Sudan University of Science and Technology

College of Engineering

School of Electrical and Nuclear Engineering

Password Based Circuit Breaker Using Arduino Uno

قاطع كهربائي مزود بكلمة مرور باستخدام أردوينو أونو

A Project Submitted in Partial Fullfillment for the Requirements of the Degree of B.Eng in Electrical Engineering

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الآية

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بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

﴿وَقُل رَّبِّ زِدۡنِي عِلۡمٗا﴾

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DEDICATION

Every challenging work needs self-efforts as well as guidance of elders especially those who were very close to our hearts, to our beloved parents who gave us their support, affection, love, encouragement and prays to complete this dissertation work.

To those who helped us behind the seen and those who help us in the shadow, our families, our friends, cheerleaders and everyone who values us research and sees it as new way of improvement.

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ABSTRACT

The electric line man safety system makes use of a new concept of password. It is found that fatal electrical accidents to the line man are increasing during the electric line repair due to the lack of communication and co-ordination between the maintenance staff and the electric substation staff. Hence to avoid this we are implementing a password based circuit breaker. These passwords provide total control to the system to turn on or off the supply to each line. The maintenance staff e.g. line man has the control to turn ON/OFF the line. If there is a problem in any particular section of the supply line, then staff wants to turn off that line and repair it. For that the Using a matrix keypad he can enter it in the system. Then the system compares the entered password with the generated password. If the passwords are matched, then the supply to that line will be made OFF. Now he can repair the line more safely and after it is over he can turn on that line by using the password. This ensures security of the worker because no one can turn on the line without his permission

المستخلص

التقدم السريع في التكنولوجيا جعل حياتنا اسهل وزاد بعض من المخاطر في مجال الكهرباء ومن أجل ضمان حماية لمهندسين الصيانة أثناء حالة العزل التام للتيار الكهربائي نتيجة لضعف التواصل بين مجموعة الصيانة ومراكز التحكم الرئيسية او لأخطاء بشرية ناتجة عن اهمال لقواعد الأمن والسلامة .
لكل ما سبق يقدم بحثنا حلا للأخطاء البشرية حيث تمكنا من تصميم دائرة تحكم بالقرب من القاطع الرئيسي يتم توصيلها على التوالي مع مراكز التحكم الرئيسية بالتالي يضمن مهندس الصيانة عدم رجوع الكهرباء إلا عندما يتم ادخاله لكلمة مرور تتغير كل مهمة لاكثر حماية. تتكون الدائرة من جهاز الأردوينو القادر على التحكم باطراف الدائرة واستخدامها لى ارسال الرسالة التي تحتوي على رمز المرور.

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LIST OF ABBREVIATIONS

A.C: Alternating Current

LCD: Liquid Crystal Display

USB: Universal Serial Bus

GSM: Global System for Mobile Communications

KM: Kilo Meter

KV: Kilo Volt

C.B: Circuit Breaker

IDE: Integrated Development Environment

CHAPTER ONE
INTRODUCTION

1.1 General Concept

Safety of human life is of a paramount importance. In high current switching system, switch gear protects electrical circuit. Security is the prime concern in our day to day life. Everyone needs to be securing as much as possible. The password based circuit breaker is a system that access only specified. When operated manually we see fatal electrical accidents to the line man are increasing during the electric line repair due to the lack of communication and coordination between the maintenance staff and the electric substation staff. In order to avoid such accidents, the breaker can be so designed such that only authorized person can operate it with a password [1].

1.2 Problem Statement

Provide confidence to protect engineers during maintenance work on high voltage installations. It is found that fatal electrical accidents to the line man are increasing during the electric line repair due to the lack of communication and co-ordination between the maintenance staff and the electric substation staff.

1.3 Objective

This proposed system provides a solution, which can ensure the safety of the maintenance staff e.g. line man. The control to turn ON/OFF the line lies with the line man only. This system has an arrangement such that a password is required to operate the circuit breaker (ON/OFF). Line man can turn off the

supply and comfortably repair it, and return to the substation, then turn on the line by entering the correct password. Since it has the provision of changing the password, person can give any password of his will and have his work done safer. In this proposed system the control (ON/OFF) of the electrical lines lies with line man. This project is arranged in such a way that maintenance staff or line man has to enter the password to ON/OFF the electrical line. Now if there is any fault in electrical line then line man will switch off the power supply to the line by entering password and comfortably repair the electrical line, and after coming to the substation line man switch on the supply to the particular in this project keypad is used to enter the password. The password which is entered is compared with the predefined password. If entered password is correct then the corresponding electrical line is turned ON or OFF. In this project a separate password is provided to each electrical line. Activation and deactivation of the line (circuit breaker) is indicated by the load.

1.4 Methodology

Save life man by making such a protective system controlled through SMS in this proposed system if there is any fault in line the lineman sends the password due to which main line is switched off after that he works on online solution and after that sends SMS and switch on the electrical line. The maintenance staff line man has the control to turn ON/OFF the line, because the line man has to put a request to the system to its working. If there is a problem in any particular section of the supply line, then staff wants to turn off that line and repair it.

1.5 Aiming

A protective system is not useful if it is not reliable. There are many ways in which Reliability can be built into the system. Good engineering

judgment plays a great part in enhancing the reliability of the protective system. Also The protective system must be attentive to the smallest fault current. The Smaller the fault current it can detect, the more sensitive it is.

1.6 Project Layout

This project contains of five chapters:

- Chapter one gives background about the general concept of the project, problem statement, objectives, aiming and methodology.
- Chapter two discusses some topics like transmission lines and their problems and ways of protecting them as it also contains the types of circuit breaker and the way it works and also contains literature review to the project.
- Chapter three shows the explanation of the elements of the project.
- Chapter four presents the implementation circuit and working circuit.
- chapter five concludes the project, and recommendations.

CHAPTER TWO
ELECTRIC POWER SYSTEM

2.1 Introduction

An electric power system is a network of electrical components used to supply, transmit and use electric power. An example of an electric power system is the network that supplies a region's homes and industry with power - for sizable regions, this power system is known as the grid and can be broadly divided into the generators that supply the power, the transmission system that carries the power from the generating centers to the load centers and the distribution system that feeds the power to nearby homes and industries. Smaller power systems are also found in industry, hospitals, commercial buildings and homes.

No power system can be designed in such a way that it would never fail. So, one has to live with the failures. In the language of protection engineers, these failures are called faults. There is no negative connotation to the word fault in this context. What is more important is how to prevent the faults and how to mitigate consequences of the faults. The ill effects of faults are minimized by quickly isolating the fault y element from the rest of the healthy system; thus limiting disturbance footprint to as small an area in time space as possible [2].

2.2Components of Electric Power Systems

System consists electrical power from a huge number of elements associated with each other and that are integrated and functionally to achieve the objective for which it was set up the system, namely the production of electric power and distribution to consumers using them as they need purposes, where the system includes the ability of all machinery and

equipment and devices for power generation, transmission, distribution or control various changes within the system and monitor the performance of parts of the system, or those that are used to protect the system components from various errors, as well as instrumentation and communication devices.

2.3 A Modern Electric Power System Consists of Six Main Components

I- The power station.

II- A set of transformers to raise the generated power to the high.

voltages used on the transmission lines.

III- The transmission lines.

IV- The substations at which the power is stepped down to the voltage on the distribution lines.

V- The distribution lines.

VI- The transformers that lower the distribution voltage to the level used by the consumer's equipment. The Figure (2.1) represents the power system.

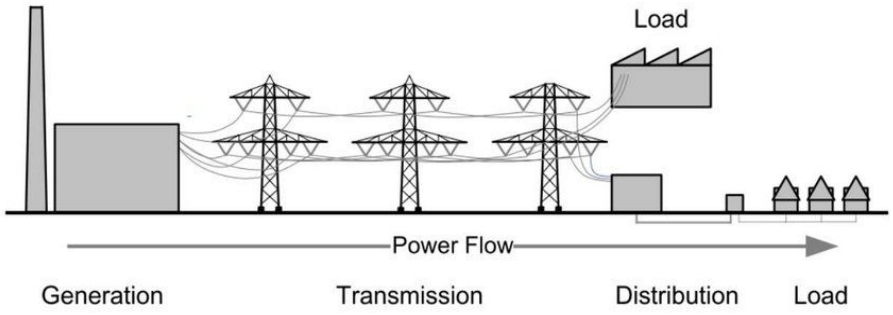

Figure 2.1: Power System planned

2.4 Transmission Lines

The transfer of electrical power from generating stations to the consumer is the main objective of the establishment of the transmission lines must also maintain the value of the voltage at different points within a

particular transmission line is the means that have been on the way the transfer of electrical power from areas of generation to areas of consumption and the transmission line in mostly line antenna, and power system performance depends mainly on the performance of the transmission line in the system, and the important considerations in Contacts transmission lines and voltage drop in the line missing the ability and efficiency of the transmission line. It owns four electric transmission lines constants Are the resistance and inductance, respectively, and the conductivity of parallelism usually neglected connectivity to the small value.

2.4.1 Growth of the Transmission System

The 19th century inventors who first began to harness electricity to useful purposes did so by putting their small generators right next to the machines that used electricity. The earliest distribution system surrounded Thomas Edison's 1882 Pearl Street Station in lower Manhattan, and another that Edison built in Menlo Park, New Jersey. These, like most of the systems constructed during the next few years, distributed power over copper lines, using direct current. This method of distribution was so inefficient that most power plants had to be located within a mile of the place using the power, known as the "load." It appeared at the time that the power industry would develop into a system of many small power plants serving nearby loads. All the early power systems were what most people now refer to as distributed generation systems: generators were located close to the machines that used electricity.

At the start of the 21st century, the transmission system is a truly interconnected network with more than 150,000 miles of high-voltage transmission lines [3].

An overhead power line is a structure used in electric power transmission and distribution to transmit electrical energy along large distances. It consists of one or more conductors (commonly multiples of three) suspended by towers or poles. Since most of the insulation is provided by air, overhead power lines are generally the lowest-cost method of power transmission for large quantities of electric energy. Towers for support of the lines are made of wood (as-grown or laminated), steel (either lattice structures or tubular poles), concrete, aluminum, and occasionally reinforced plastics. The bare wire conductors on the line are generally made of aluminum (either plain or reinforced with steel, or composite materials such as carbon and glass fiber), though some copper wires are used in medium voltage distribution and low voltage connections to customer premises. A major goal of overhead power line design is to maintain adequate clearance between energized conductors and the ground so as to prevent dangerous contact with the line, and to provide reliable support for the conductors, resilient to storms, ice load, earthquakes and other potential causes of damage. Today overhead lines are routinely operated at voltages exceeding 765,000 volts between conductors, with even higher voltages possible in some cases. Classified as electric power transmission lines, according to:

I - The lengths to Short Transmission lines at least length of 88 Kilo meter(km).

II- Medium and transmission lines ranging in length from 88 to 480 km.

III- And long transmission lines longer than 480 Km.

And each group is different from the other in a way to represent the constants and take them into account or neglected, as the transmission lines in a short while neglecting capacity transmission lines in the middle are taken into account as a value focused at a certain point in line, but in the long transmission lines was needed considering the distribution of amplitude along the line where the rising value of the capacitive current on-line to increase the length [4].

2.4.2 Short Transmission lines

Are the lines that have a length of less than 80 KM and effort to run less than 20 kilo volt (KV), and the capacity to be very small so it can be neglected, and so the performance of the transmission lines Short depends on the resistance and inductance of the line. Figure (2.2) represents the short transmission lines.

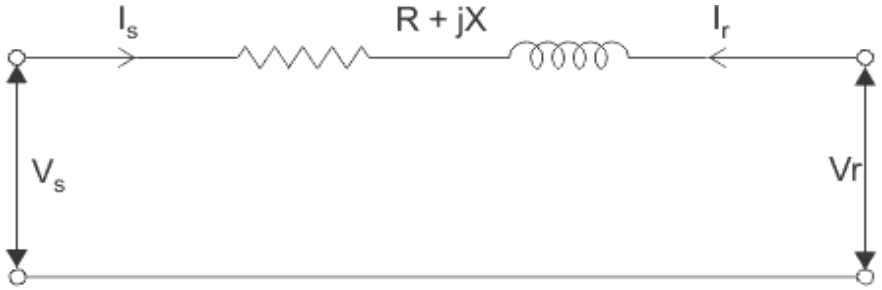

Figure (2.2): Short Transmission Lines

2.4.3 Medium Transmission Lines

Are the lines that have a length of between 80 KM to 200 KM and effortless operation be between 20KV to 100KV in these lines because of the effort and length have the effect of charging current remarkable so cannot neglect capacity where the regular distribution along the line, are represented by lines of transport medium in the form of π or T-shaped.

Representation of the transmission lines in the form of medium π:

In this way the capacity of the line is split into two halves, one half at the beginning of the line and the other half at the end of the line. Figure (2.3). represents medium transmission lines π type and Figure (2.4) represents the T type.

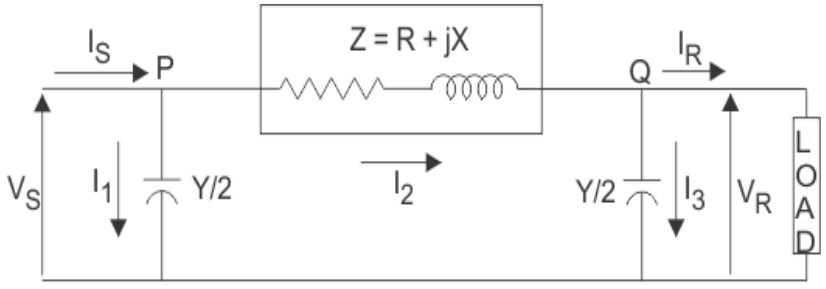

Figure (2.3): Medium Transmission Line π

Representation of the transmission lines in the form of Medium-T: In this way, is to focus capacity line at the middle of the line

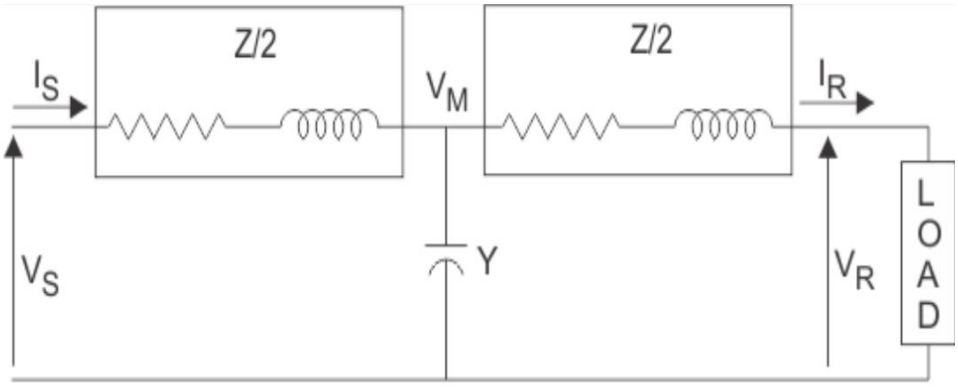

Figure (2.4): Medium Transmission Line T

2.4.4 Long Transmission lines

Are the lines that have a length greater than 200KM and an operating voltage greater than 100KV in these lines must be considered that the impedance and Admittance regular distribution line can be considered a component of several lines of short lines utmost associated with each.

2.5 Problems Facing Transmission Lines

The problems that occur in transmission lines are directly proportional to the degree of insulation of the system and the accuracy of its protection, such as dust and dirt, and their risk can be reduced by cleanliness or by using high-insulation conductors.

Electric transmission lines can generate a small amount of sound energy as a result of corona. Corona is a phenomenon associated with all transmission lines. Under certain conditions, the localized electric field near energized components and conductors can produce a tiny electric discharge or corona, that causes the surrounding air molecules to ionize, or undergo a slight localized change of electric charge. Utility companies try to reduce the amount of corona because in addition to the low levels of noise that result, corona is a power loss, and in extreme cases, it can damage system components over time. Corona occurs on all types of transmission lines, but it

becomes more noticeable at higher voltages (345 kV and higher). Under fair weather conditions, the audible noise from corona is minor and rarely noticed. During wet and humid conditions, water drops collect on the conductors and increase corona activity. Under these conditions, a crackling or humming sound may be heard in the immediate vicinity of the line [5].

The efficiency of the system is based mainly on the continuity of the service, avoiding faults that suppose economical losses for companies and users. To maintainthis continuity, one of the main problems that have beenfound is the effect produced by pollution in the insulatorsof electric lines. This pollution is one of the main causesof flashover in the insulators. The insulator begins to failwhen the pollutants that exist in the air settle in thesurface of the insulator and combine with the humidity ofthe fog, rain, or dew. The mixture of pollutants, plus thehumidity form a layer that can become conductor andallow passing currents that will facilitate the conditionsof short circuit. This is due to a decrease of the resistanceof the insulator surface. Unless there is a natural cleaningor an adequate maintenance, the electrical activity will beaffected by a possible flashover in the insulator.In other words, the pollution degrades the insulators andaffects severely to their electric characteristics, being oneof the main causes of miss - operation of the insulators. Therefore, the electric companies should prevent the interruptions of the service, produced by insulators contaminated [6].

Figure 2.5: corona phenomenon

Lightning and thunder can destroy lines. Also, the winds can cause the towers to fall, or too close to the lines, which can cause the insulation between them to collapse.

Transmission lines due to their passing through different terrain areas, which leads to their being affected by a great impact, so when designing transmission lines, consideration must be given to:

- Humidity.
- Snow.
- the heat.
- Wind.
- Lightning.

These are affected by what is known as the Sag, the appearance of vibrations, the convergence of the phases conductors from each other by an undesirable distance, and other phenomena.

Accordingly, studying these factors and their effects is very important when designing transmission lines to avoid the occurrence of unwanted problems after construction, installation and use.

2.6 Switchgear

A switch is used opening and closing in electric circuit and a fuse is device and a protective device the switching and protective device have been developed in various forms. Switchgear is necessary at every switching point in ac power system. Between the generating station and final load point, there are several voltage levels and fault levels.

2.7 AC Circuit-Breaker

Circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and interrupt current flow. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation.

The circuit breaker serves two basic purposes:

(1) Switching during normal operating condition for the purpose of operation and maintenance.

(2) Switching during abnormal condition such as short circuits and interrupting the fault current.

The circuit breaker are automatic switches which can interrupt fault currents in some applications like single phase traction system, single pole circuit- breaker are used. The part of circuit breaker connected in one phase is called the pole. A circuit breaker suitable for three phase system is called a 'triple pole circuit breakers'.

Each pole of the circuit breaker comprises one more interrupter or arc extinguishing chambers. the interrupters are mounted on support insulators. The interrupter encloses a set of fixed and moving contact. The moving contacts can be drawn apart by means of the operating links the operating mechanism.

The operating mechanism of the circuit-breaker gives the necessary energy for opening and closing of contacts of the circuit-breakers. The arc produced by the separation of current carrying contacts is interrupted by a suitable medium and by adopting suitable techniques for arc extinction. The circuit-breaker can be classification the basis of the arc extinction medium.

2.8 Fault Clearing Process

During the normal operating condition, the circuit-breaker can be opened or closed by a station operator for the purpose of switching and maintenance. During the abnormal or faulty condition, the relays sense the fault and close the trip circuit of the circuit-breaker. There after the circuit-breaker opens, the circuit-breaker has two working positions, open and closed.

These corresponding to open circuit-breaker contacts and closed circuit-breaker contacts respectively. The operation of automatic opening and closing the contacts is achieved by means of the operating mechanism of the circuit-breaker. As the relay contacts close, the trip circuit is closed and the operating mechanism of circuit-breaker starts the opening operation. The contacts of the circuit-breaker open and arc is drawn between them. The arc is extinguished at some natural current zero of A.C wave. The process of current interruption is completed when the arc extinguished and the current reaches final zero value [7]. The fault when the arc is extinguished and the current reaches final zero value. The fault is said to be cleared. The process of fault-clearing has following sequence Fault occurs. As the fault impedance being low, the current the relay gets actuated the moving part of the relay move because of the increase in the operating torque. the relay takes some time to close its contact.

- Relay contacts close, the trip circuit of the circuit-breaker closes and trip coil is energized.
- The operating mechanism starts operating for the opening operation the circuit-breaker contacts separate.
- Arc is drawn between the beaker contacts the arc is extinguished in the circuit-breaker by suitable techniques. The current reaches final zero as the arc extinguished.

2.9 The Trip-Circuit

Control circuit discuss the equipment connected to circuit breaker as shown in Figure 2.6.

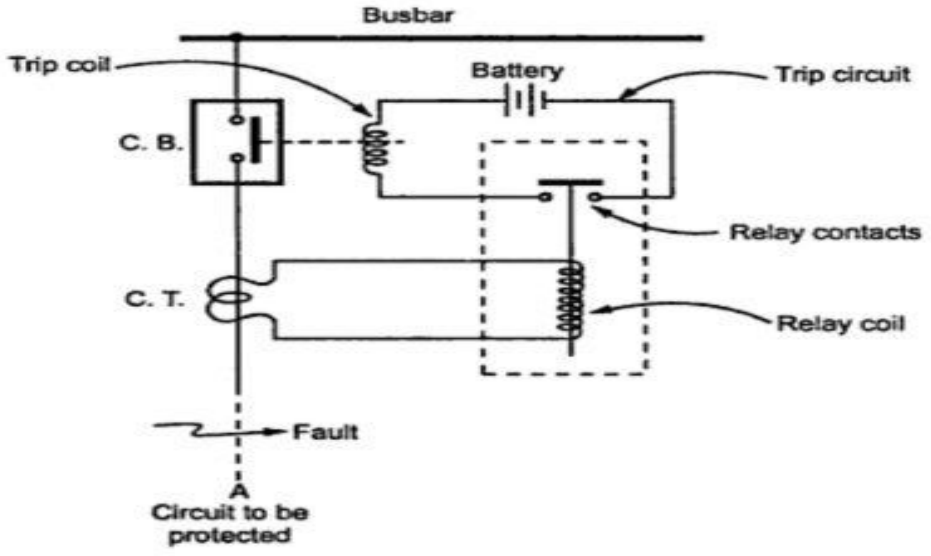

Figure 2.6: Trip circuit

2.10 Classification Based on Arc Quenching Medium

The A.C circuit breaker can be classified on basis of rated voltage. circuit breaker below rated voltage of 1000 V are called low voltage circuit-breaker and above 1000 V are called high voltage A.C circuit-breakers.

2.11Classification According to the Medium Arc Extinction

The type of the circuit-breaker is usually identified according to the medium arc extinction:

- Air break-circuit breaker /miniature circuit breaker.
- Oil circuit breaker (tank of bulk oil).
- Minimum oil circuit breaker.

- Air blast circuit-breaker.
- Sulphur hexafluoride circuit breaker (single pressure or double pressure).
- Vacuum circuit breaker.

2.12 Air Circuit Breaker

The air at atmosphere pressure is used as an arc extinguishing medium in air-break circuit -breakers. These circuit –breaker employ the high resistance interruption principle. The arc is rapidly lengthened by means of the arc runners and arc chutes and the resistance of the arc is increased by cooling lengthening and splitting the arc.

The arc resistance increases to such an extent that the voltage drop across the arc becomes more than the supply voltage and the arc extinguished.

The air-break circuit-breakers are used in D.C circuit and A.C circuit up to 12kv. AC air-break circuit-breakers are widely uses in indoor medium voltage and low voltage switchgear as shown in Figure 2.7[8].

Figure 2.7:Air break circuit-breaker

2.13Air Blast Circuit-Breakers

Air blast circuit-breakers were used before 1980s for 11 to 1100KV. A compressor plant is necessary to maintain high air pressure in the air receiver.

During the period 1950-1970s,air-blast circuit-breakers were preferred for 220KV and above however today, SF6 circuit-breakers are preferred for this range.For 11KV and 33KV application. as shown in Figure 2.8.

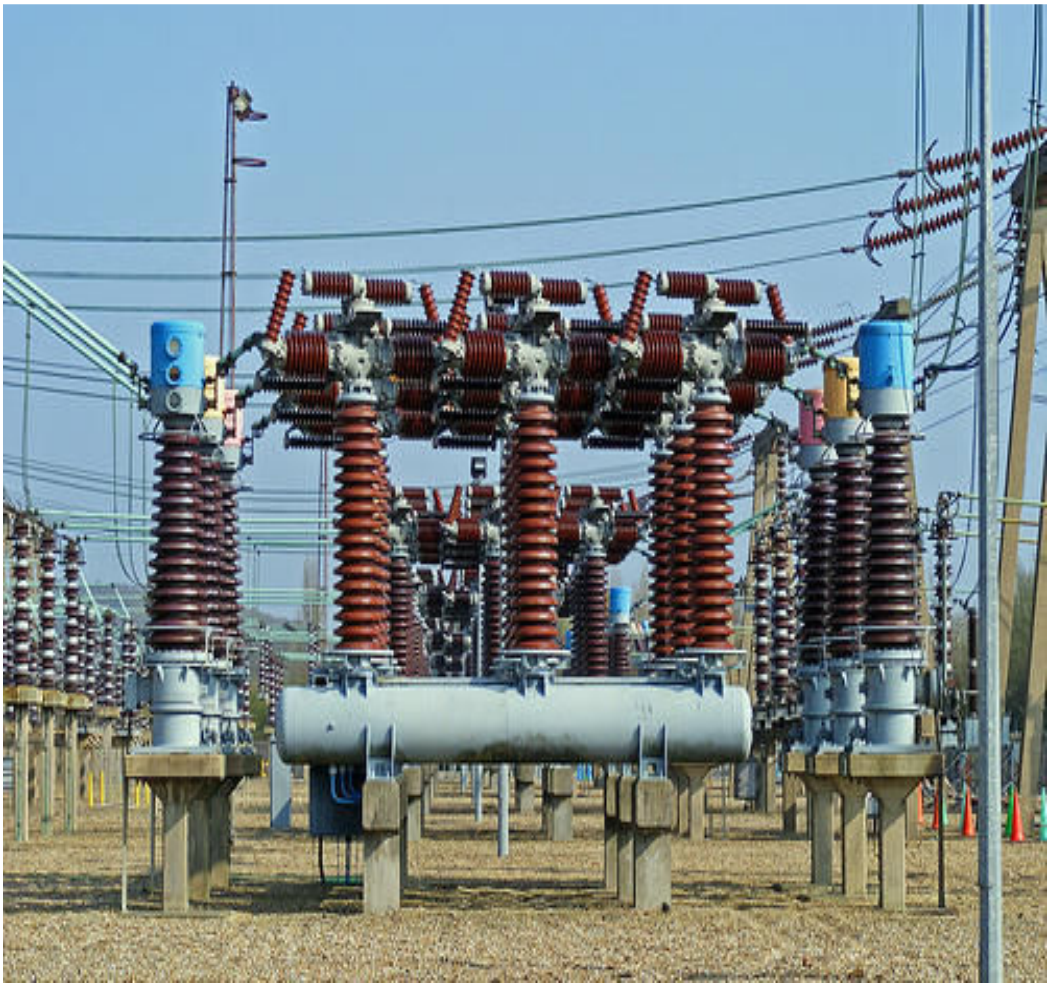

Figure 2.8:Air blast circuit-breakers

2.14 Sulphur Hexafluoride (SF6) Circuit-Breaker

Sulphur hexafluoride (SF6) is an inert, heavy gas having good dielectric and arc extinguishing properties. SF6 gas insulated metalclad

switchgear is also called Gas Insulated Substation (GIS) and is preferred for 12KV, 36KV, 72KV, 145KV, 245KV, 420KV and above.

in such a substation, the various equipment like circuit – breaker bus bars, isolators load break switches. current-transformers, voltage transformers earthling switches etc. are housed in separate metal enclosed modules filled with sf6 gas. The sf6 gas provides the phase to ground insulation. As strength of sf6 gas is higher than air, the clearances required are smaller. Hence the overall size of each equipment and the complete sub-station is reduced. as shown in Figure 2.9.

2.14.1 Physical Properties of SF6 Gas

- Color less
- Dour less
- Nontoxic pure SF6 gas is not harmful to health

Figure 2.9: Sulphur hexafluoride (SF6)

2.15 Minimum Oil Circuit-Breaker and Bulk Oil Circuit-Breaker

In minimum oil circuit-breakers, dielectric oil is used as an arc quenching medium and dielectric medium. Oil circuit-breakers were used for voltage up to 145KV. This type of breaker has been replaced by sf6 breakers . Oil circuit-breaker use dielectric oil (transformer oil) for the purpose of arc extinction. In bulk oil circuit breaker, the arc-extinction takes place in a tank; whereas in minimum oil circuit –breakers the arc-extinction takes place in insulating housing enclosed in ceramic enclosures.

For MOCB rated up to 145KV single break designs prevail, for higher voltage multibreak designs were common. Modular construction was adopted for minimum oil circuit –breaker of 245KV and above. However, sf6 circuit-breakers are now preferred entire range of breakers. As shown in Figure 2.10 [8].

Figure 2.10: Minimum oil circuit-breaker

2.16 Vacuum Circuit Breaker

Vacuum interrupters are sealed units comprising a pair of fixed and moving contact, metallic bellows, vapor condensing shield insulating enclosure etc. vacuum interrupters are compact and give very long operational life without any maintenance. They are popular for rating up to 36KV, 25KA and are being widely used for indoor metal-clad switchgear, trackside sub-station etc. Surge suppressors comprising non-linear resistors or resistance capacitor combination are connected on load side of vacuum circuit-breaker for limiting switching over-voltage. these are necessary for low-power factor load switching. As shown in Figure 2.11.

Figure 2.11: Vacuum circuit breaker

2.17 Literature Review

In the recent years, researches have been focusing their work in the area of staff safety. Maintenance of fault in electrical Line has always been a challenge to the lineman. The safety and supply control system have to be upgraded to provide a better safety to the maintenance staff. Time and again there have been innovations in the control of circuit breaker and other control system technologies for the secure and smooth functioning of substation and its staff.

2.17.1 Password Based Distribution Panel and Circuit Breaker Operation for the Safety of Lineman during Maintenance Work

AMIT SACHAN has designed this project is to acquire the remote electrical parameters like Voltage, Current and Frequency and send these real time values over GSM network using GSM Modem/phone along with temperature at power station. This project is also designed to protect the electrical circuitry by operating an Electromagnetic Relay. This Relay gets activated whenever the electrical parameters exceed the predefined values. The Relay can be used to operate a Circuit Breaker to switch off the main electrical supply. User can send commands in the form of SMS messages to read the remote electrical parameters. This system also can automatically send the real time electrical parameters periodically (based on time settings) in the form of SMS.

2.17.2 Electric Line Man Safety with Password Based Circuit Breaker

SHUSMITA deb, P. DIVYA, Sindhu The system is fully controlled by the 8-bit microcontroller of 8051 families. Then the program is stored in an EEPROM, interfaced to the microcontroller and it can be changed any time unlike a fixed one burnt permanently on to the microcontroller. A keypad is used to operate the Remote and a relay to open or close circuit breaker, which is indicated by a lamp.

CHAPTER THREE
SYSTEM COMPONENTS

3.1 Introduction

The history of electrical-power technology throughout the world is one of steady and, in recent years, rapid progress, which has made it possible to design and construct economic and reliable power systems capable of satisfying the continuing growth in the demand for electrical energy, In this power system protection and control play a significant part, and progress in design and development in these fields has necessarily had to keep pace with advances in the design of primary plant, such as generators, transformers, switchgear, overhead lines and underground cables, indeed, progress in the fields of protection and control is a vital prerequisite for the efficient operation and continuing development of power supply systems as a whole.

The word 'protection' is used here to describe the whole concept of protecting a power system. The term 'protective gear' or 'protective equipment' is widely used in that sense [9]. The purpose of an electrical power system is to generate and supply electrical energy to consumers. The system should be designed and managed to deliver this energy to the utilization points with both reliability and economy. Severe disruption to the normal routine of modern society is likely if power outages are frequent or prolonged, placing an increasing emphasis on reliability and security of supply. As the requirements of reliability and economy are largely opposed, power system designs inevitably a compromise.

In this project we are easily break the load by keypad. Now if there is any fault in electrical line then line man will switch off the power supply to the line by entering password and comfortably repair the electrical line, and after coming to the substation line man switch on the supply to the particular line by entering the correct password.

3.2 Arduino

Arduino is a small microcontroller board with a universal serial bus (USB) plug to connect to your computer and a number of connection sockets that can be wired to external electronics such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, and more. They can either be powered through the USB connection from the computer, from a 9volt battery, or from a power supply. They can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently. The board design is open source. This means that anyone is allowed to make Arduino-compatible boards. This competition has led to low costs for the boards. The basic boards are supplemented by accessory shield boards that can be plugged on top of the Arduino board. The software for programming your Arduino is easy to use and also freely available for windows, mac, and Linux computers.

3.3 Types of Arduino

- Arduino Uno
- Arduino Leonardo
- Arduino LILYPAD
- Arduino Mega
- Arduino Nano
- Arduino Mini
- Arduino Mini Pro
- Arduino BT

3.4 Arduino Uno

The Arduino Uno is a microcontroller board based on the atmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 megahertz (MHZ) ceramic resonator, a USB connection, a

power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC -to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the fetid USB-to-serial driver chip. Instead, it features the atmega16u2 (atmega8u2 up to version r2) programmed as a USB-to serial converter, as shown in figure 3.1.

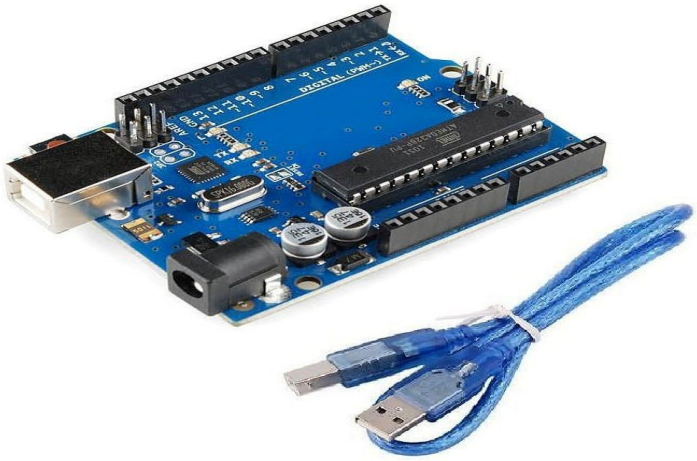

Figure 3.1: Arduino Uno

3.4.1 Power USB

Arduino board can be powered by using the USB cable from your computer. All you need to do is connect the USB cable to the usb connection (1).

3.4.2 Power (barrel jack)

Arduino boards can be powered directly from the ac mains power supply by connecting it to the barrel jack (2).

3.4.3 Voltage Regulator

The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the dc voltages used by the processor and other elements.

3.4.4 Crystal Oscillator

The crystal oscillator helps Arduino in dealing with time issues. How does Arduino calculate time? The answer is, by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000h9h. It tells us that the frequency is 16,000,000 hertz or 16 MHZ.

3.4.5Arduino Reset

You can reset your Arduino board, i.e., start your program from the beginning. You can reset the Uno board in two ways. First, by using the reset button (17) on the board. Second, you can connect an external reset button to the Arduino pin labelled reset (5).

3.4.6 Pins (3.3, 5, GND, VIN)

- 3.3V (6): supply 3.3 output volt
- 5V (7): supply 5 output volt
- Most of the components used with Arduino board works fine with 3.3 volt and 5 volts.
- GND (8) (ground): there are several GND pins on the Arduino, any of which can be used to ground your circuit.
- VIN (9): this pin also can be used to power the Arduino board from an
- External power source, like ac mains power supply.

3.4.7 Analog Pins

The Arduino Uno board has five analog input pins a0 through a5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

3.4.8 Main Microcontroller

Each Arduino board has its own microcontroller (11). You can assume it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL company. You must know what IC your board has before

loading up a new program from the Arduino ide. This information is available on the top of the IC. For more details about the IC construction and functions, you can refer to the data sheet.

3.4.9 ICSP Pin

Mostly, ICSP (12) is an AVR, a tiny programming header for the Arduino consisting of MOSI, miso, SCK, reset, VCC, and gnd. It is often referred to as an SPI (serial peripheral interface), which could be considered as an "expansion" of the output. Actually, you are slaving the output device to the master of the SPI bus.

3.4.10 Power LED Indicator

This led should light up when you plug your Arduino into a power source to indicate that your board is powered up correctly. If this light does not turn on, then there is something wrong with the connection.

3.4.11 TX and RX LEDs

On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the Arduino Uno board. First, at the digital pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led (13). The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board. Rx flashes during the receiving process.

3.4.12 Digital I/ O

The Arduino Uno board has 14 digital i/o pins (15) (of which 6 provide PMW (pulse width modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labeled “~” can be used to generate PMW.

.

3.4.13 AREF

AREF stands for analog reference. It is sometimes, used to set an external reference voltage (between 0 and 5 volts) as the upper limit for the analog input pins.

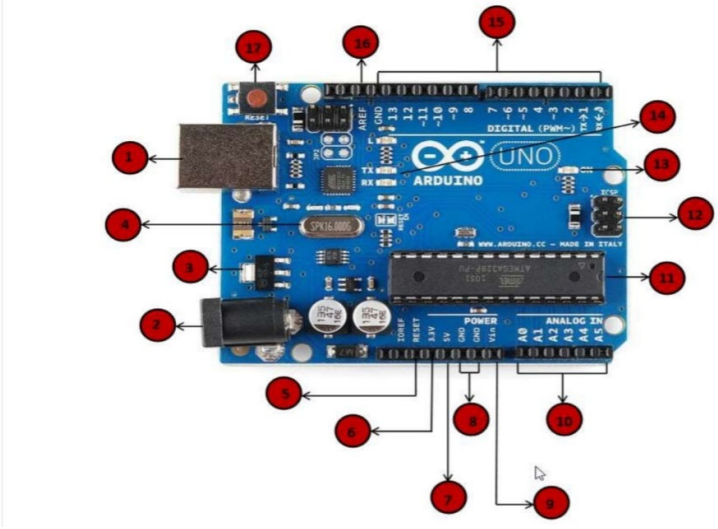

figure 3.2: Arduino Uno Parts

3.4.14Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them. A Programs written using Arduino software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extensionUno. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right hand corner of the window displays the

configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, Automatic control to regulate the voltage "AVR" Studio and the newer Atmel Studio. The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main () into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program argued to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. As shown in Figure 3.3.

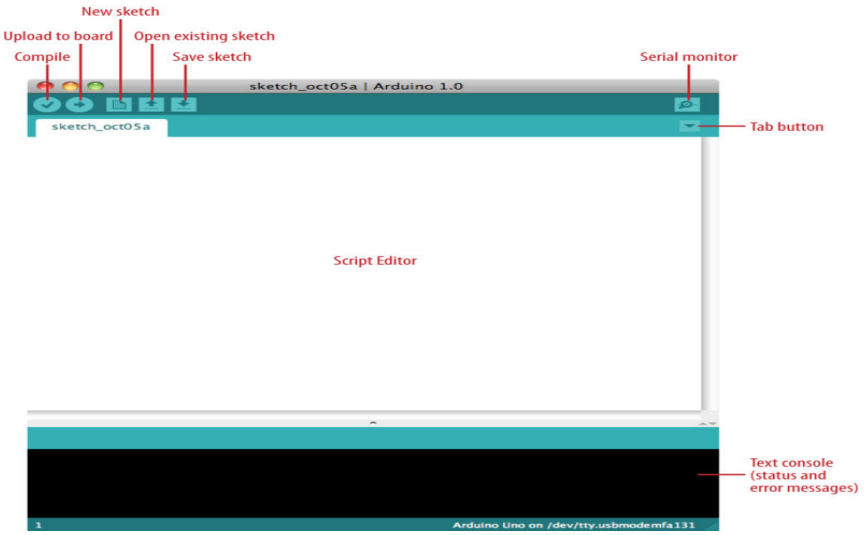

Figure 3.3: Arduino IDE

3.4.15 Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an ac-to-dc adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and vin pin headers of the power connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7v, however, the 5v pin may supply less than five volts and the board may be unstable. If using more than 12v, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. The power pins are as follows:

• vin. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

• 5v. This pin outputs a regulated 5v from the regulator on the board. The board can be supplied with power either from the dc power jack (7 - 12V), the usb connector (5V), or the vin pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

• 3.3V. A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mas.

• gnd. Ground pins

3.5 Relay

A relay an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very usefully device and allow one circuit to switch another one while they are completed separated. The required current to run the relay coil is more than can be supplied by various integrated circuits like operation amplifier, etc. Figure 3.4illustrates relay device.

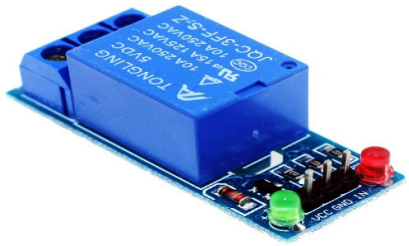

Figure 3.4: Relay device

3.6 Liquid Crystal Display (16 x 2)

LCD stands for liquid crystal display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons:

1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics. This is in contrast to LEDs Which are limited to numbers and a few characters.
3. Incorporation of a refreshing controller into the LCD, thereby relieving the central processing unit (CPU) of the task of refreshing the LCD. In contrast, the led must be refreshed by the CPU to keep displaying the data.
4. Ease of programming for characters and graphics.

These components are “specialized” for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD. As shown in figure 3.5.

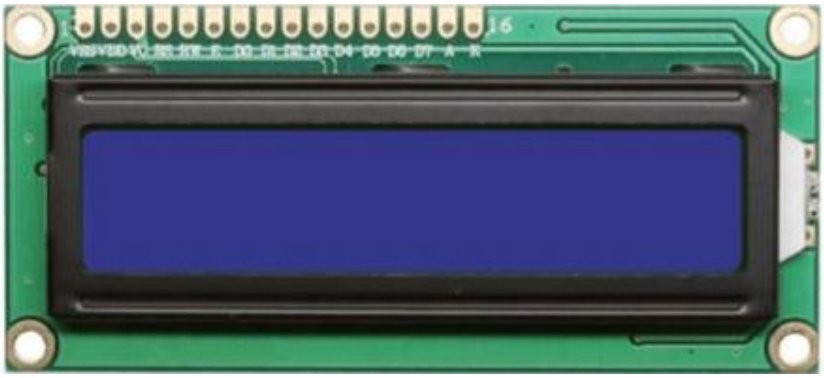

Figure 3.5: liquid crystal display (16 x 2)

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the hd44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right),

appearance of the pointer, backlight etc. Are considered as useful characteristics [10].

3.7 Global System for Mobile Communications

The beginning of the 1980s it was realized that the European countries were using many different, incompatible mobile phone systems. At the same time, the needs for telecommunication services were remarkably increased. Due to this, founded a group to specify a common mobile system for western Europe. This group was named “group special mobile” and the system name GSM arose.

Figure 3.6: GSM

3.7.1 Operation GSM

The basis of the GPS is a constellation of satellites that are continuously orbiting the earth. These satellites, which are equipped with atomic clocks, transmit radio signals that contain their exact location, time, and other information.

The radio signals from the satellites, which are monitored and corrected by control stations, are picked up by the GPS receiver. A global positioning system receiver needs only three satellites to plot a rough, 2d position, which will not be very accurate.

3.7.2 GSM Applications

- Mobile telephony.
- GSM-r.
- Telemetry system.
- Fleet management.
- Automatic meter reading.
- Toll collection.
- Remote control and fault reporting of dg sets.

3.8 Hexadecimal Keypad

Hexadecimal keypad is a standard device with 16 keys connected in a 4x4 matrix, giving the characters 0-9, a, b, c, d, * and #. Interfacing of hex key pad topic 16f886 microcontroller is essential while designing embedded system projects which requires character or numeric input or both. For example, projects like digital code lock, numeric calculator etc. Here we are using this to enter numeric password for turn on/off the circuit breaker. As shown in Figure 3.7.

Figure 3.7: Hexadecimal keypad

3.9 Breadboard

Bread board is a flat board used a base for connecting electronic components to build electronic circuits. And prototyping of electronic device. It requires no soldering and is reusable, which makes it easy to use for creating temporary prototypes and circuit design experiments.

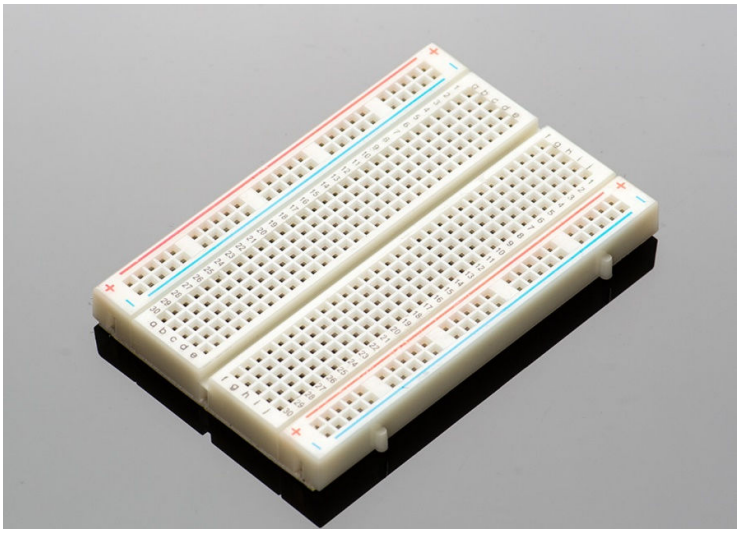

Figure 3.8: Breadboard

3.10 Variable Resistance

The variable resistance is one of the types of resistors that control the change of current flow by presenting a different set of values. The higher the value of the resistance decreases the value of the current flowing through the circuit and vice versa.

Variable resistors can control voltage in electronic circuits, so these resistors are useful in applications that require voltage or current control.

Figure3.9:Variable Resistance.

CHAPTER FOUR

IMPLEMENTATION AND RESULT

4.1 Circuit design

The Arduino Uno was connected to the execution board by soldering input and output pins. As shown as in Figure4.1.

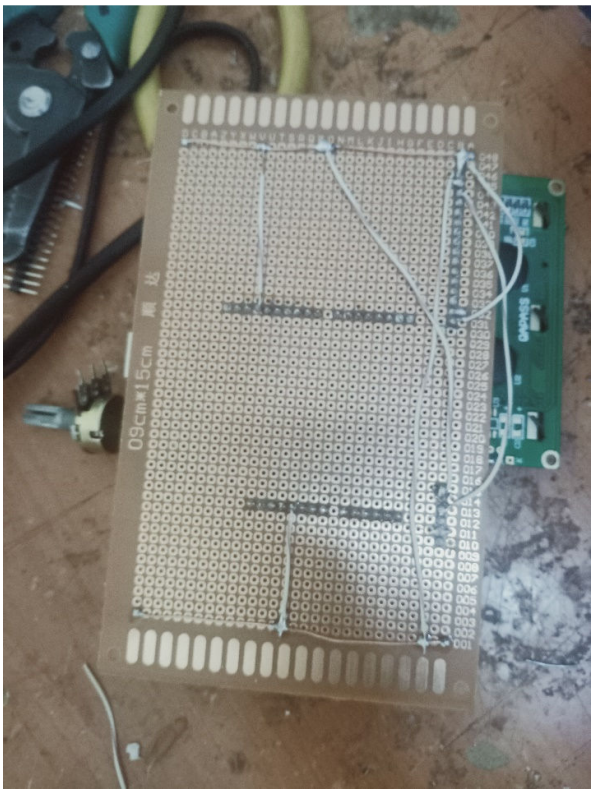

Figure 4.1: Arduino Uno Connection in Circuit.

LCD 16×2 was connected at pins (5,4,6,11,10,9) on the Arduino Uno. In addition to connecting LCD with variable resistance. As shown as in Figure4.2 and Figure4.3.

```
#include<LiquidCrystal.h>
```

```
LiquidCrystal lcd(9, 11, 10, 6, 5, 4);
```

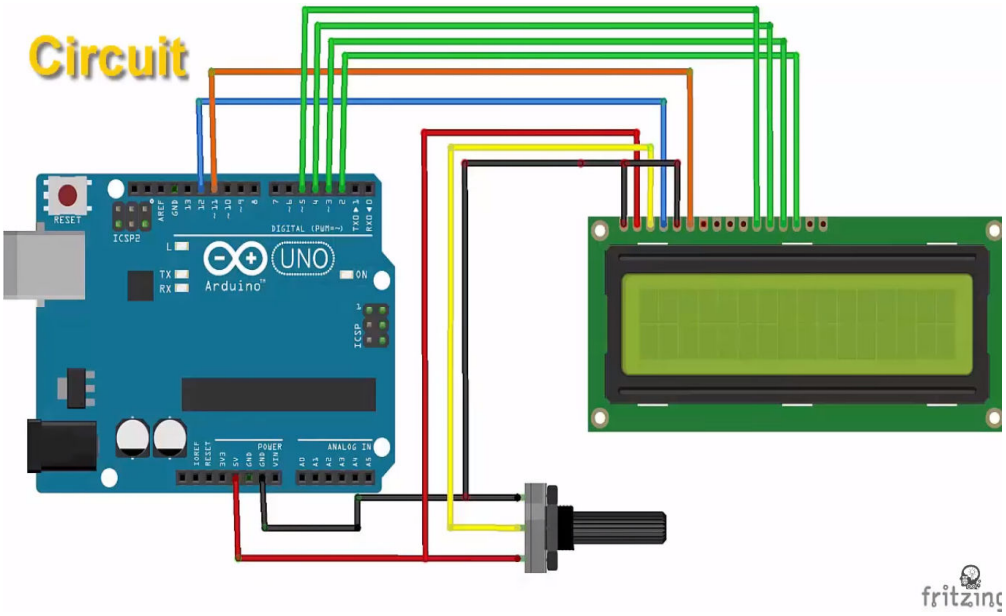

Figure 4.2: Circuit Diagram for LCD.

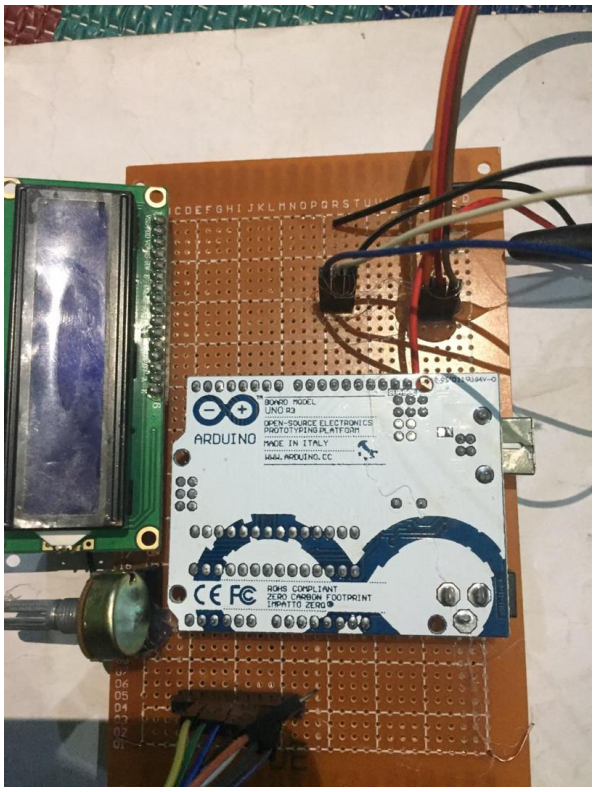

Figure 4.3: LCD Connection.

The variable resistor was connected in the circuit where it was fed from the Arduino Uno and connected with the LCD to control the LCD illumination. As shown as in Figure 4.4 and Figure 4.5.

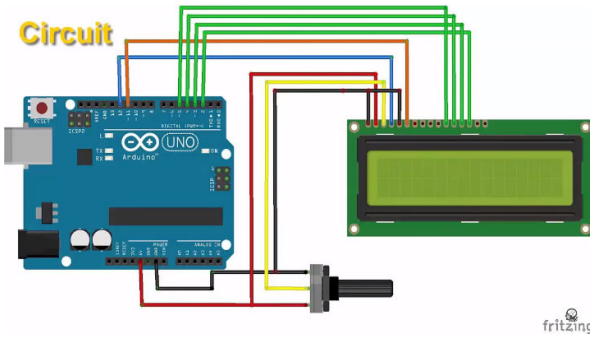

Figure 4.4: Circuit Diagram for Variable Resistor.

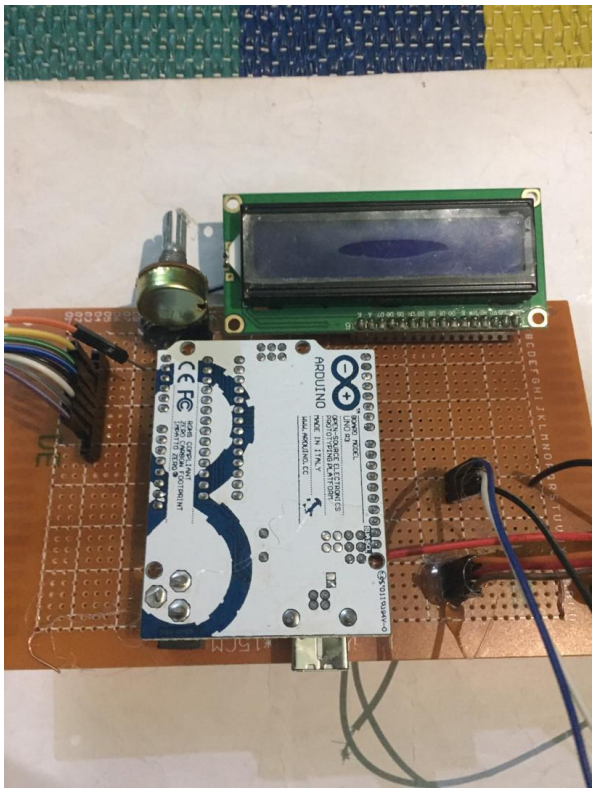

Figure 4.5: Variable Resistor Connection.

A keypad 4×4 was connected in the circuit where the keypad points were connected as follows:

A5, A4, A3, A2, 3, 2, A0, A1.

```
#include <Keypad.h>


const byte ROWS = 4;
const byte COLS = 4;

char hexaKeys[ROWS][COLS] = {
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
```

};

byte rowPins[ROWS] = {3,2,A0,A1};

byte colPins[COLS] = {A2,A3,A4,A5};

Keypad customKeypad = Keypad(makeKeymap(hexaKeys), rowPins, colPins, ROWS, COLS);

Figure 4.6 and Figure 4.7 shown circuit diagram and connection circuit.

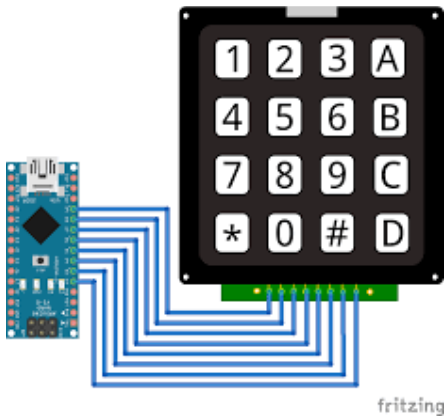

Figure 4.6: Circuit Diagram for Keypad 4×4.

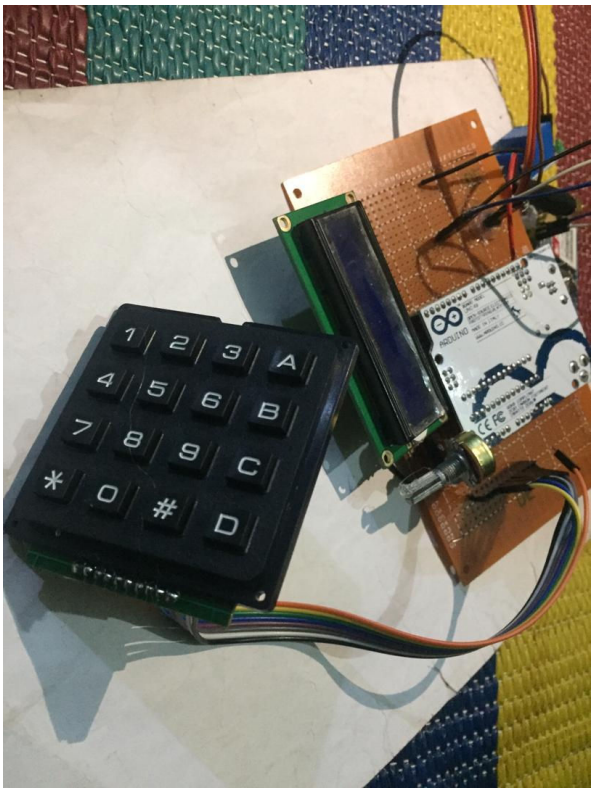

Figure 4.7: keypad Connection.

Relay is plugged into the circuit as follow: GND goes to ground, VCC goes to 5V, input pin receives the control signal from Arduino. As shown as in Figure 4.8 and Figure 4.9.

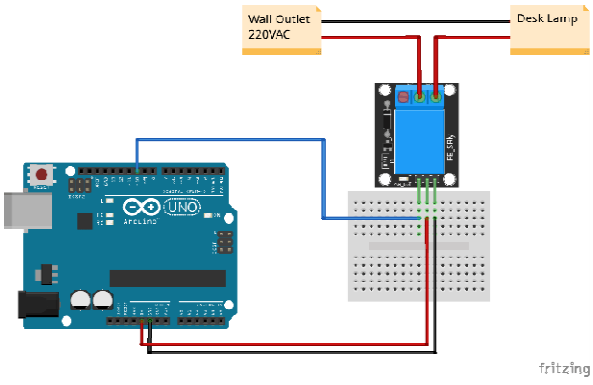

Figure 4.8: Circuit Diagram for Relay.

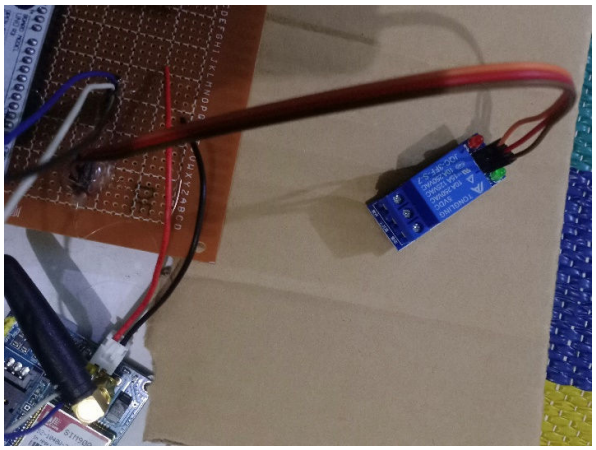

Figure 4.9: Relay Connection.

Figure 4.10 shown connection circuit for GSM.

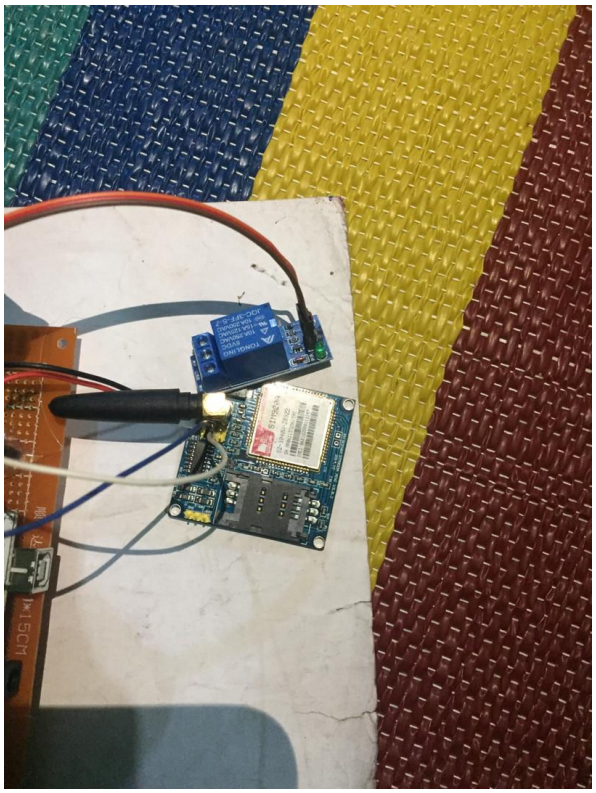

Figure 4.10: GSM Connection.

4.2 The Method of Work

First, the Arduino IDE program is loaded into the computer and installed, then the components used in the work circuit are defined in the

manage libraries, and finally the code is loaded into the Arduino Uno. As shown as in Figure 4.11 and Figure 4.12.

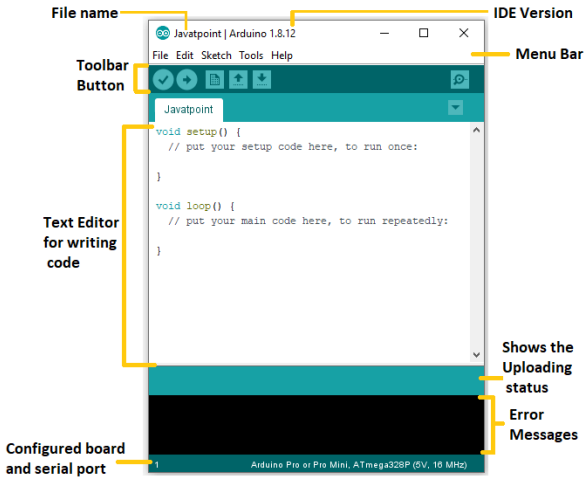

Figure4.11: Arduino IDE.

Figure 4.12: Enter the password of the circuit.

4.3 Result

When the correct password is entered, GSM sends a message to electric substation staff. As shown as in figure 4.13. figure4.14 show the message.

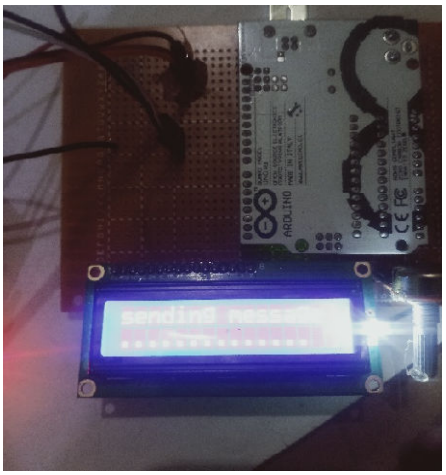

Figure 4.13: Sending message.

Figure 4.14: Confirmation message.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The project titled “alert messages to the power circuit for line man security” is a model for reducing fatal accidents with the help of Arduino UNO and GSM modem.

For repairing the electric lines, the lineman and his safety plays a major role Technology is ruling the world now days, but it should not erase problems for our development. Human safety is the most important factor.

We have completed the project as per the requirements of our project.

Finally, the aim of the project to avoid the fatal accidents for line man.

5.2 Recommendations

- In future can send an SMS to switch on the power circuit after the control panel accept to return the circuit breaker.
- can place sensors for each and every line to detect the fault and automatic Send fault SMS to lineman for repair of line.

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APPENDEIXES

ARDUINO CODE

```
#include <Keypad.h>
#include<LiquidCrystal.h>
#include <SoftwareSerial.h>
SoftwareSerial GPRS(7, 8);

LiquidCrystal lcd(9, 11, 10, 6, 5, 4);

#define Password_Length 8

int signalPin = 13;
//////////////////////
//////////////////////
String inputString = "";         // a string to hold incoming data
boolean stringComplete = false;  // whether the string is complete
String incomingString ="";
int startIndex = 0;
int endIndex = 0;
//////////////////////
//////////////////////
char Data[Password_Length];
char Master[Password_Length] = "1234567";
byte data_count = 0, master_count = 0;
bool Pass_is_good;
char customKey;
```

```
const byte ROWS = 4;
const byte COLS = 4;

char hexaKeys[ROWS][COLS] = {
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};

byte rowPins[ROWS] = {3,2,A0,A1};

byte colPins[COLS] = {A2,A3,A4,A5};

Keypad customKeypad = Keypad(makeKeymap(hexaKeys), rowPins, colPins, ROWS, COLS);




void setup(){

  lcd.begin(16, 2);
  pinMode(signalPin, OUTPUT);
//////////////////////////////
//////////////////////////////
  GPRS.begin(9600);
  Serial.begin(9600);
  GPRS.println("AT+CMGF=1");
  delay(1000);
```

```
//////////////////////////
//////////////////////////
}

void loop(){
  lcd.setCursor(0,0);
  lcd.print("Enter Password:");
    while(GPRS.available()) {
    Serial.write(GPRS.read());
  }
  customKey = customKeypad.getKey();
  if (customKey){
    Data[data_count] = customKey;
    lcd.setCursor(data_count,1);
    lcd.print(Data[data_count]);
    data_count++;
    }
  if(data_count == Password_Length-1){
    lcd.clear();

    if(!strcmp(Data, Master)){
        lcd.setCursor(0,0);
      lcd.print("sending message");
        lcd.setCursor(0,1);
      lcd.print(".............");

            for(;;){
                while(GPRS.available()) {
    Serial.write(GPRS.read());
```

```
  }
  sendSMS();
  digitalWrite(signalPin, HIGH);lcd.clear();  delay(250);
        lcd.setCursor(0,0);  lcd.print("closeing circuit");
        lcd.setCursor(5,1);  lcd.print("breaker");
lcd.clear();  delay(50000);
        lcd.setCursor(0,0);  lcd.print("closeing circuit");
        lcd.setCursor(5,1);  lcd.print("breaker");
  digitalWrite(signalPin, LOW);delay(500);lcd.clear();
          }
    ////////////////////////////////////
    ////////////////////////////////////
    ////////////////////////////////////
     }
   else{
     lcd.print("error");
     delay(1000);
     }

   lcd.clear();
   clearData();
  }
}
void clearData(){
  while(data_count !=0){
    Data[data_count--] = 0;
  }
  return;
}
```

```
//////////////////////////////
//////////////////////////////
//////////////////////////
void sendSMS(){
  Serial.print("close circuit breaker");
  GPRS.println("AT+CMGF=1");
  delay(1000);

  GPRS.println("AT+CMGS=\"+249990221966\"");
  delay(500);
  GPRS.print("close circuit breaker");

  GPRS.write( 0x1a ); // ctrl+Z character

  delay(500);
  }
```