conditions specified in them. These php file will further send a notification to

1) IFTTT that is nothing but (If This Then That) loop. It contains some events. The events in the IFTTT will be initiated according to the fault occurred and then if all the conditions are satisfied, IFTTT will send the notification online on the mobile number which is registered during the event programming. Notification will contain the information, which is written during the event formation such as (for example:-Fault is in the R phase @ 2km. Kindly restore the fault).
2) www.way2sms.com to send the offline text message to the registered mobile number which contain the information about fault.(For example:- Fault is on the R phase @ 2km.Kindly restore the system.).

If the fault is at 2 or more than 2 phases all the LED's will be turn OFF and the LCD will display the situation of the 3 phases and one online as well as one offline message will come to the mobile number registered. [4]

CHAPTER 5

HARDWARE PARTS

5.1 Power Supply

The power supply circuit consists of centre tapped step down transformer which is 230v step down to 12v.In this circuit 2 diodes are used to form full wave rectifier which delivers pulsating dc voltage & then fed to capacitor filter the output voltage from rectifier is fed to filter to eliminate any A.C. components present even after rectification. The filtered DC voltage is given to regulator to produce 5v constant DC voltage.

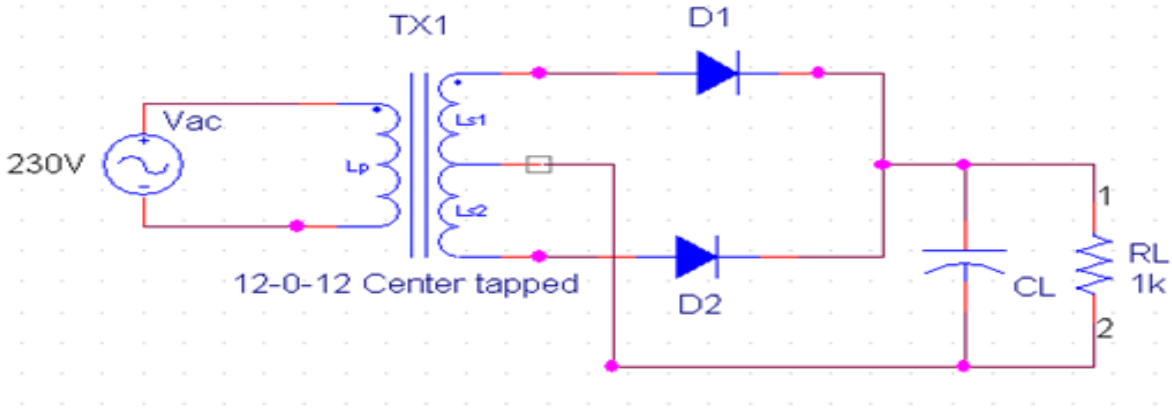

Fig.5.1 Centre tapped transformer with full wave rectifier circuit

5.2 Arduino UNO R3

The Microcontroller

It is important to understand that the Arduino board includes a microcontroller, and this microcontroller is what executes the instructions in your program.

ATmega328

The ATmega328 microcontroller is the MCU used in Arduino UNO R3 as a main controller. ATmega328 is an MCU from the AVR family; it is an 8-bit device, which means that its data-bus architecture and internal registers are designed to handle 8 parallel data signals.[6]

ATmega328 has three types of memory:

Flash memory: 32KB nonvolatile memory. This is used for storing application, which explains why you don't need to upload your application every time you unplug arduino from its power source.

SRAM memory: 2KB volatile memory. This is used for storing variables used by the application while it's running.

EEPROM memory: 1KB nonvolatile memory. This can be used to store data that must be available even after the board is powered down and then powered up again.

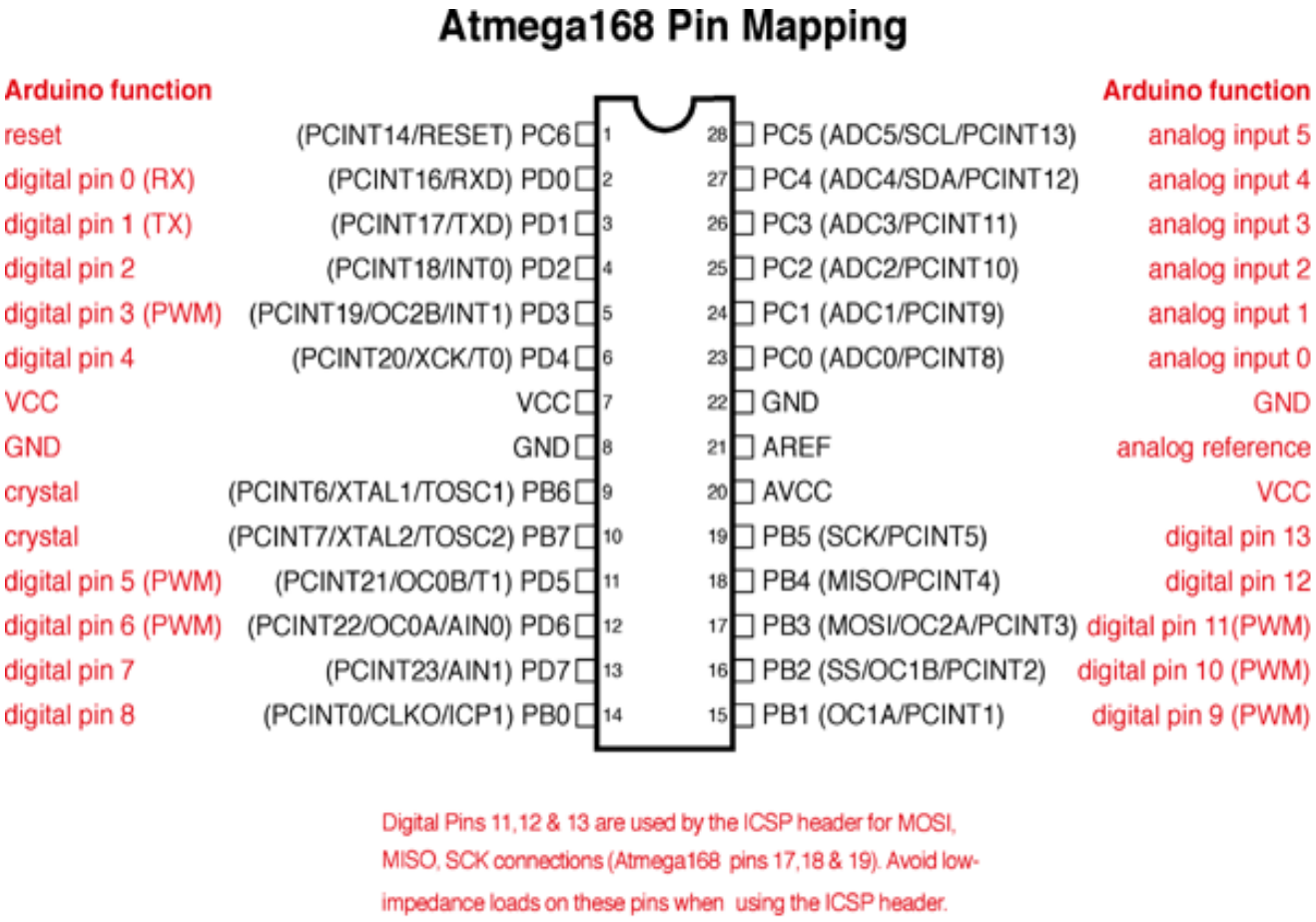

Fig.5.2 Arduino UNO R3

Features of the Arduino UNO R3

- Microcontroller: ATmega328
- Operating Voltage: 5V

- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz

5.3 ESP 8266 WIFI MODEL

Espressif Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed WiFi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement ESP8266EX offers a complete and self-contained WiFi networking solution; it can be used to host the application or to offload WiFi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Alternately, serving as a WiFi adapter, wireless internet access can be added to any micro controller based design with simple connectivity (SPI/SDIO or I2C/UART interface). ESP8266EX is among the most integrated WiFi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

Features

• 802.11 b/g/n

• Integrated low power 32-bit MCU

• Integrated 10-bit ADC

• Integrated TCP/IP protocol stack

• Integrated TR switch, balun, LNA, power amplifier and matching network
• Integrated PLL, regulators, and power management units
• Supports antenna diversity
• WiFi 2.4 GHz, support WPA/WPA2
• Support STA/AP/STA+AP operation modes
• Support Smart Link Function for both Android and iOS devices
• SDIO 2.0, (H) SPI, UART, I2C, I2S, IR Remote Control, PWM, GPIO
• STBC, 1x1 MIMO, 2x1 MIMO
• A-MPDU & A-MSDU aggregation & 0.4s guard interval
• Deep sleep power <10uA, Power down leakage current < 5uA
• Wake up and transmit packets in < 2ms
• Standby power consumption of < 1.0mW (DTIM3)
• +20 dBm output power in 802.11b mode
• Operating temperature range -40C ~ 125C
• FCC, CE, TELEC, WiFi Alliance, and SRRC certified

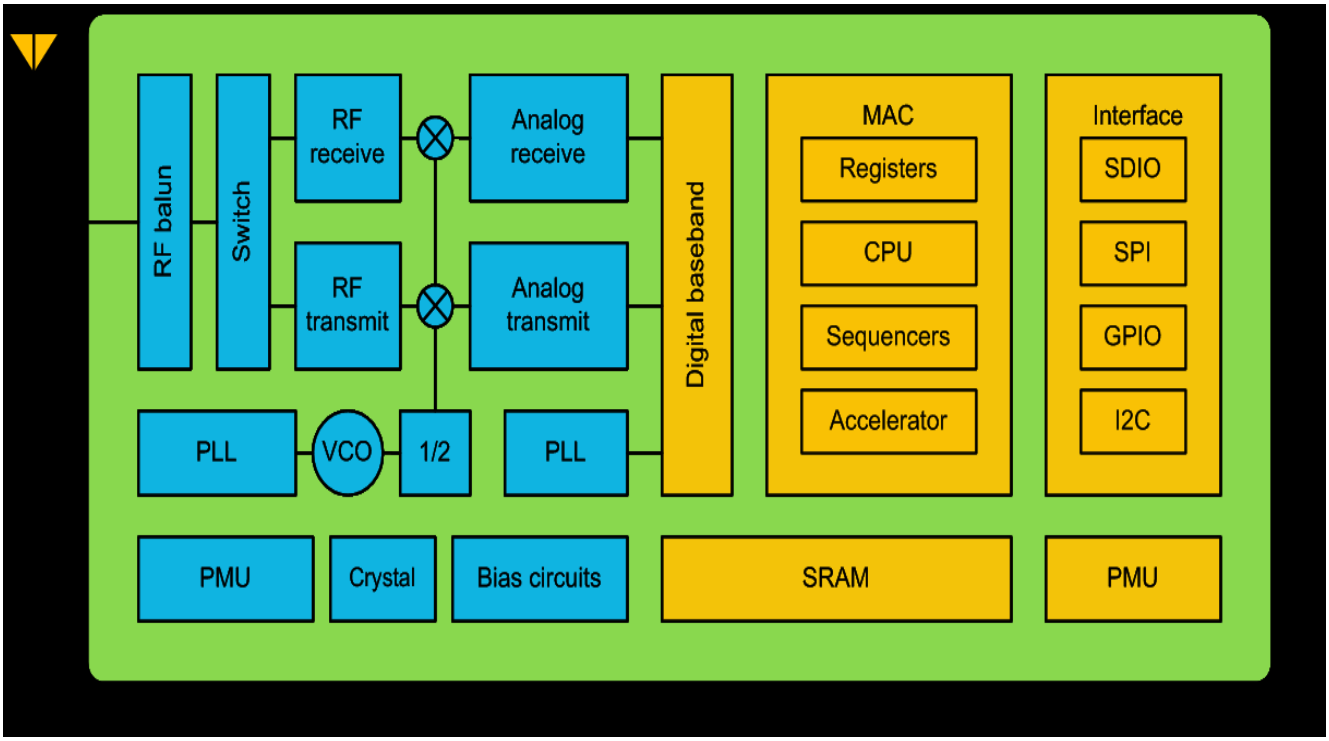

Fig.5.3 Block Diagram of ESP8266 WIFI Model

Major Applications

Major fields of ESP8266EX applications to Internet-of-Things include:

• Home Appliances

• Home Automation

• Smart Plug and lights

• Mesh Network

• Industrial Wireless Control

• Baby Monitors

• IP Cameras

• Sensor Networks

• Wearable Electronics

Fig. 5.4 ESP 8266 WIFI MODEL

5.4 16*2 LIQUID CRYSTAL DISPLAY(LCD)

16×2 character LCD display is a very basic LCD module which is commonly used in electronic projects. 16×2 means it can display 2 rows of 16 characters (columns). Its other variants such as 16×1, 16×4 etc are also available. These LCDs are usually made using HD44870 compatible controllers.. Arduino provides built in libraries for interfacing HD44870 compatible LCDs.

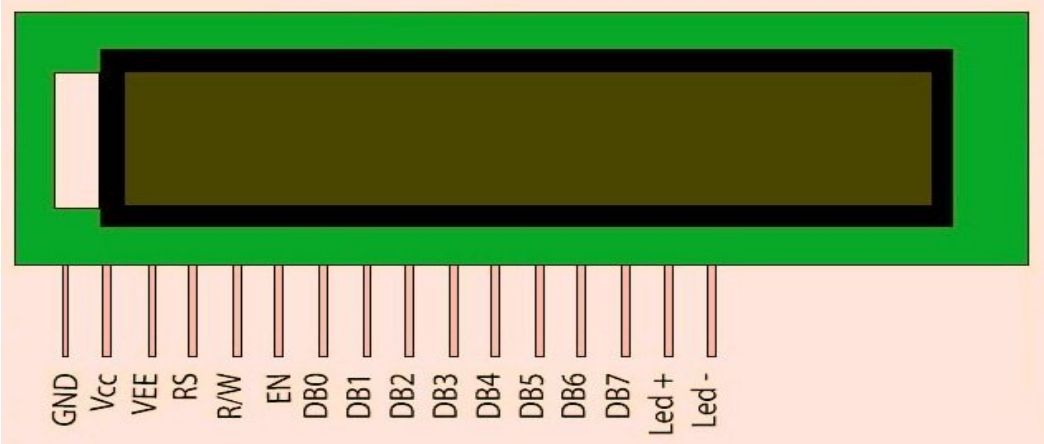

Fig.5.5 16*2 LCD Display

Interfacing LCD with Arduino Uno

In a 16×2 character LCD display, there are 16 pins. First two pins VSS and VDD are for providing power to the display. Connect these pins to the GND and 5V supply pins in the Arduino Uno. 3rd pin of the LCD is named as Vo which is used for adjusting display contrast. We can use a 10KΩ preset for that, connect variable end to Vo and fixed ends to VSS and VDD. 4th pin RS is the Register Select pin which is used to multiplex the data and command information send to the LCD module. Data information is the ASCII value of the information to be displayed on the LCD and the command information will contain instructions such as the position in which the data is to be displayed etc. These two information will be multiplexed using pin RS and will send through DB0 – DB7 pins of LCD. If RS is high, then DB0 – DB7 will contain data information and when it is LOW then these lines will contain command information. 5th pin R/W is Read or Write pin which will determine whether the data is to be written or it is to be read from the LCD display. HIGH value of this pin will indicate the data is read from the display and LOW value indicates writing information to the display. Normally we need only writing values to the display, so we usually tie RW to GND. 6th pin E is the Enable pin of LCD. High value on E will indicate valid information on DB0 – DB7 pins. We can power the LCD's back-light LED using last two pins.

The interface between this LCD and Arduino can be 8 bit or 4 bit and the difference between them is in how the data or commands are send to LCD. In the 8 bit mode, 8 bit data and commands are send through the data lines DB0 – DB7 and data strobe is given through E input of the LCD. But 4 bit mode uses only 4 data lines. In this 8 bit data and commands are splitted into 2 parts (4 bits each) and are sent sequentially through data lines DB4 – DB7 with its own data strobe through E

input. The idea of 4 bit communication is introduced to save pins of the controller. You may think that 4 bit mode will be slower than 8 bit. But the speed difference is only minimal. As LCDs are slow speed devices, the tiny speed difference between these modes is not significant. Just remember that Arduino Uno is operating at high speed in the range of 16MHz and we are viewing LCD with our eyes. Due to Persistence of Vision of our eyes we will not even feel the speed difference.

5.5 Voltage Regulator

L7812CV Voltage Regulator

The L7812CV is a three-terminal positive Voltage Regulator with several fixed output voltages, making it useful in a wide range of applications. This regulator can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type embeds internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.Fixed output voltage is +12v.

- Thermal Overload Protection
- Short-circuit Protection
- Output Transition SOA Protection

L7805CV Voltage Regulator

This regulator can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. It employs internal current limiting, thermal shutdown and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, it can deliver over 1A output current. Although designed primarily as fixed voltage regulator, this device can be used with external components to obtain adjustable voltages and currents

- Thermal overload protection
- Short circuit protection
- Output Transition SOA Protection
- Fixed Output voltage =+5v

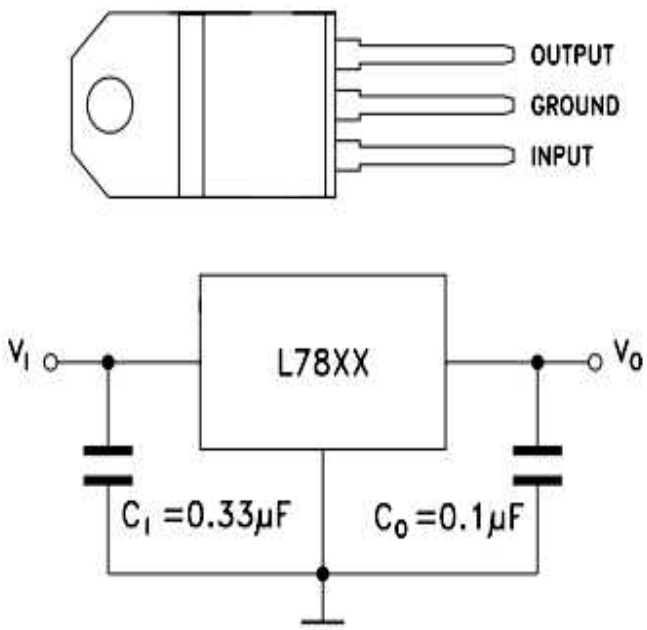

Fig.5.6. L8XX Voltage Regulator

5.6 Crystal oscillator (16MHZ)

A **crystal oscillator** is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators, but other piezoelectric materials including polycrystalline ceramics are used in similar circuits. A crystal oscillator, particularly one made of quartz crystal, works by being distorted by an electric field when voltage is applied to an electrode near or on the crystal. This property is known as electrostriction or inverse piezoelectricity. When the field is removed, the quartz - which oscillates in a precise frequency - generates an electric field as it returns to its previous shape, and this can generate a voltage. The result is that a quartz crystal behaves like an RLC circuit.

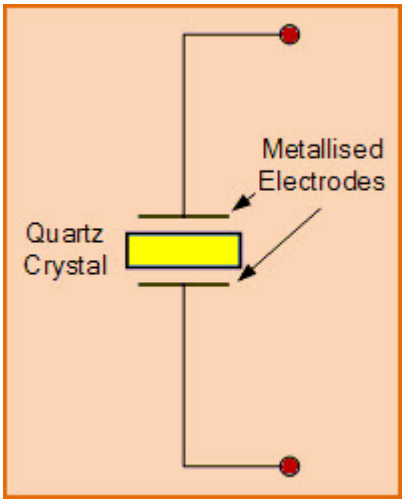

Fig.5.7 Electronic Symbol For Piezoelectric Crystal Resonator

5.7 Light Emitting Diodes (LED)

LED is a semiconductor device which emmites light energy.In this project 3 LEDs are used, each of them represents each phases of underground cables.When fault takes place in any of phases then LED will turn off.Thus it shows whether system is normal or abnormal.

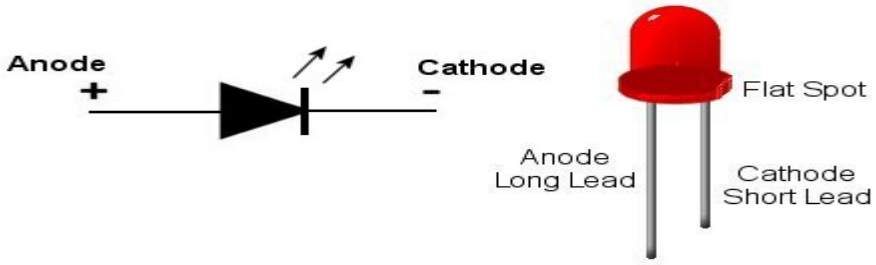

Fig.5.8 LED

5.8 DPST SWITCH

Double pole single throw, or **DPST**, refers to a switch that makes two connections simultaneously: two pairs of contacts are closed at the same time when the switch is pressed. One advantage of this design is reliability: should damage or oxidisation interfere with one pair of contacts, the other pair may remain functional, extending the life of the switch. DPST microswitches typically take the form of a symmetrical slider with identical contacts on either side. The same slider may be used for both the SPST and DPST versions. Numerous switch families

were designed with DPST support, including many Cherry switch series.DPST should not be confused with double action switches, which contain two sets of contacts, but make the connections at different points in the force curve.

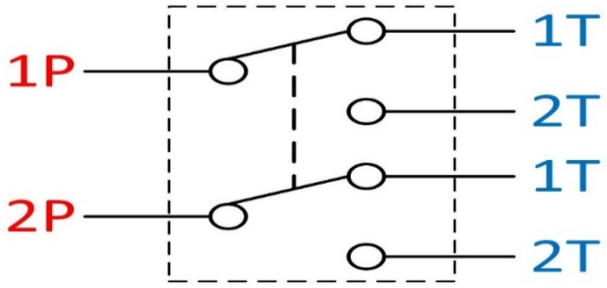

FIG.5.9 DPST Switch

5.9 Potentiometer

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat. The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name. Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load. As in this project,the brightness of an LCD display can be varied by varying resistance of potentiometer.

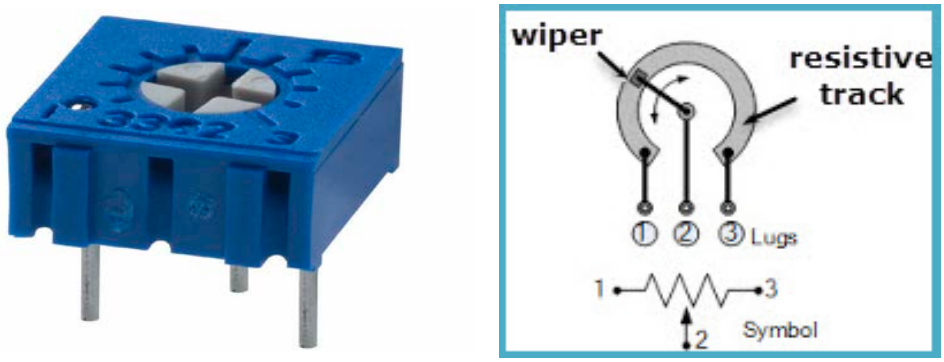

Fig.5.10 Potentiometer

CHAPTER 6

PROGRAMMING

6.1 Flowchart Of UGC Fault Detection

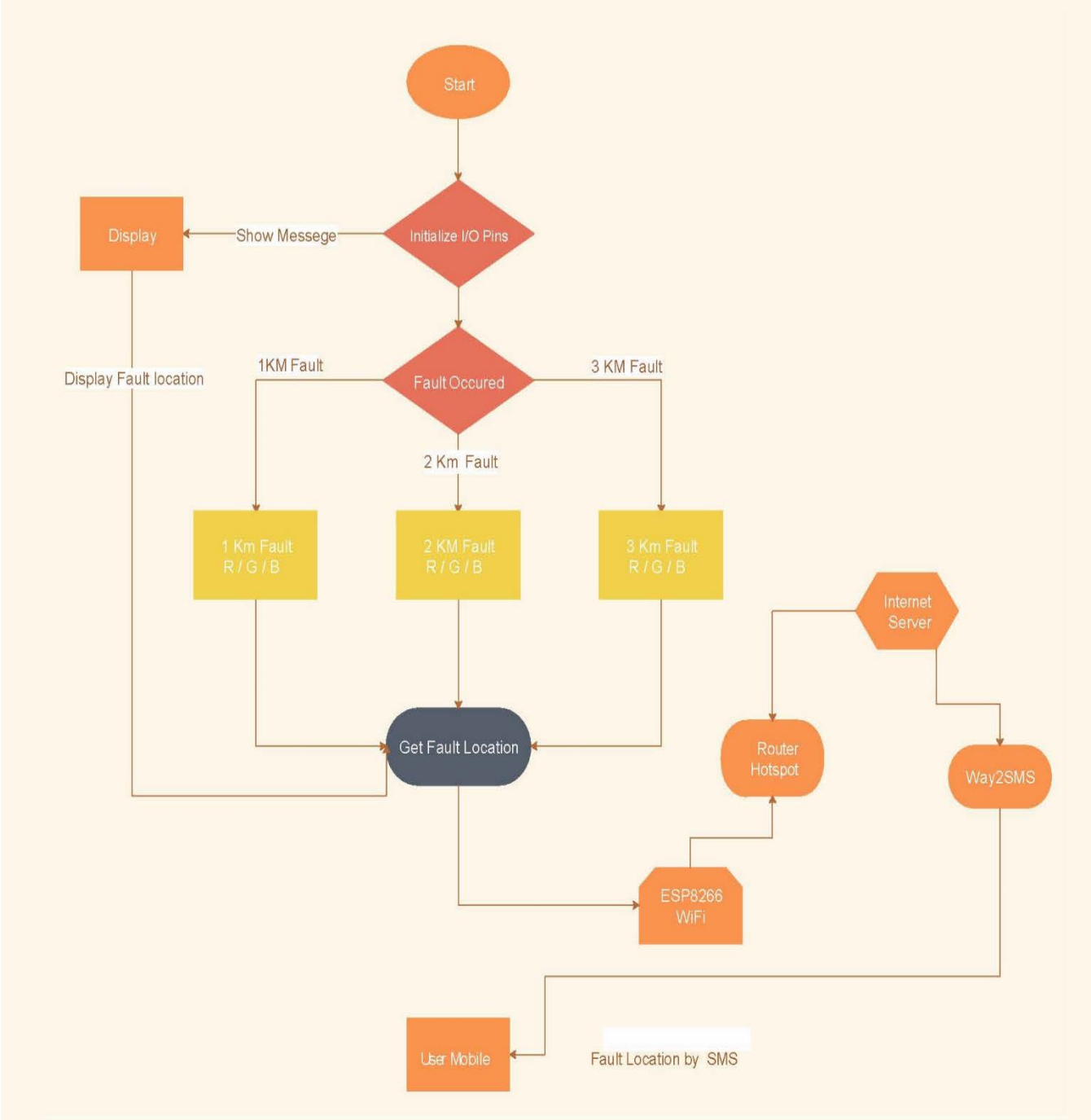

Fig.6.1 Flowchart of UGC fault detection

6.2 Algorithm for Arduino

1) #include the #include directive tells the preprocessor to insert the contents of another file into the source code at the point where the #include directive is found.
2) int rphasevalue = 0; in this command rphasevalue is the name of variable and 0 is the value assigned to the variable.
3) Lcd.print ; which specifies the content that will print on lcd. We are specifying lcd.print (" R , G , B "); to print R G B on lcd.
4) rphasevalue = analogRead(rphase); which will read the value of rphase in digital form.

Digital value read from r/g/b phase if ((rphasevalue >= 1000)	Display on lcd lcd.print("OK");	Action of LED digitalWrite(rled, HIGH);
rphase>=1000	OK	HIGH
700>=rphase>=400	1K	LOW
250>=rphase>=70	2K	LOW
50>=rphase=10	3K	LOW

Table No.6.2 Algorithm for Arduino

6.3 Algorithm for ESP 8266 WiFi Model

1) const char* ssid = "UndergroundFault"; specifying ssid of the hotpsot.
2) const char* password = "vishal123"; password needed to access the website via internet
3) const char* host = "undergroundfault.000webhostapp.com"; to specify the host web
4) Table describes the fault occurred on specific phase with distance

Distance in KM int d = atoi(t);	Message displayed on Android Serial.print("All Ok");
If d==0	All OK
If d==1	Fault at 1KM Red phase
If d==2	Fault at 2KM Red phase
If d==3	Fault at 3KM Red phase
If d==4	Fault at 1KM Green phase
If d==5	Fault at 2KM Green phase
If d==6	Fault at 3KM Green phase
If d==7	Fault at 1KM Blue phase
If d==8	Fault at 2KM Blue phase
If d==9	Fault at 3KM Blue phase
Else	Fault at two or more phases

Table No.6.3 Algorithm for ESP 8266

6.4 Database On Internet And Connectivity

Database: Database is provided over the internet for the nine php files, which is programmed for nine events containing three phases and nine fault condition on that phase (undergroundfault.000webhostapp.com) is the website hosting the 9 php files and used for the further sequence for program which is initiated during particular fault condition.

Connectivity: Connectivity to website is provided over internet. For the internet connectivity, mobile hotspot or local routers can be used (The internet provided should already be registered in the program.)

CHAPTER 7

PROJECT RESULT

Pre-fault condition:

As system of UGC operates in normal working condition ,the LCD will display the (R-OK, B-OK and G-OK) for the 3 phase system as every condition is fine. The Wi-Fi module will be getting the internet access from the hotspot provided by the local provider such as mobile, Router etc. which is already configured and set in program itself.

There are three different colour LED's representing 3 different phases (R-Red,G-Green and B-Blue).These 3 LED will glow simultaneously if the condition is normal or fine and turn OFF if the fault is occurred in the particular phase & according to the severity of the faulty condition.

Post-fault condition:

Once after the fault has occurred at some distance then the analog value which is the representative of voltage senses by arduino will changes accordingly. And it become less according to the distance at which fault is occurring like for 1km -values will be 700-400,for fault at 2km-values will be 250-70 hence likewise for each Km and for each of the 3 phases. As shown in fig.7.2, the fault has been occurred in G phase at 1km.Thus Green LED will turn off showing fault in G phase. After few seconds the notification "fault at green phase within 1km range kindly repair it" will be send on mobile by IFTTT which is shown in fig.7.4. Also when fault occur in two or more phases ,LCD will show M1(more than two phase) to all phases (shown in fig.7.3)and notification "fault at more than two phases" will be displayed on mobile.(shown in fig.7.4)

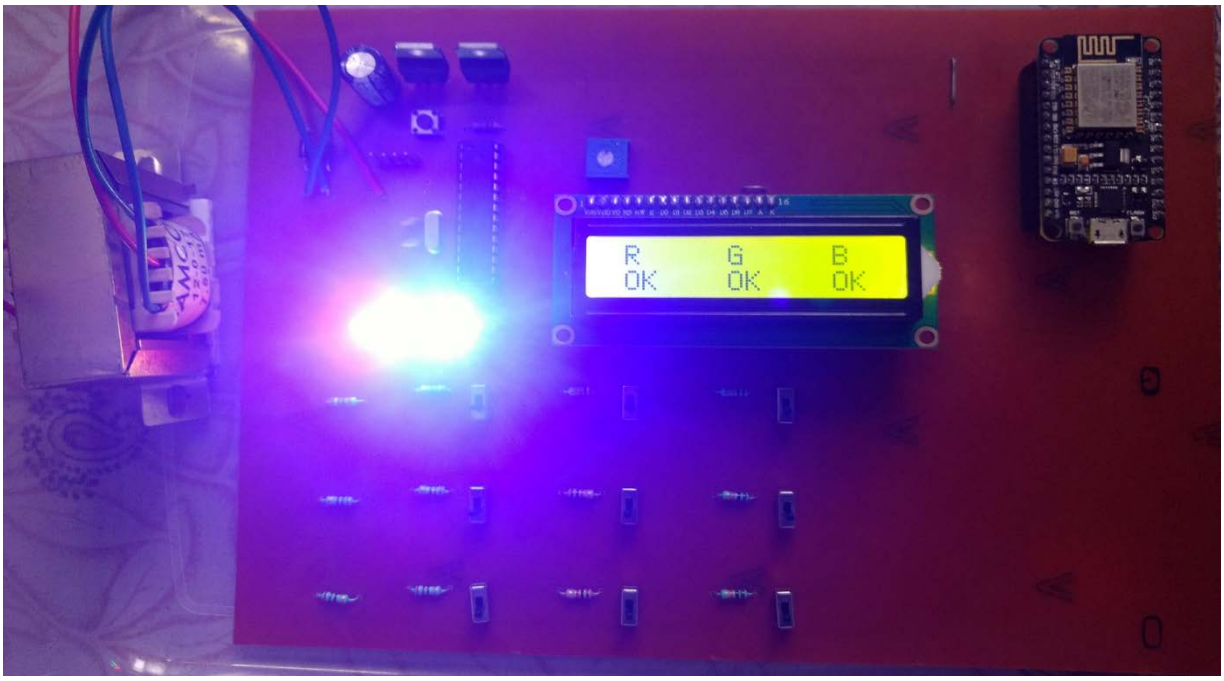

Fig.7.1 UGC under normal operating condition

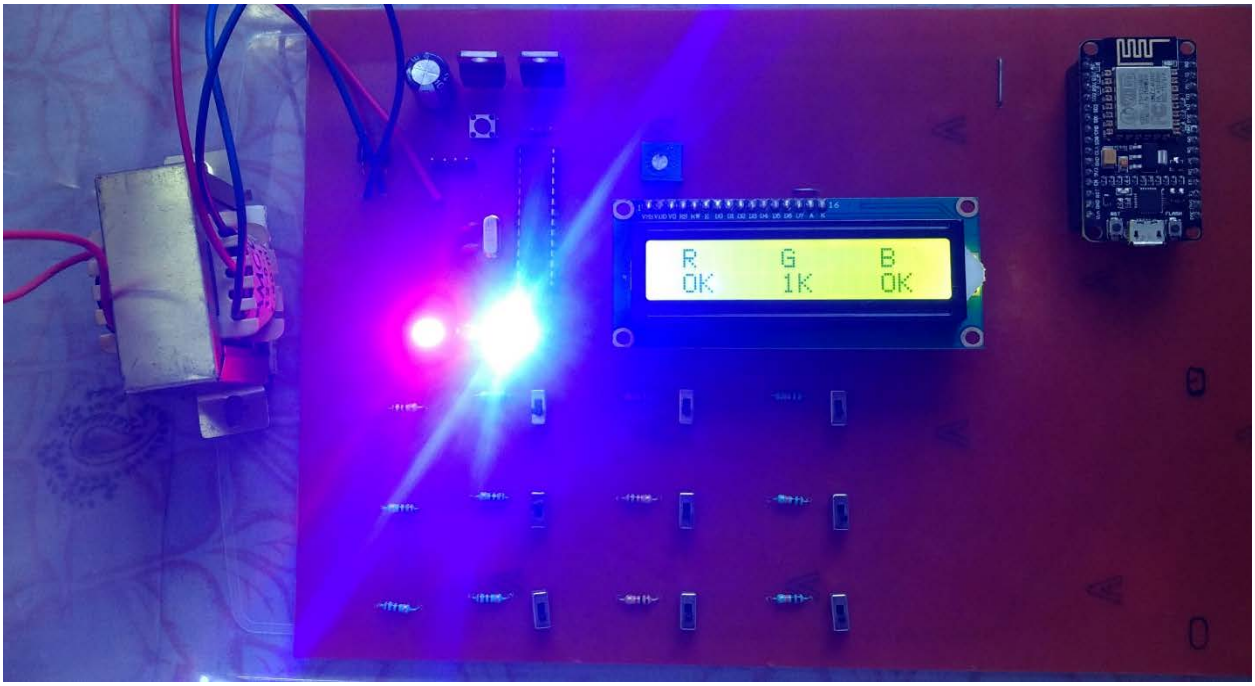

Fig.7.2 Fault occur in G phase at 1 km

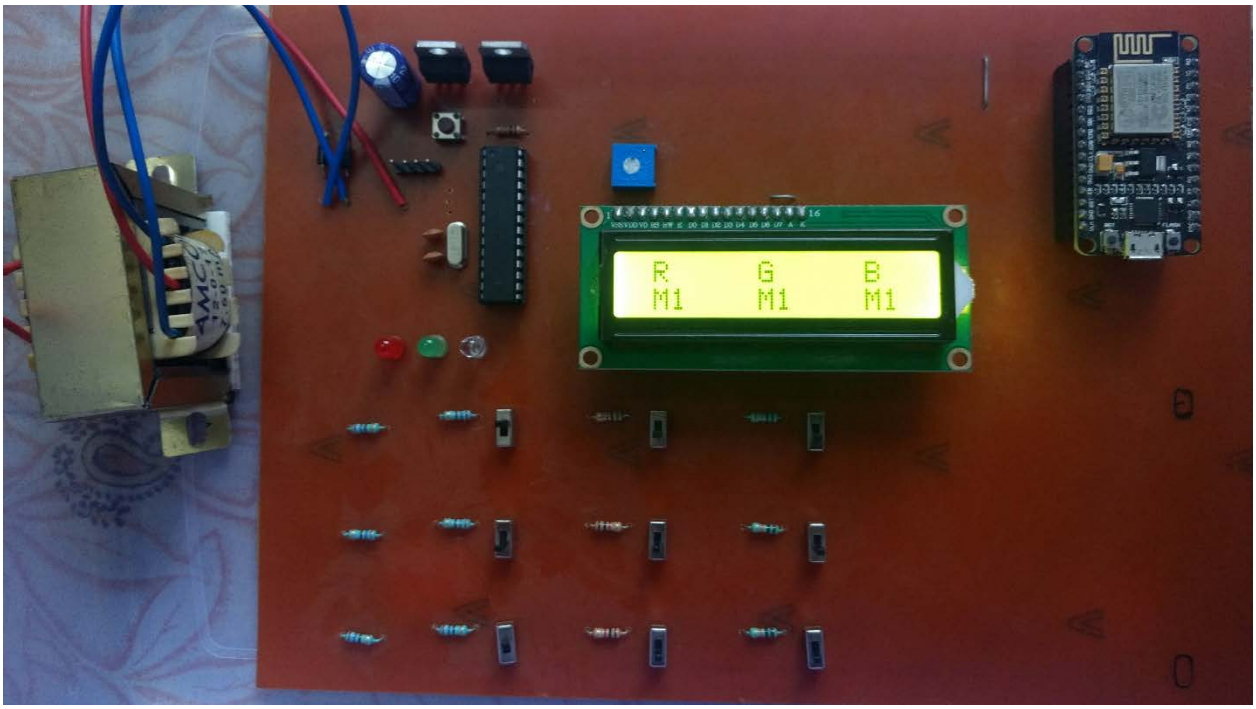

Fig.7.3 Fault occur in two or three phase of UGC

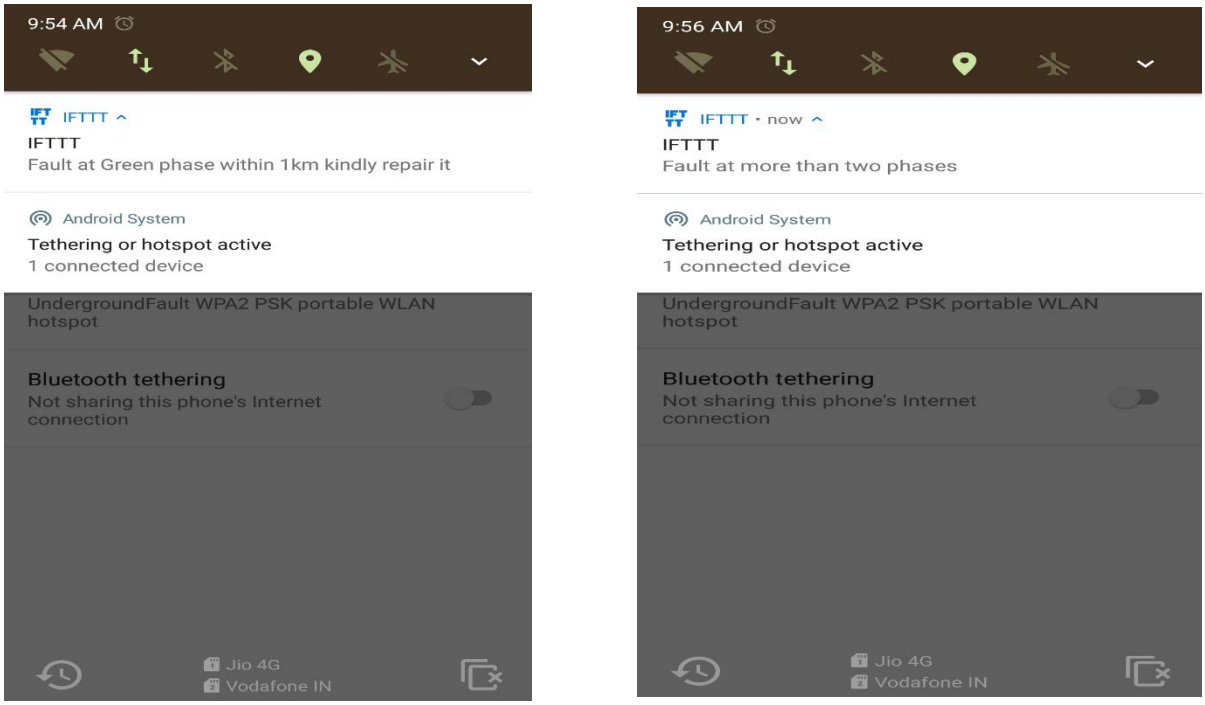

Fig.7.4 Mobile user get notification when fault occur in system via IFTTT

APPLICATIONS

- This display of underground cable fault distance over internet system, could be used in underground transmission system for tracing the approximation fault location and distance in:

1) Urban areas or densely populated areas where overhead lines are not suitable to use.
2) Industries, Commercial sectors, Municipal sectors

- Underground cable fault location model are applicable to all types of cable ranging from 1kv to 500kv.
- It can also be used for other types of cable fault such as-Short circuit fault, cable cuts, Resistive fault, Sheath faults, Water trees, Partial discharges.

ADVANTAGES

- It has Less maintenance.
- It has higher efficiency.
- Less fault occur in underground cable.
- This system is more compact and reliable as compared to the other systems.
- By using this system, the user or supply company can easily know about the fault location and distance at their work place through the dedicated website
- By using this system, the user or supply company can save their precious time.
- By using this system, the user or supply company can reduce their tracing expenses.
- Underground cable fault location model are applicable to all types of cable ranging from 1kv to 500kv&other types of cable fault such as-Short circuit fault, cable cuts, Resistive fault, Sheath faults, Water trees, Partial discharges.

DISADVANTAGES

- Design and programming of circuit becomes complex as the network expands.
- In case of failure of internet connection or some technical errors in website the total fault detection system will collapse.
- The proposed system can only be applicable in urban areas where strong network connection availability is possible.
- The proposed system will not provide information about health of cable insulation hence fault occur due to insulation failure can’t be controlled.
- It does not give the exact location of the fault, so conventional tracer method is required.
- It requires different programming for the different type of faults. Hence the programme becomes more complex.
- It requires external protection circuit such as voltage stabilizer and UPS for the protection and continuous operation of the model.

CONCLUSION

The objective of **UNDERGROUND CABLE FAULT DISTANCE CONVEYED OVER INTERNET** project report is to determine the distance of underground cable fault from the base station in kilometers. When the faults occur in an underground cable, to solve this problem it is very time consuming, and costly. So, we could know about the fault at base Station using the Arduino and find the distance in kilometers. This paper proposes fault location model for underground power cable using a Arduino. It uses the simple concept of ohm's law. When any fault like short circuit occurs, the voltage drop will vary depending on the length of fault in the cable, since the current varies. A set of resistors are therefore used to represent the cable. And a dc voltage is fed at one end and the fault is detected by detecting the change in voltage using an analog to voltage converter and a Arduino is used to make the necessary calculations so that the fault Distance is displayed on the LCD display and send to mobile via web (undergroundfault.000webhostapp.com).

Circuitry used in fault detection of cable lines is Suitable to a low resistance grounded system, long distance line and multi circuit line. The maximum detectable distance is 11 km with the accuracy of lm, the time needed is 5-10 sec using the modern technology with android phones, and android IFTTT application .It is concluded that underground cable fault distance locator performs better than conventional method.

FUTURE SCOPE

- In this project we detect only the location of short circuit fault in underground cable line, but we also detect the location of open circuit fault, to detect the open circuit fault capacitor is used in ac circuit which measure the change in impedance & calculate the distance of fault.
- It is used in neural network structure for fault section and fault location estimation.
- Relay circuitry can also be used to minimize the faults.
- Proposed system can be used to find out exact fault location of the fault and to send data in graphical format to a dedicated website.
- This system can also be used for overhead transmission line.

REFERENCES

[1] IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676, p-ISSN: 2320-3331, Volume 11, Issue 2 Ver. III (Mar. – Apr. 2016), PP 06-1

[2] Dhivya Dharani. A and Sowmya. T, Development of a Prototype of Underground Cable Fault Detector, International Journal Electrical, Electronics, and Computer Systems, Volume-2, 2014.

[3] K.K. Kuan, Prof. K. Warwick, Real-time expert system for fault location on high voltage underground distribution cables, IEEE Proceedings-C, Volume. 139, No. 3, MAY 1992.

[4] M. Fonseca_ Badillo, L. Negrete_ Navarrete, A. Gonzalez_ parada, A. Castaneda_ Miranda, Simulation and analysis of underground power cables faults, 2012 Elsevier Procedia Engineering

[5] Modern power system analysis by D.P. Kothari & I.J. Nagrath pp 401-411.

[6] Arduino Programming Notebook By Brian W. Evans pp 1-50

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