A

Project

On

Arduino Based Three Phase AutoMatic Fault Detection Analysis

B.E (ELECTRICAL ENGINEERING) SEM-8

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1.INTRODUCTION

Till last decades, a million miles of cables are threaded in the air across the country. But currently it is laid in the underground, which is larger to an earlier method. Because, underground cables are not affected by any adverse weather condition like pollution, heavy rainfall, snow and storm, etc. But, when any problem occurs in cable, it is very difficult to find the exact location of the fault due to not knowing the exact location of the cable. Day by day, the world is becoming digitized so the project is proposed to find the location of fault in digital way. When the fault occurs, the process of repairing related to that particular cable is very difficult. The fault of the cable mainly occurs due to many reasons. They are inconsistent, any defect, weakness of the cable, insulation failure and breaking of the conductor. To overcome this problem, here is a project namely underground cable fault distance locator, used to find the location of the fault for underground cable. Before attempting to find underground cable faults on direct hidden cable, it is essential to know where the cable is situated and what direction it takes. Since it is extremely difficult to find a cable fault without knowing where the cable is, it makes sense to master cable locating and tracking before start the fault locating process .The success of fault tracking and locating of an underground cable is mainly depends on the skill, knowledge and experience of that person. Although tracing of the cable can be an intricate job, it will very likely become even more complex as more underground plant is installed. It is just as important to understand how the equipment works.

The main concept of this project is to find the distance of underground cable fault from the base station in kilometres. In many urban areas, cable fault is a common problem. When a fault occurs due to some reason, the process of fault tracking without knowing the location related to that particular cable is very difficult. The proposed system is designed to track the exact location of the fault occurred in the cable.

This project uses Ohms Law concept, when a low voltage DC is applied to the feeder end through cable lines, then the voltage would differ based on the location of fault occurred in the cable. In case there occurs any fault, then the voltage across the lines vary accordingly, then it is fed to Arduino Microcontroller.

The fault creation is designed with a set of switches at every known kilometre (KM) to cross check the exactness of the same. The fault happening at a specific distance is displayed on an LCD interfaced to the Arduino microcontroller which is pre programmed.

1.1 EARLY METHODS OF FAULT LOCATION

Free location methods can be classified into different types that are discussed below.

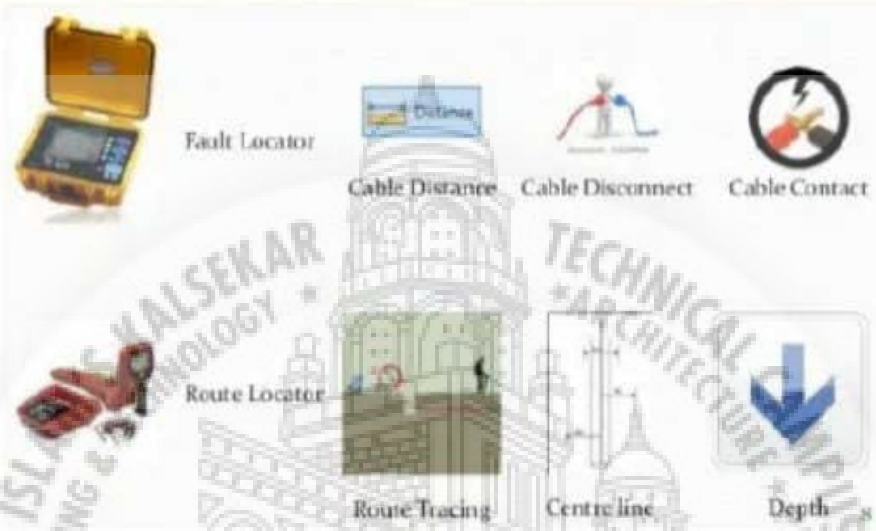


FIG 1.1a CABLE FAULT LOCALIZATION

ONLINE METHOD

Online method uses and process the sampled current and voltages to determine the fault points. This method for underground cable are less than above lines.

OFFLINE METHOD : This method uses a special instrument to test out service of cable in the field. Offline method is classified into two methods such as tracer method and terminal method.

TRACER METHOD : In this method fault of the cable can be detected by walking on the cable lines.Fault location is denoted from electromagnetic signal or audible signal. This method is used to find the fault location very accurately.

TERMINAL METHOD : Terminal method is used to detect the location of the fault in a cable from one end or both the ends without tracking. This method is used to find general areas of the fault to accelerate tracking on buried cable.

2.LITERATURE SURVEY

This section provided the list of some significant works carried out by different investigators for underground cable fault detection.

Pooja P.S and Lekshmi. M [2015], developed a resilient incipient fault location algorithm in the time-domain, which utilizes data collected by PQ monitors to estimate the fault location in terms of the line impedance by taking into account the arc voltage associated with the incipient cable faults So the algorithm predicts cable fault location between two adjacent manholes. The ANNs are a family of statistical learning algorithm inspired by biological neural networks and are used to appropriate functions that depend on the large number of inputs. The proposed algorithm exactly pin-points the exact fault in the underground cable.

A.Ngaopitakkul, C. Pothisarn, M. Leelajindakrairerk [2011], presented behaviour of simultaneous fault signals in distribution underground cable using DWT. The simulations were performed using ATP/EMTP, and the analysis behaviour of characteristics signals was performed using DWT. Various case studies have been carried out including the single fault and simultaneous fault.

Abhishek Pandey, Nicolas H. Younan, [2010], presented underground cable fault detection and identification via fourier analysis. The methods of impedance calculation via sending end voltage and differential voltage can be used for differentiating between the different types of cable defects from phase information. It needs study to be conducted to find the best way of visualizing the results, especially the magnitude response.

H. Shateri, S. Jamali Et Al [2010] proposed An impedance based fault location method for phase to phase and three phase faults. This method utilized the measured impedance by distance relay and the super imposed current factor to discriminate the fault location. This method is sensitive to the measured impedance accuracy and super imposed current factor.

Yuan Liao, Ning Kang [2009] has presented fault location algorithms without utilizing line parameters. By utilizing unsynchronized voltage and current measurements from both ends of line without requiring line parameters based on the distributed parameter line model. The fault location estimate is not sensitive to measurement errors while line parameter estimates are sensitive to measurement errors. Thus relatively precise measurements are required to obtain accurate line parameter estimates.

S. Navaneethan, J. J. Soraghan, W. H. Siew, F. McPherson, P. F. Gale [2001] , presented an automatic fault location method using TDR. This method uses acquired data from an existing TDR instrument. It enables user of TDR equipment to locate ULVDN cable faults without user interpretation.

3.HARDWARE REQUIREMENTS

3.1 HARDWARE COMPONENTS

1. TRANSFORMER (220-12V AC)
2. VOLTAGE REGULATOR
3. RECTIFIER
4. FILTER
5. ARDUINO
6. LIQUID CRYSTAL DISPLAY
7. POPO BUTTONS
8. BUZZER
9. POTENTIOMETER
10. RESISTOR
11. DIODE
12. CAPACITOR

3.1.1 TRANSFORMER

A transformer is a static machine used for transforming power from one circuit to another without changing frequency. Since there is no rotating or moving part so transformer is a static device. Transformer operates on ac supply. Transformer works on the principle of mutual induction .Generation of electrical power in low voltage level is very much cost effective. Theoretically, this low voltage level power can be transmitted to the receiving end. This low voltage power if transmitted results in greater line current which indeed causes more line losses but if the voltage level of a power is increased, the current of the power is reduced which causes reduction in ohmic or I^2R losses in the system, reduction in cross sectional area of the conductor i.e. reduction in capital cost of the system and it also improves the voltage regulation of the system. Because of these, low level power must be stepped up for efficient electrical power transmission. This is done by step up transformer at the sending side of the power system network. As this high voltage power may not be distributed to the consumers directly, this must be stepped down to the desired level at the receiving end with the help of step down transformer. Electrical power transformer thus plays a vital role in power transmission.

Step up transformers increase voltage , step down transformers reduce voltage. Most power supplies use a step down transformer to reduce the dangerously high voltage to a safer low voltage.

Fig 3.1.1a A typical Transformer

The input coil is called primary coil and the output coil is called secondary. there is no electrical coonection between two coils; instead they are linked by an alternating magnetic field created in soft iron core of transformer.The two lines in the middle of the circuit symbol represent the core.As voltage is stepped down current is stepped up.

The ratio of the number of turns on each coil ,called turns ratio , determines the ratio of voltages.A step down transformer has a large no. of turns on its primary coil which is connected to the high voltage mains supply, and a small number of turns on its secondary coil to give a low output voltage.

$$\text{TURNS RATIO} = (\text{Vp} / \text{Vs}) = (\text{Np} / \text{Ns})$$

Where,

Vp = Primary (input) voltage

Vs = Secondary (output) voltage

Np = number of turns on primary coil

Ns = number of turns on secondary coil

Ip = primary (input) current

Is = secondary (output) current

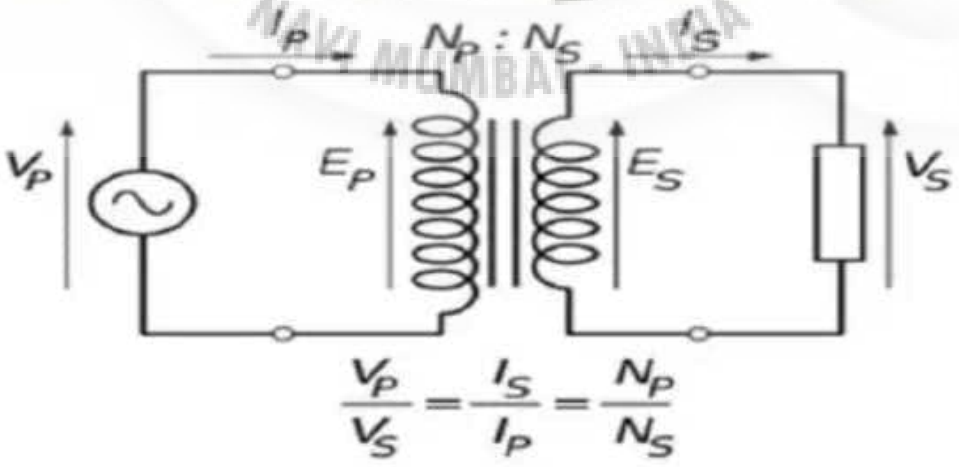


Fig 3.1.1b CIRCUIT DIAGRAM OF TRANSFORMER

3.1.2 RECTIFIER

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification, since it "straightens" the direction of current. rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches. Rectifiers have many uses, but are often found serving as components of DC power supplies and high-voltage direct current power transmission systems. Rectification may serve in roles other than to generate direct current for use as a source of power. As noted, detectors of radio signals serve as rectifiers.The output from the transformer is fed to the rectifier.It converts AC into pulsating DC.The rectifier may be a half wave or full wave rectifier.In this project,a Bridge-rectifier is used because of its merits like good stability and full wave rectification.In positive half cycle only two diodes (1 set of parallel diodes)will conduct, & in negative half cycle remaining two diodes will conduct and they will conduct only in forward bias only.

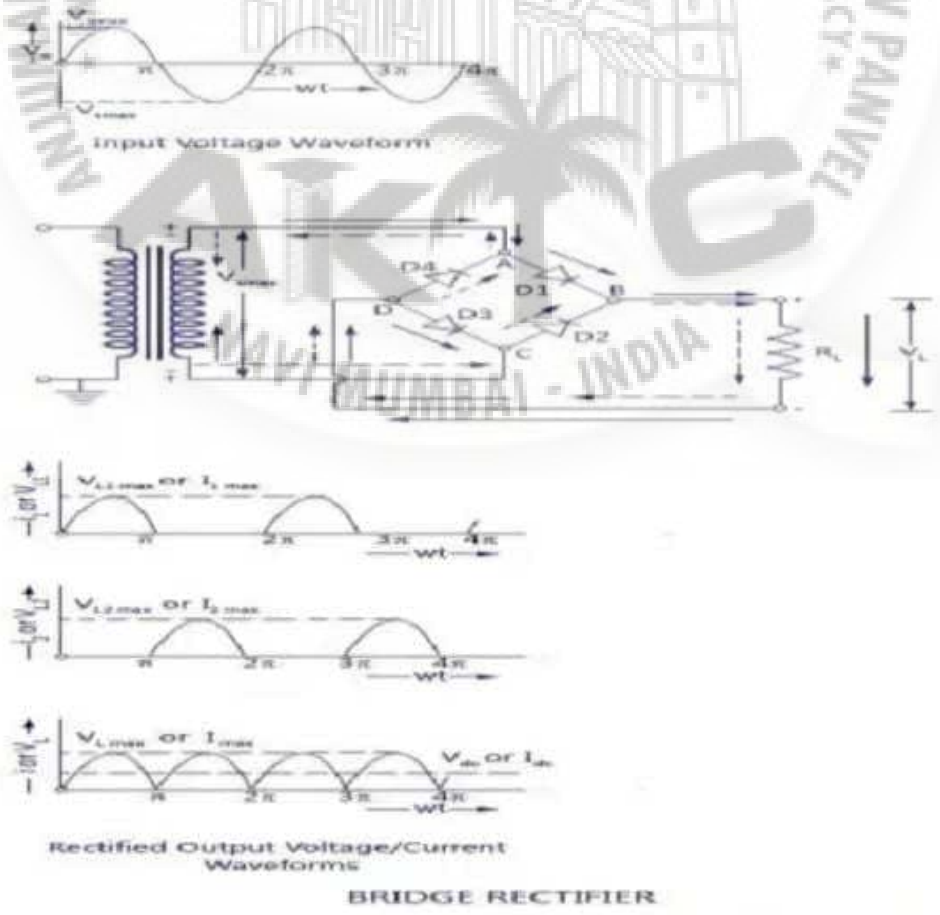
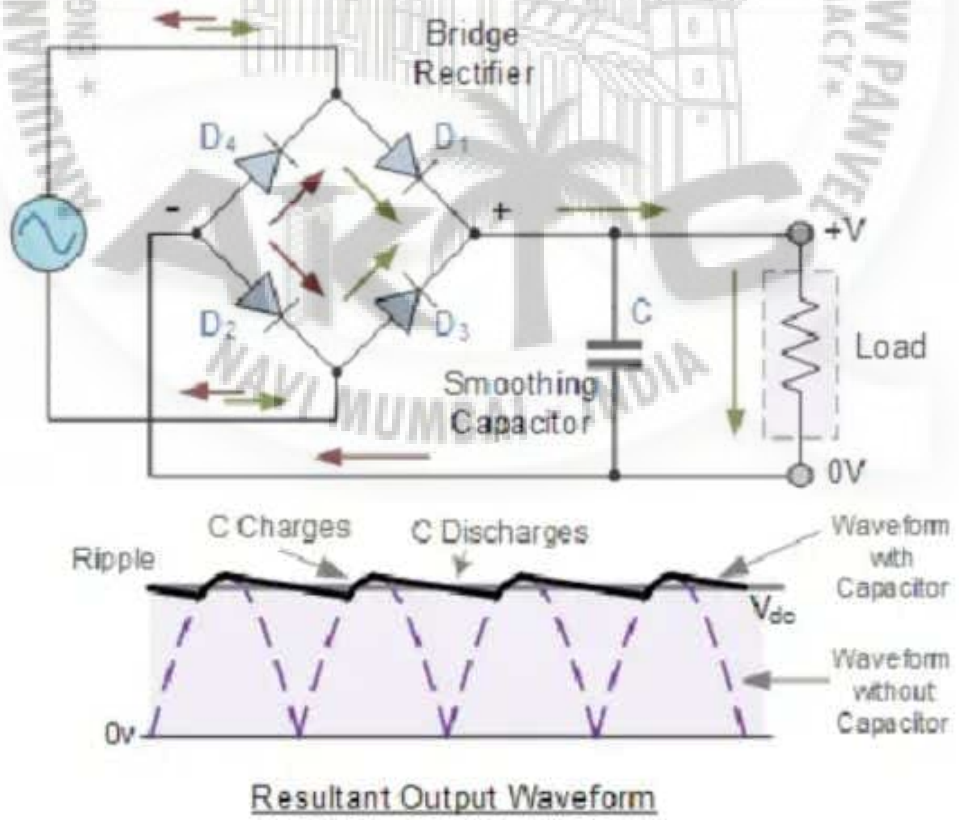


FIG 3.1.2a FULL WAVE BRIDGE RECTIFIER

3.1.3 FILTER

Capacitive filter is used in this project. It removes the ripples from the output of rectifier and smoothens the DC output received from this filter and remains constant until the mains voltage and load is maintained constant. However, if either of the two is varied , DC voltage received at this point changes .Therefore a regulator is applied at the output stage

The simple capacitor filter is the most basic type power supply filter .The use of this filter is very limited. It is sometimes used on extremely high voltage, low current power supplies for cathode-ray and similar electron tubes that require very little load current from the supply. This filter is also used in circuits where the power supply , ripple frequency is not critical and can be relatively high. Below figure shows how the capacitor charges and discharges.



Resultant Output Waveform

FIG 3.1.3a FILTER CIRCUIT

3.1.4 VOLTAGE REGULATOR

Voltage sources in a circuit may have fluctuations resulting in not giving fixed voltage outputs. Voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a voltage regulator integrated circuit (IC) is a member of 78xx series of fixed linear voltage regulator ICs used to maintain such fluctuations. The xx in 78xx indicates the fixed output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add heat sink as well. 7812 will require an input above 13V and will produce a fixed 12V at its output.

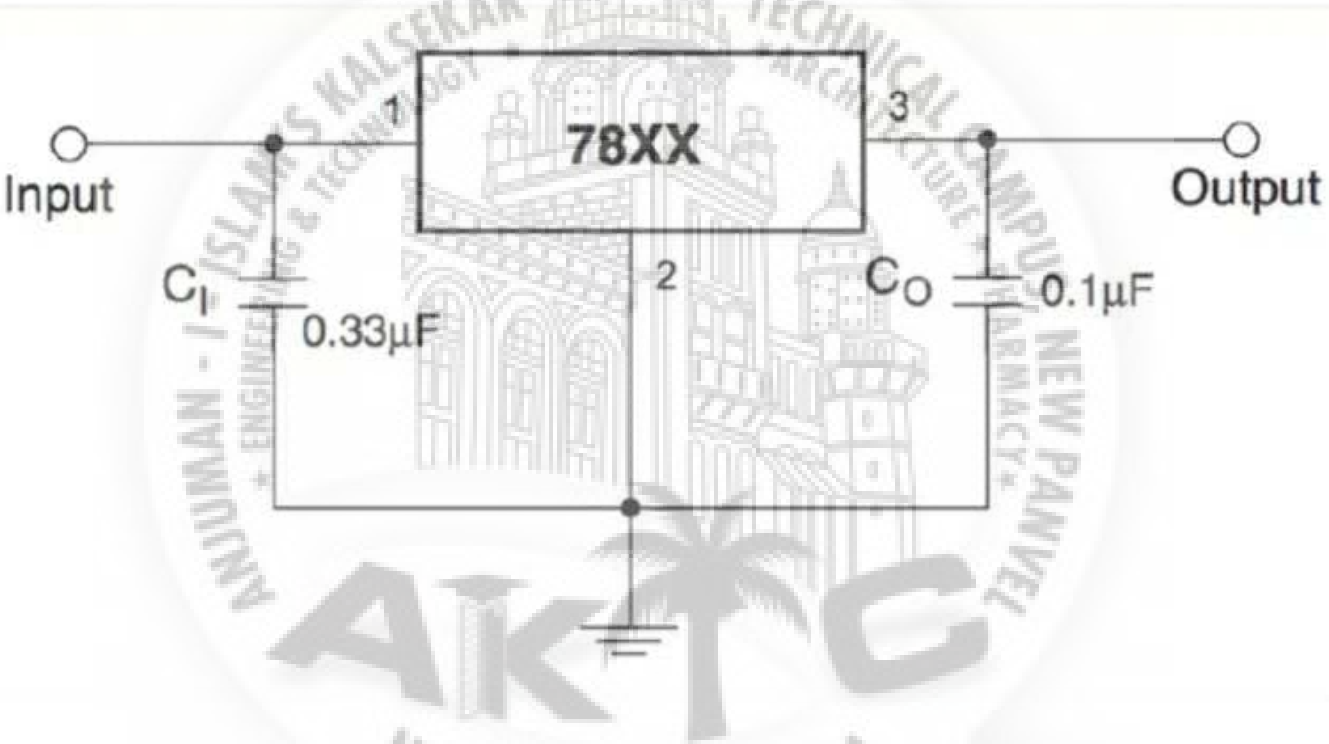


FIG 3.1.4a VOLTAGE REGULATOR

3.1.5 ARDUINO

An micro-controller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/ output peripherals.The important part for us is that a micro-controller contains the processor (which all computers have) and memory, and some input/output pins that you can control (often called GPIO - General Purpose Input Output Pins).

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. The Arduino project was started in Italy to develop low cost hardware for interaction design. The Arduino hardware comes in several flavours. With the Arduino board, you can write programs and create interface circuits to read switches and other sensors, and to control motors and lights with very little effort. This is what the Arduino board looks like

FIG 3.1.5a ARDUINO UNO

The project is based on microcontroller board designs, manufactured by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an *integrated development environment (IDE)* based on the Processing project, which includes support for the *C* and *C++* programming languages.

The first Arduino was introduced in 2005, aiming to provide an inexpensive and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors

Arduino is best known for its hardware, but you also need software to program that hardware. Both the hardware and software are called "arduino". The combination enables you to create projects that sense and control the physical world. The software is free, open source, and cross- platform. The boards are inexpensive to buy, or you can build your own (the hardware designs are also open source). In addition, there is an active and supportive arduino community that is accessible worldwide through the arduino forums and the wiki (known as the arduino playground).

3.1.5.1. Arduino software

Software programs, called sketches, are created on a computer using the arduino integrated development environment (IDE). The IDE enables you to write and edit code and convert this code into instruction that arduino hardware understands. The IDE also transfers those instructions to the arduino board (a process called uploading).

3.1.5.2 Arduino hardware

An Arduino board historically consists of an Atmel 8, 16 or 32-bit AVR microcontroller (although since 2015 other makers' microcontrollers have been used) with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which lets users connect the CPU board to a variety of interchangeable add-on modules known as *shields*. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an *I²C serial bus*—so many shields can be stacked and used in parallel. Prior to 2015 Official Arduino had used the Atmel megaAVR series of chips, specifically the ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560 and in 2015 units by other manufacturers were added. A handful of other processors have also been used by Arduino compatible devices. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator (or ceramic resonator in some variants), although some designs such as the LilyPad run at 8 MHz and dispense with the on-board voltage regulator due to specific form-factor restrictions. An Arduino microcontroller is also pre-programmed with a boot loader that simplifies uploading of

programs to the on-chip *flash memory*, compared with other devices that typically need an *external programmer*. This makes using an Arduino more straightforwardby allowing the use of an ordinary computer as the programmer. Currently, optiboot boot loader is the default boot loader installed on Arduino UNO[3].

FIG 3.1.5.2a ARDUINO

There are many Arduino-compatible and Arduino-derived boards. Some are functionally equivalent to an Arduino and can be used interchangeably. Many enhance the basic Arduino by adding output drivers, often for use in school-level education to simplify the construction of buggies and small robots. Others are electrically equivalent but change the form factor, sometimes retaining compatibility with shields, sometimes not.

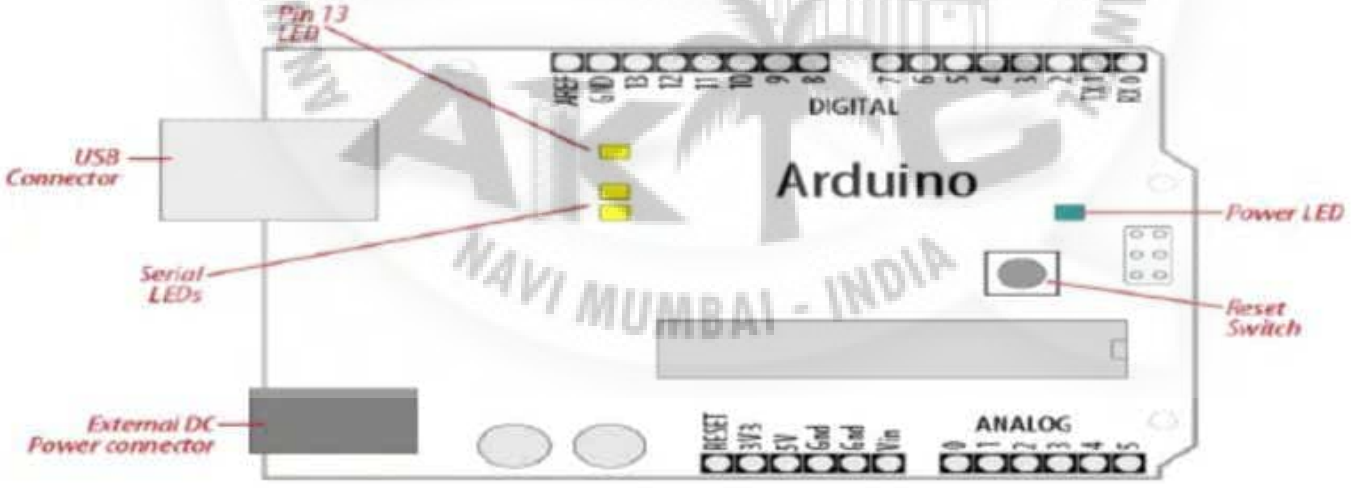


FIG 3.1.5.2b AN OFFICIAL ARDUINO UNO

The original Arduino hardware was manufactured by the Italian company Smart Projects. Some Arduino-branded boards have been designed by the American companies **Spark Fun** and **AdafruitIndustries**. Sixteen versions of the Arduino hardware have been commercially produced to date.

3.1.5.3 TYPES OF ARDUINO

- Arduino Uno
- Arduino Leonardo
- Arduino LilyPad
- Arduino Mega
- Arduino Nano
- Arduino Mini
- Arduino Mini Pro

3.1.6 ARDUINO NANO

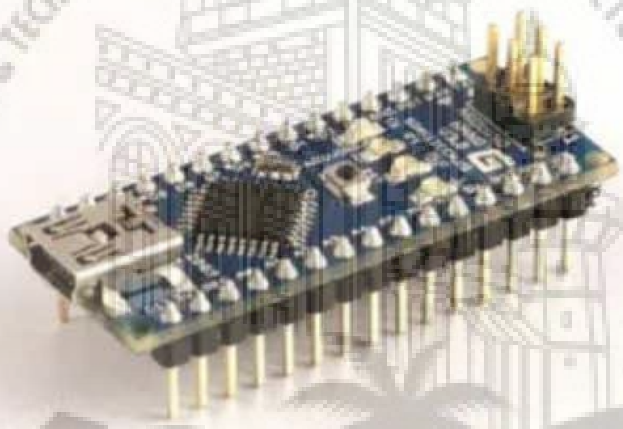


FIG 3.1.6a ARDUINO NANO

3.1.6.1 OVERVIEW

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by Gravitech.

3.1.6.2 SUMMARY

Table 3.1.6.2a "Features of Nano"

Microcontroller	Atmel ATmega168 or ATmega328
Operating Voltage (logic level)	5 V
Input Voltage (recommended)	7-12 V
Input Voltage (limits)	6-20 V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	8
DC Current per I/O Pin	40 mA
Flash Memory	16 KB (ATmega168) or 32 KB (ATmega328) of which 2 KB used by bootloader
SRAM	1 KB (ATmega168) or 2 KB (ATmega328)
EEPROM	512 bytes (ATmega168) or 1 KB (ATmega328)
Clock Speed	16 MHz
Dimensions	0.73" x 1.70

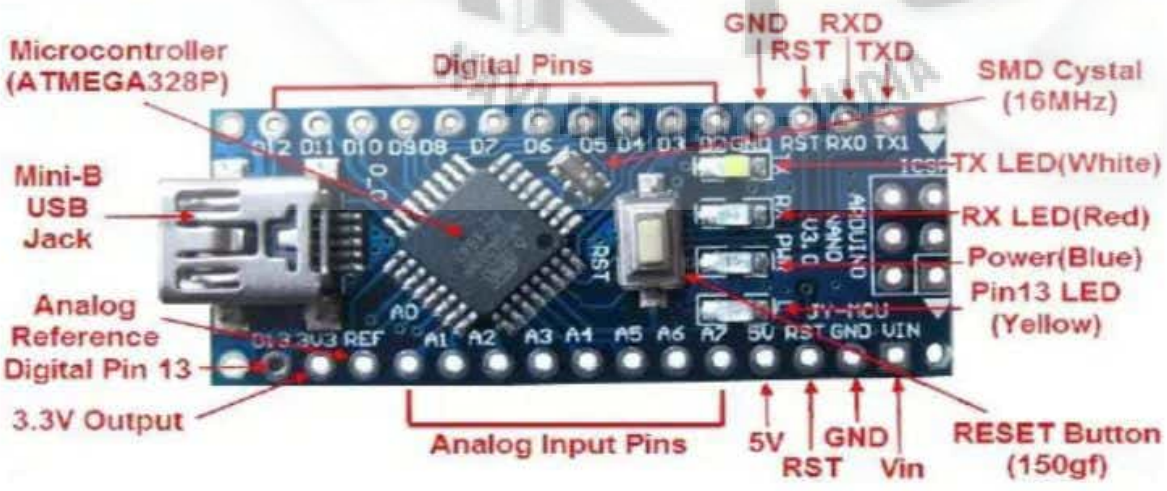


FIG 3.1.6.2b ARDUINO NANO PIN DESCRIPTION

3.1.6.3 POWER

The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source.

The FTDI FT232RL chip on the Nano is only powered if the board is being powered over USB. As a result, when running on external (non-USB) power, the 3.3V output (which is supplied by the FTDI chip) is not available and the RX and TX LEDs will flicker if digital pins 0 or 1 are high.

3.1.6.4 MEMORY

The ATmega168 has 16 KB of flash memory for storing code (of which 2 KB is used for the bootloader); the ATmega328 has 32 KB, (also with 2 KB used for the bootloader). The ATmega168 has 1 KB of SRAM and 512 bytes of EEPROM (which can be read and written with the EEPROM library); the ATmega328 has 2 KB of SRAM and 1 KB of EEPROM.

3.1.6.5 INPUT AND OUTPUT

Each of the 14 digital pins on the Nano can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip.
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- **PWM: 3, 5, 6, 9, 10, and 11.** Provide 8-bit PWM output with the analogWrite() function.

- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- **LED: 13.** There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Nano has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the analogReference() function. Additionally, some pins have specialized functionality:

- **I2C: 4 (SDA) and 5 (SCL).** Support I2C (TWI) communication using the Wire library (documentation on the Wiring website).

There are a couple of other pins on the board:

- **AREF.** Reference voltage for the analog inputs. Used with analogReference().
- **Reset.** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

3.1.6.6 COMMUNICATION

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega168 and ATmega328 provide UART

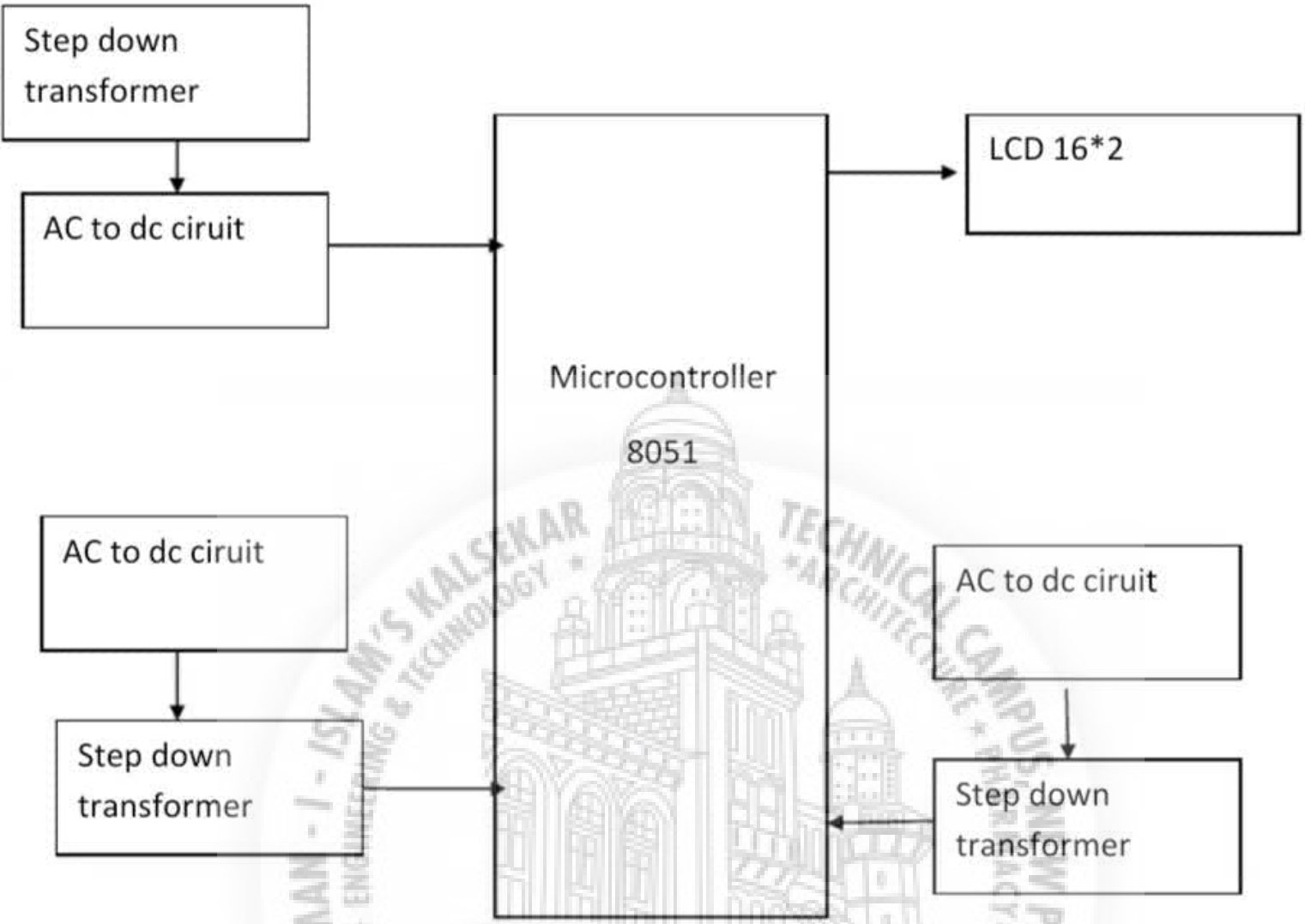
TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An FTDI FT232RL on the board channels this serial communication over USB and the FTDI drivers (included with the Arduino software) provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the FTDI chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A SoftwareSerial library allows for serial communication on any of the Nano's digital pins.

The ATmega168 and ATmega328 also support I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus.

3.1.6.7 AUTOMATIC SOFTWARE RESET

Rather than requiring a physical press of the reset button before an upload, the Arduino Nano is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the FT232RL is connected to the reset line of the ATmega168 or ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. This setup has other implications. When the Nano is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Nano. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

FIG. 3.1.6.7a PIN DIAGRAM OF AT MEGA328



BLOCK DIGRAM OF TRANSMISSION LINE FAULT MONITORING

Precautions:

While wiring, assembly and installation of the circuit ,make sure that you

1. use good quality wires.

2. use good quality relay

3. Iron soldering temperature should be below 350 degree cent.

4.Use good quality soldering wire.

compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

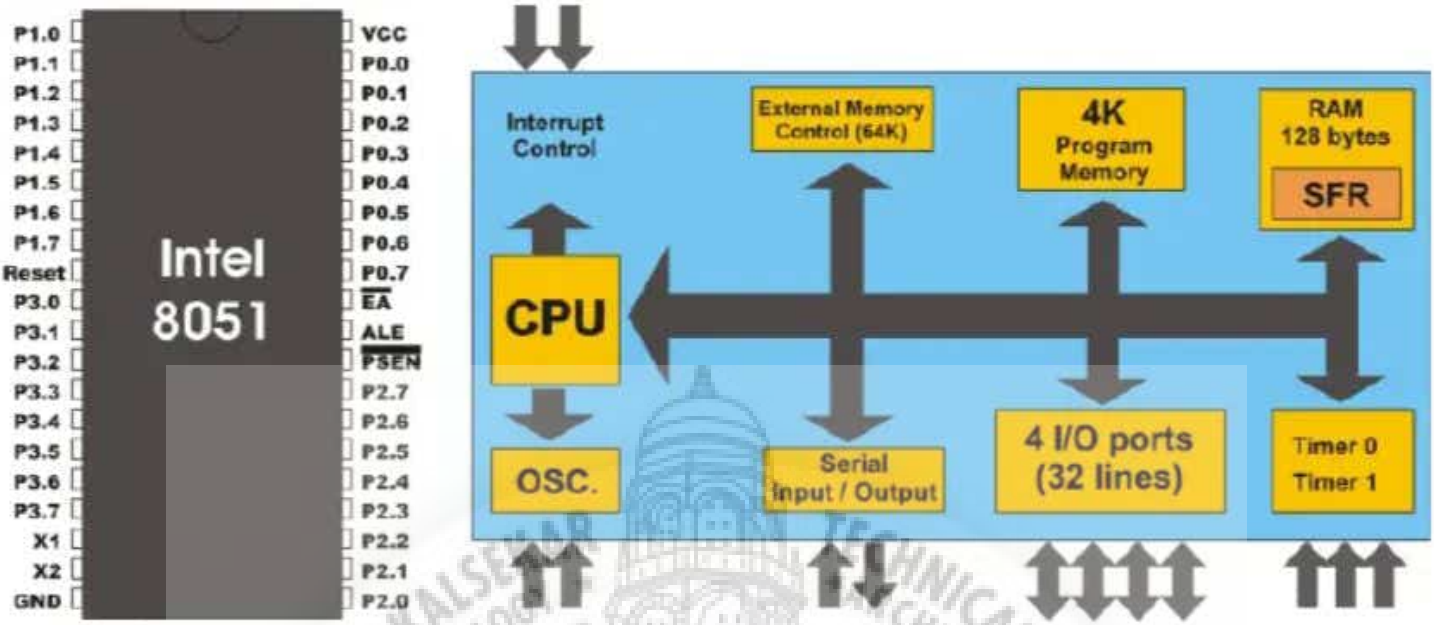
Some microcontrollers may use four-bit words and operate at clock rate frequencies as low as 4 kHz, for low power consumption (millwatts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption

Microcontroller 8051:

The Intel 8051 is an 8-bit microcontroller which means that most available operations are limited to 8 bits. There are 3 basic "sizes" of the 8051: Short, Standard, and Extended. The Short and Standard chips are often available in DIP form, but the Extended 8051 models often have a different form factor, and are not "drop-in compatible". All these things are called 8051 because they can all be programmed using 8051 assembly language, and they all share certain features (although the different models all have their own special features).

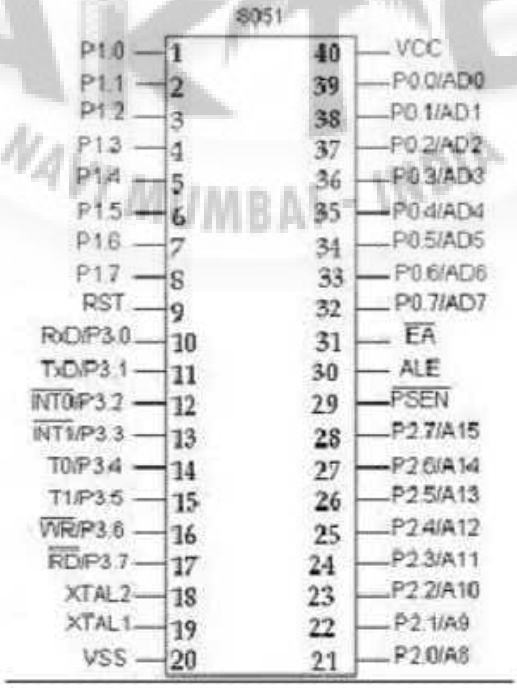
Some of the features that have made the 8051 popular are:

- 8-bit data bus
- 16-bit address bus
- 32 general purpose registers each of 8 bits
- 16 bit timers (usually 2, but may have more, or less).
- 3 internal and 2 external interrupts.
- Bit as well as byte addressable RAM area of 16 bytes.
- Four 8-bit ports, (short models have two 8-bit ports).
- 16-bit program counter and data pointer



INTEL 8051

Pin description of intel 8085:



3.1.7 LIQUID CRYSTAL DISPLAY

A liquid crystal display or LCD draws its definition from its name itself. It is combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screen that are generally used in laptop computer screen, TVs, cell phones and portable video games. LCD's technologies allow displays to be much thinner when compared to cathode ray tube (CRT) technology.

Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes. LCD technology is used for displaying the image in notebook or some other electronic devices like mini computers. Light is projected from a lens on a layer of liquid crystal. This combination of colored light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the colored image. This image is then displayed on the screen.

An LCD is either made up of an active matrix display grid or a passive display grid. Most of the Smartphone's with LCD display technology uses active matrix display, but some of the older displays still make use of the passive display grid designs. Most of the electronic devices mainly depend on liquid crystal display technology for their display. The liquid has a unique advantage of having low power consumption than the LED or cathode ray tube.

Liquid crystal display screen works on the principle of blocking light rather than emitting light. LCD's requires backlight as they do not emits light by them. We always use devices which are made up of LCD's displays which are replacing the use of cathode ray tube. Cathode ray tube draws more power compared to LCD's and are also heavier and bigger.

Most of the LCD Displays available in the market are 16X2 (That means, the LCD displays are capable of displaying 2 lines each having 16 Characters a), 20X4 LCD Displays (4 lines, 20 characters). It has 14 pins. It uses 8lines for parallel data plus 3 control signals, 2 connections to power, one more for contrast adjustment and two connections for LED back light. Let us have a look to typical pin configurations

This 20x4 Character LCD Display is built-in with RW1063 controller IC which are 6800, 4 line SPI or I2C interface options. The WH2004G 20x4 LCD Display have the same AA

size and pin assignment as existing WH2004A and WH2004B character LCD modules but with smaller outline and VA size. Below are the available series model numbers

- WH2004G - 6800 interface
- WH2004G1 - 4 line SPI interface
- WH2004G3 - I2C interface

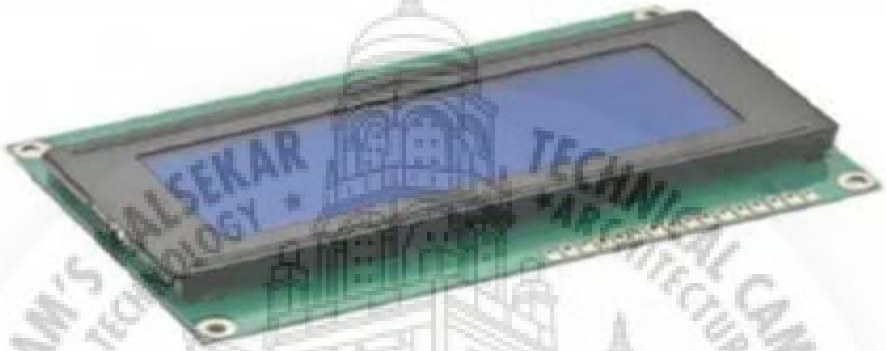


FIG 3.1.7a LCD 20x4

3.1.7.1 LCD BACKGROUND

Frequently , an Arduino Programm must interact with the outside world using input and output devices that communicate directly with a human being .One of the most common devices attached to an arduino is an LCD Display .Some of the most common LCDs connected to the arduino are 16x2 and 20x4 displays .This means 16 characters per line by 2 lines and 20 characters per line by 4 lines respectively.

Fortunately a very popular standard exists which allows us to communicate with the vast majority of LCDs regardless of their manufacturer. The standard is reffered to as HDD44780U , which refers to the controller chip , which receives data from an external source (in this case , the arduino) and communicates directly with the LCD.

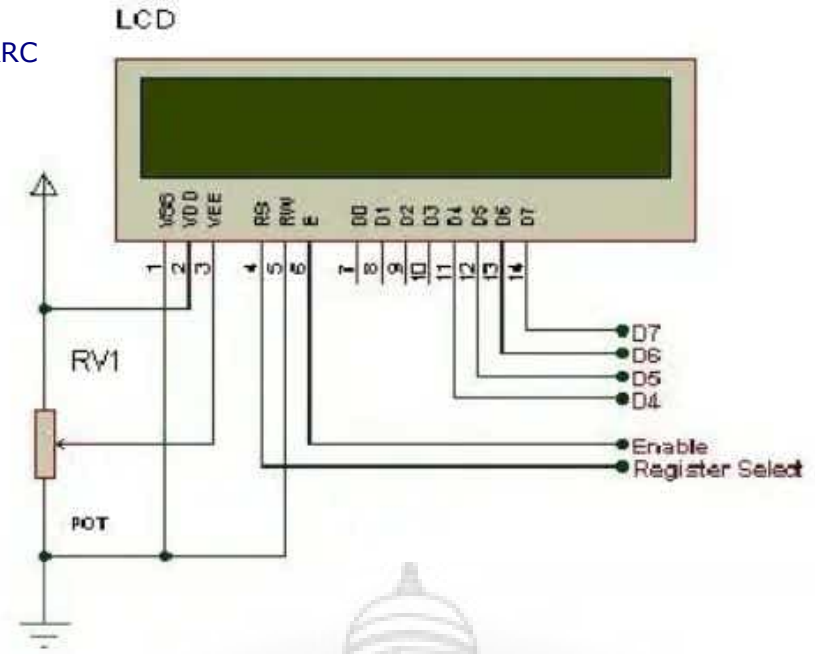


FIG 3.1.7.1a LCD CONNECTIONS

The 44780 standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. The user may select whether the LCD is to operate with a 4-bit data bus or an 8-bit data bus. If a 4-bit data bus is used the LCD will require a total of 7 data lines (3 control lines plus the 4 lines for the data bus). If an 8-bit data bus is used the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus).

The three control lines are referred to as **EN**, **RS**, and **RW**.

The **EN** line is called "Enable." This control line is used to tell the LCD that you are sending it data. To send data to the LCD, your program should make sure this line is low (0) and then set the other two control lines and/or put data on the data bus. When the other lines are completely ready, bring **EN** high (1) and wait for the minimum amount of time required by the LCD datasheet (this varies from LCD to LCD), and end by bringing it low (0) again.

The **RS** line is the "Register Select" line. When RS is low (0), the data is to be treated as a command or special instruction (such as clear screen, position cursor, etc.). When RS is high (1), the data being sent is text data which sould be displayed on the screen. For example, to display the letter "T" on the screen you would set RS high.

The **RW** line is the "Read/Write" control line. When RW is low (0), the information on the data bus is being written to the LCD. When RW is high (1), the program is effectively querying (or reading) the LCD. Only one instruction ("Get LCD status") is a read command. All the rest are write commands--so RW will almost always be low.

Finally, the data bus consists of 4 or 8 lines (depending on the mode of operation selected by the user). In the case of an 8-bit data bus, the lines are referred to as DB0, DB1, DB2, DB3, DB4, DB5, DB6, and DB7.

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

TABLE 3.1.7.1a LCD PIN DESCRIPTION

3.1.7.2 ADVANTAGES OF AN LCD'S:

- LCD's consumes less amount of power compared to CRT and LED
- LCD's are consist of some microwatts for display in comparison to some mill watts for LED's
- LCDs are of low cost
- Provides excellent contrast
- LCD's are thinner and lighter when compared to cathode ray tube and LED

3.1.7.3 DISADVANTAGES OF AN LCD'S:

- Require additional light sources
- Range of temperature is limited for operation
- Low reliability
- Speed is very low
- LCD's need an AC drive

3.1.7.4 APPLICATIONS OF LIQUID CRYSTAL DISPLAY

Liquid crystal technology has major applications in the field of science and engineering as well on electronic devices.

- Liquid crystal thermometer
- Optical imaging
- The liquid crystal display technique is also applicable in visualization of the radio frequency waves in the waveguide
- Used in the medical applications

3.1.8 POPO BUTTONS

A push button is a switch used to close or open an electric control circuit. They are primarily used for starting and stopping of operation of machinery. They also provide manual override when the emergency arises. Push button switches are actuated by pushing the actuator into the housing. This causes set of contacts to open or close. Push buttons are of two types i) Momentary push button ii) Maintained contact or detent push button Momentary push buttons return to their unactuated position when they are released. Maintained (or mechanically latched) push buttons has a latching mechanism to hold it in the selected position.

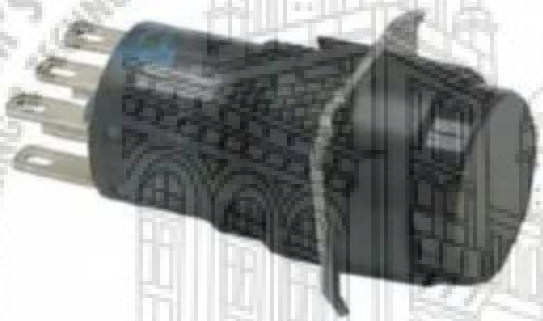


FIG 3.1.8a POPO BUTTON

The contact of the push buttons, distinguished according to their functions, i) Normally open (NO) type ii) Normally closed (NC) type iii) Change over (CO) type. The cross section of various types of push buttons in the normal and actuated positions and their symbols are given in the Figure 1.1 In the NO type, the contacts are open in the normal position, inhibiting the energy flow through them. But in the actuated position, the contacts are closed, permitting the energy flow through them. In the NC type, the contacts are closed in the normal position, permitting the energy flow through them. And, the contacts are open in the actuated position, inhibiting the energy flow through them. A changeover contact is a combination of NO and NC contacts.

Normally Open Push Buttons don't make electrical contact with the circuit when not pressed down.

Once pressed down, normally open push buttons now make contact and the circuit is now closed and powers or turns on the respective part the button was made for.

FIG 3.1.8b NO CONDITION

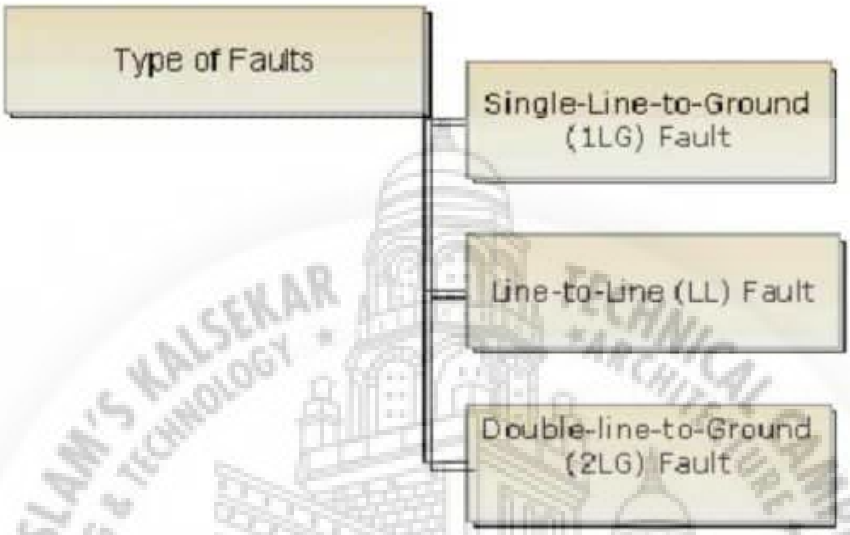
Normally Closed Push Buttons make electrical contact wtih the circuit in its default state, when not pressed.

Once pressed down, normally closed push buttons no longer make electrical contact with the circuit and now forms an open circuit. This means it will no longer power or turn on the device it was made for.

FIG 3.1.8c NC CONDITION

Common types of asymmetric faults.

Three Types of Faults



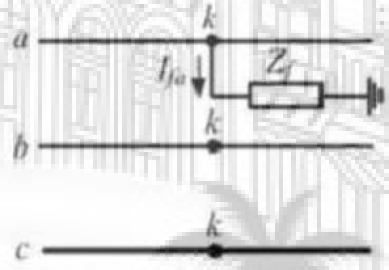
- *line-to-line* - a short circuit between lines, caused by ionization of air, or when lines come into physical contact, for example due to a broken insulator.

- *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

- *double line-to-ground* - two lines come into contact with the ground (and each other), also commonly due to storm damage.

Single line to ground fault:

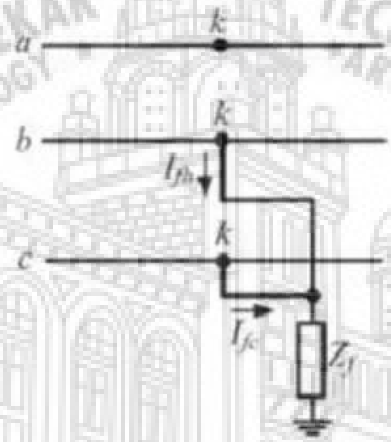
In this fault out of three phases any one of the line is grounded. When this fault occurs this fault sense by microcontroller and send to the LCD screen and we can detect this fault easily.



Single line to ground fault

TWO-LINE TO GROUND FAULT:

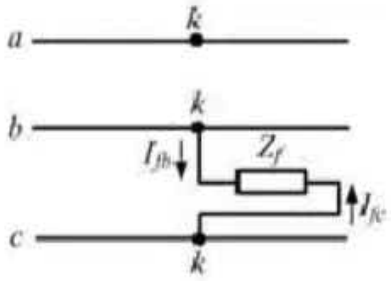
In this fault out of three phases any two of the line is grounded. When this fault occurs this fault sense by microcontroller and send to the LCD screen and we can detect this fault easily.



Two line to ground fault

LINE TO LINE FAULT:

In this fault out of three phases any two of the line are touch to each other. When this fault occur this fault sense by microcontroller and send to the LCD screen and we can detect this fault easily.

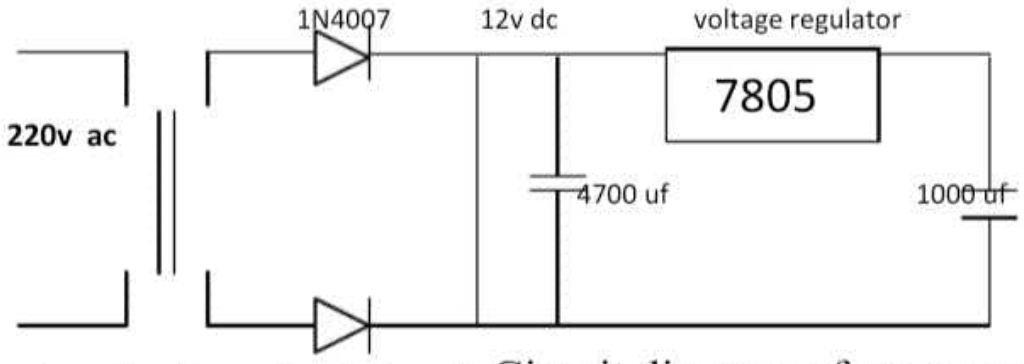


Line to line fault

Components:

DESCRIPTION OF POWER SUPPLY:

This circuit is a small +12 volts power supply, which is useful when experimenting with digital electronics. Small inexpensive wall transformers with variable output voltage are available from any electronics shop. Those transformers are easily available, but usually their voltage regulation is very poor, which makes them not very usable for digital circuit experimenter unless a better regulation can be achieved in some way. The following circuit is the answer to the problem. This circuit can give +12V output at about 1A current. The circuit has overload and terminal protection.



Step down transformer (centre tapped) Circuit diagram of power supply

Working of power supply circuit:

In this project we use for power supply use various components such as centre tapped step down transformer, diode, electrolyte, voltage regulator.

First 220v ac supply given to the centre tapped transformer which step down the 220v ac supply in to 12v ac supply. After step-down transformer we use rectifier to convert ac supply in to dc supply. For rectification of power we use diode which rectifies ac supply into dc supply. After rectification of power its converted in dc but this dc is pulsating so we use electrolyte which gives the static dc. After the electrolyte we use voltage regulator.

Voltage regulator maintains the terminal voltage of different voltage sources within required limits despite variations in input voltage or load. Voltage regulator gives the 5v dc supply to the circuit and again gives to the electrolyte circuit to give static dc.

Then we connect power supply circuit to the vcc of microcontroller.

Microcontroller :

A microcontroller (sometimes abbreviated µC, uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, and toys. By reducing the size and cost

3.1.9 RESISTORS

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits.

FIG 3.1.9a RESISTORS

The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

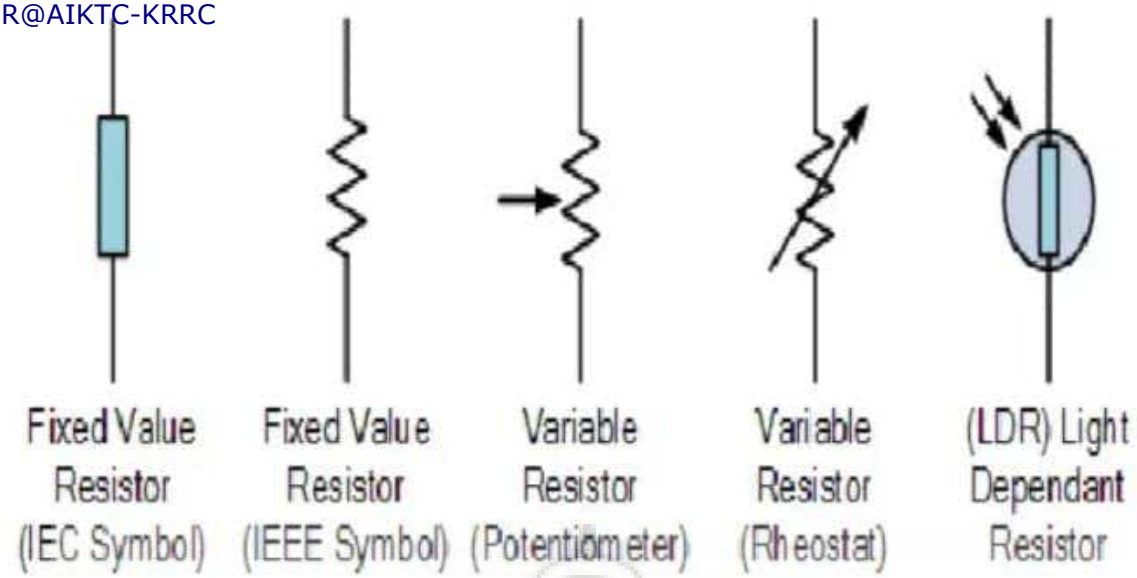


FIG 3.1.9b RESISTOR SYMBOLS

3.1.8.1 THEORY OF OPERATION

OHM'S LAW:

The behaviour of an ideal resistor is dictated by the relationship specified by Ohm's law:

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I), where the constant of proportionality is the resistance (R). For example, if a 300 ohm resistor is attached across the terminals of a 12 volt battery, then a current of 12 / 300 = 0.04 amperes flows through that resistor.

Practical resistors also have some inductance and capacitance which affect the relation between voltage and current in alternating current circuits.

The ohm (symbol: Ω) is the SI unit of electrical resistance, named after Georg Simon Ohm. An ohm is equivalent to a volt per ampere. Since resistors are specified and manufactured over a very large range of values, the derived units of milliohm (1 mΩ = 10^{-3} Ω), kilohm (1 kΩ = 10^{3} Ω), and megohm (1 MΩ = 10^{6} Ω) are also in common usage.

Power dissipation

At any instant, the power P (watts) consumed by a resistor of resistance R (ohms) is calculated as: where V (volts) is the voltage across the resistor and I(amps) is

the current flowing through it. Using Ohm's law, the two other forms can be derived. This power is converted into heat which must be dissipated by the resistor's package before its temperature rises excessively.

Resistors are rated according to their maximum power dissipation. Discrete resistors in solid-state electronic systems are typically rated as 1/10, 1/8, or 1/4 watt. They usually absorb much less than a watt of electrical power and require little attention to their power rating.

Resistors required to dissipate substantial amounts of power, particularly used in power supplies, power conversion circuits, and power amplifiers, are generally referred to as power resistors; this designation is loosely applied to resistors with power ratings of 1 watt or greater. Power resistors are physically larger and may not use the preferred values, color codes, and external packages described below.

If the average power dissipated by a resistor is more than its power rating, damage to the resistor may occur, permanently altering its resistance; this is distinct from the reversible change in resistance due to its temperature coefficient when it warms. Excessive power dissipation may raise the temperature of the resistor to a point where it can burn the circuit board or adjacent components, or even cause a fire. There are flameproof resistors that fail (open circuit) before they overheat dangerously.

Since poor air circulation, high altitude, or high operating temperatures may occur, resistors may be specified with higher rated dissipation than is experienced in service.

All resistors have a maximum voltage rating; this may limit the power dissipation for higher resistance values.

3.1.10 POTENTIOMETER

A potentiometer or *pot* is a three-terminal resistor with a continuously adjustable tapping point controlled by rotation of a shaft or knob or by a linear slider. It is called a potentiometer because it can be connected as an adjustable voltage divider to provide a variable potential at the terminal connected to the tapping point. A volume control for an audio device is a common use of a potentiometer. A typical low power potentiometer is constructed of a flat resistance element *(B)* of carbon composition, metal film, or conductive plastic, with a springy phosphor bronze wiper contact *(C)* which moves along the surface. An alternate construction is resistance wire wound on a form, with the wiper sliding axially along the coil. These have lower resolution, since as the wiper moves the resistance changes in steps equal to the resistance of a single turn.

FIG 3.1.10a POT

High-resolution multiturn potentiometers are used in a few precision applications. These have wirewound resistance elements typically wound on a helical mandrel, with the wiper moving on a helical track as the control is turned, making continuous contact with the wire. Some include a conductive-plastic resistance coating over the wire to improve resolution. These typically offer ten turns of their shafts to cover their full range. They are usually set with dials that include a simple turns counter and a graduated dial, and can typically achieve three digit resolution. Electronic analog computers used them in quantity for setting coefficients, and delayed-sweep oscilloscopes of recent decades included one on their panels

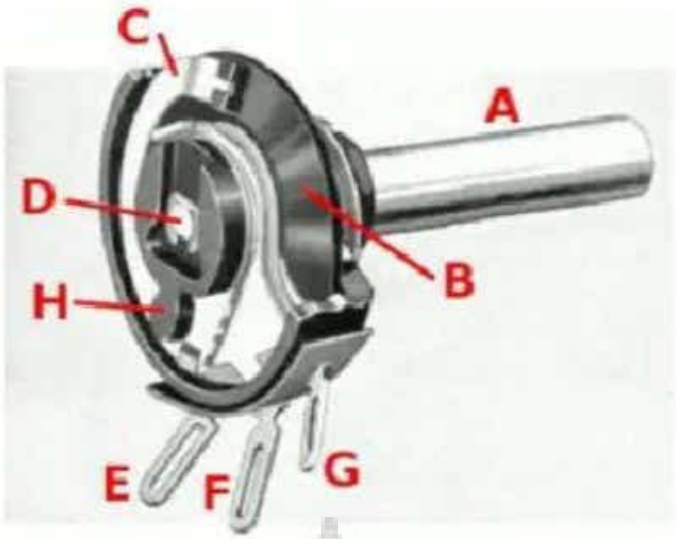


FIG 3.1.10b DRAWING OF POT

Drawing of potentiometer with case cut away, showing parts: (*A*) shaft, (*B*) stationary carbon composition resistance element, (*C*) phosphor bronze wiper, (*D*) shaft attached to wiper, (*E, G*) terminals connected to ends of resistance element, (*F*) terminal connected to wiper.

3.1.11 CAPACITOR

A capacitor is a passive two-terminal electrical component that stores electrical energy in an electric field. The effect of a capacitor is known as capacitance. While capacitance exists between any two electrical conductors of a circuit in sufficiently close proximity, a capacitor is specifically designed to provide and enhance this effect for a variety of practical applications by consideration of size, shape, and positioning of closely spaced conductors, and the intervening dielectric material. A capacitor was therefore historically first known as an electric condenser

The physical form and construction of practical capacitors vary widely and many capacitor types are in common use. Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The nonconducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy.

When two conductors experience a potential difference, for example, when a capacitor is attached across a battery, an electric field develops across the dielectric, causing a net positive charge to collect on one plate and net negative charge to collect on the other plate. No current actually flows through the dielectric , however, there is a flow of charge through the source circuit. If the condition is maintained sufficiently long, the current through the source circuit ceases. However, if a time-varying voltage is applied across the leads of the capacitor, the source experiences an ongoing current due to the charging and discharging cycles of the capacitor.

Capacitance is defined as the ratio of the electric charge on each conductor to the potential difference between them. The unit of capacitance in the International System of Units (SI) is the farad (F), defined as one coulomb per volt (1 C/V). Capacitance values of typical capacitors for use in general electronics range from about 1 pF (10^{-12} F) to about 1 mF (10^{-3} F).

The capacitance C of a capacitor is proportional to the surface area of the plates (conductors) and inversely related to the gap between them. In practice, the dielectric between the plates passes a small amount of leakage current. It has an electric field strength limit, known as the breakdown voltage. The conductors and leads introduce an undesired inductance and resistance.

Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In Analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems, they stabilize voltage and power flow.[3] The property of energy storage in capacitors was exploited as dynamic memory in early digital computers

3.1.11.1 THEORY OF OPERATION

A capacitor consists of two conductors separated by a non-conductive region.[17] The non-conductive region can either be a vacuum or an electrical insulator material known as a dielectric. Examples of dielectric media are glass, air, paper, and even a semiconductor depletion regionchemically identical to the conductors. A capacitor is assumed to be self-contained and isolated, with no net electric charge and no influence from any external electric field. The conductors thus hold equal and opposite charges on their facing surfaces,[18] and the dielectric develops an electric field. In SI units, a capacitance of one farad means that one coulomb of charge on each conductor causes a voltage of one volt across the device.

An ideal capacitor is sufficiently characterized by a constant capacitance C, defined as the ratio of a positive or negative charge Q on each conductor to the voltage V between them:

Because the conductors (or plates) are close together, the opposite charges on the conductors attract one another due to their electric fields, allowing the capacitor to store more charge for a given voltage than when the conductors are separated, yielding a larger capacitance.

In practical devices, charge build-up sometimes affects the capacitor mechanically, causing its capacitance to vary. In this case, capacitance is defined in terms of incremental changes:

$$C = Q / V$$

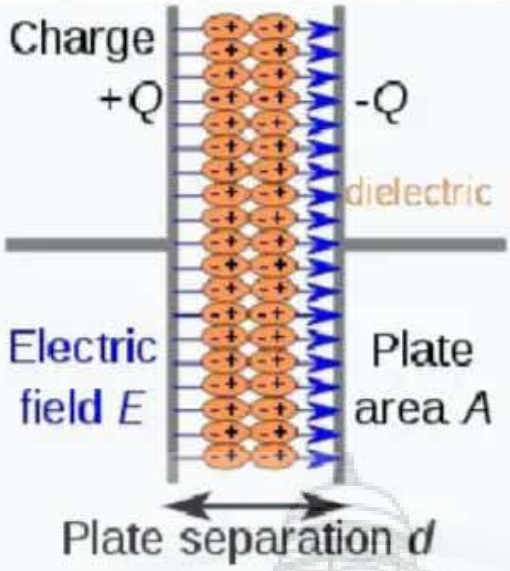


FIG 3.1.11a CHARGE SEPARATION IN A PARALLEL-PLATE CAPACITOR CAUSES AN INTERNAL ELECTRIC FIELD. A DIELECTRIC (ORANGE) REDUCES THE FIELD AND INCREASES THE CAPACITANCE.

3.1.12 BUZZER

Buzzer is an electronic device commonly used to produce sound. Light weight, simple construction and low price make it usable in various applications like car/truck reversing indicator, computers, call bells etc. Piezo buzzer is based on the inverse principle of piezo electricity discovered in 1880 by Jacques and Pierre Curie. It is the phenomena of generating electricity when mechanical pressure is applied to certain materials and the vice versa is also true. Such materials are called piezo electric materials. Piezo electric materials are either naturally available or manmade. Piezoceramic is class of manmade material, which poses piezo electric effect and is widely used to make disc, the heart of piezo buzzer. When subjected to an alternating electric field they stretch or compress, in accordance with the frequency of the signal thereby producing sound.

buzzer also called piezo transducer operating at DC voltage. Encapsulated in a cylindrical plastic coating, it has a hole on the top face for sound to propagate. A yellow metallic disc which plays an important role in the producing sound can be seen through the hole.

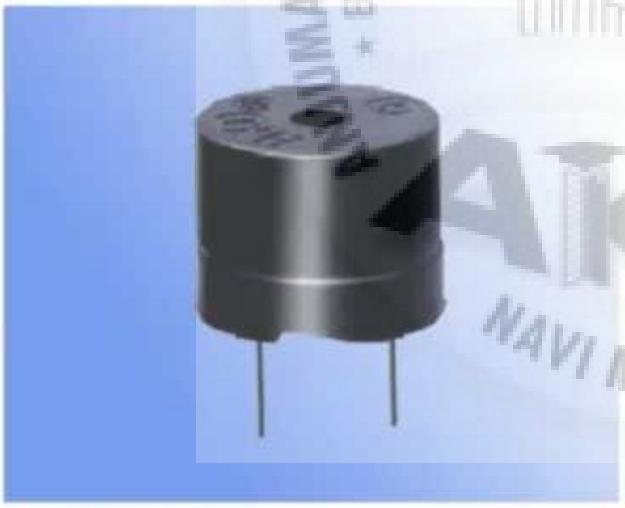


FIG 3.1.12a BUZZER

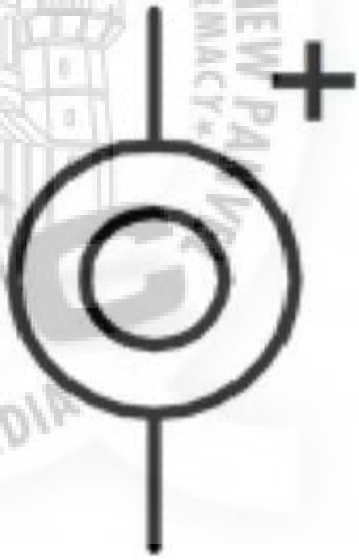


FIG 3.1.12b SYMBOL

3.1.13 DIODE

A PN Junction Diode is one of the simplest semiconductor devices around, and which has the characteristic of passing current in only one direction only. However, unlike a resistor, a diode does not behave linearly with respect to the applied voltage as the diode has an exponential current-voltage (I-V) relationship and therefore we cannot describe its operation by simply using an equation such as Ohm's law.

If a suitable positive voltage (forward bias) is applied between the two ends of the PN junction, it can supply free electrons and holes with the extra energy they require to cross the junction as the width of the depletion layer around the PN junction is decreased.

By applying a negative voltage (reverse bias) results in the free charges being pulled away from the junction resulting in the depletion layer width being increased. This has the effect of increasing or decreasing the effective resistance of the junction itself allowing or blocking current flow through the diode.

Then the depletion layer widens with an increase in the application of a reverse voltage and narrows with an increase in the application of a forward voltage. This is due to the differences in the electrical properties on the two sides of the PN junction resulting in physical changes taking place. One of the results produces rectification as seen in the PN junction diodes static I-V (current-voltage) characteristics. Rectification is shown by an asymmetrical current flow when the polarity of bias voltage is altered as shown below.

Junction Diode Symbol and Static I-V Characteristics.

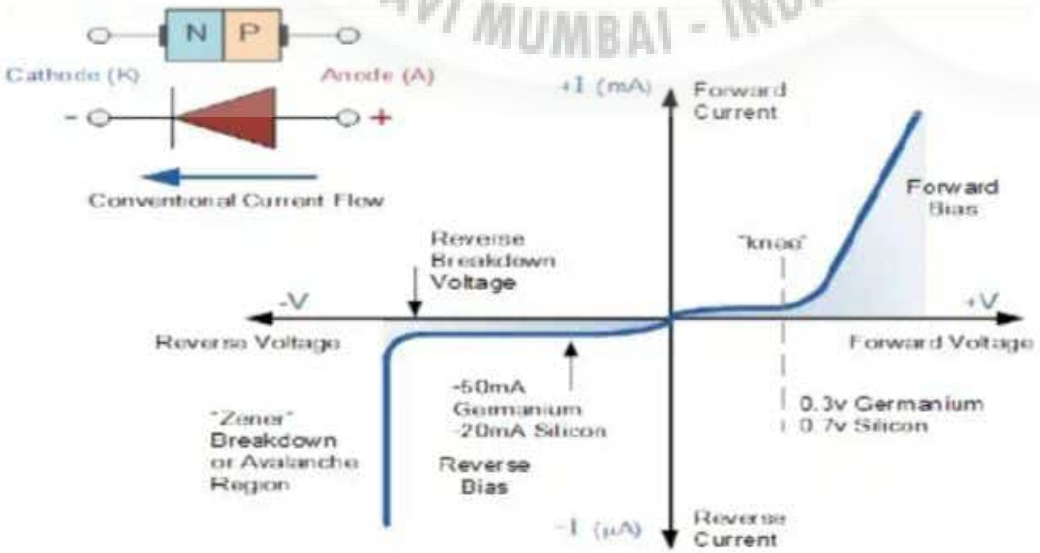


FIG 3.1.13a DIODE SYMBOL AND STATIC I-V CHARACTERISTICS

But before we can use the PN junction as a practical device or as a rectifying device we need to firstly bias the junction, ie connect a voltage potential across it. On the voltage axis above, "Reverse Bias" refers to an external voltage potential which increases the potential barrier. An external voltage which decreases the potential barrier is said to act in the "Forward Bias" direction.

There are two operating regions and three possible "biasing" conditions for the standard Junction Diode and these are:

- 1. Zero Bias – No external voltage potential is applied to the PN junction diode.
- 2. Reverse Bias – The voltage potential is connected negative, (-ve) to the P-type material and positive, (+ve) to the N-type material across the diode which has the effect of Increasing the PN junction diode's width.
- 3. Forward Bias – The voltage potential is connected positive, (+ve) to the P-type material and negative, (-ve) to the N-type material across the diode which has the effect of Decreasing the PN junction diodes width.

3.1.14 LED

A light emitting diode (LED) is known to be one of the best optoelectronic devices. The device is capable of emitting a fairly narrow bandwidth of visible or invisible light when its internal diode junction attains a forward electric current or voltage. The visible lights that an LED emits are usually orange, red, yellow, or green. The invisible light includes the infrared light.

We know that a P-N junction can connect the absorbed light energy into its proportional electric current. The same process is reversed here. That is, the P-N junction emits light when energy is applied on it. This phenomenon is generally called electro luminance, which can be defined as the emission of light from a semi-conductor under the influence of an electric field. The charge carriers recombine in a forward P-N junction as the electrons cross from the N-region and recombine with the holes existing in the P-region. Free electrons are in the conduction band of energy levels, while holes are in the valence energy band. Thus the energy level of the holes will be lesser than the energy levels of the electrons. Some part of the energy must be dissipated in order to recombine the electrons and the holes. This energy is emitted in the form of heat and light.

The electrons dissipate energy in the form of heat for silicon and germanium diodes. But in Galium-Arsenide-phosphorous (GaAsP) and Galium-phosphorous (GaP) semiconductors, the electrons dissipate energy by emitting photons.

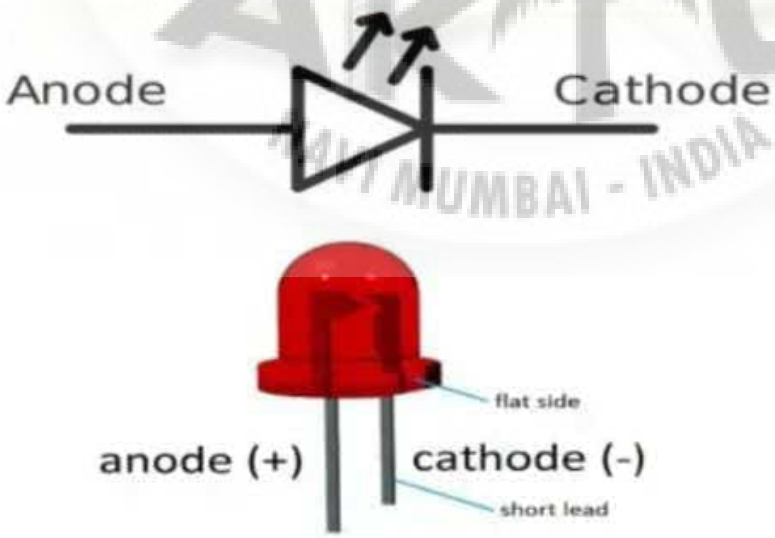


FIG 3.1.14a LED SYMBOL AND DIAGRAM

4.WORKING

4.1 CIRCUIT DIAGRAM

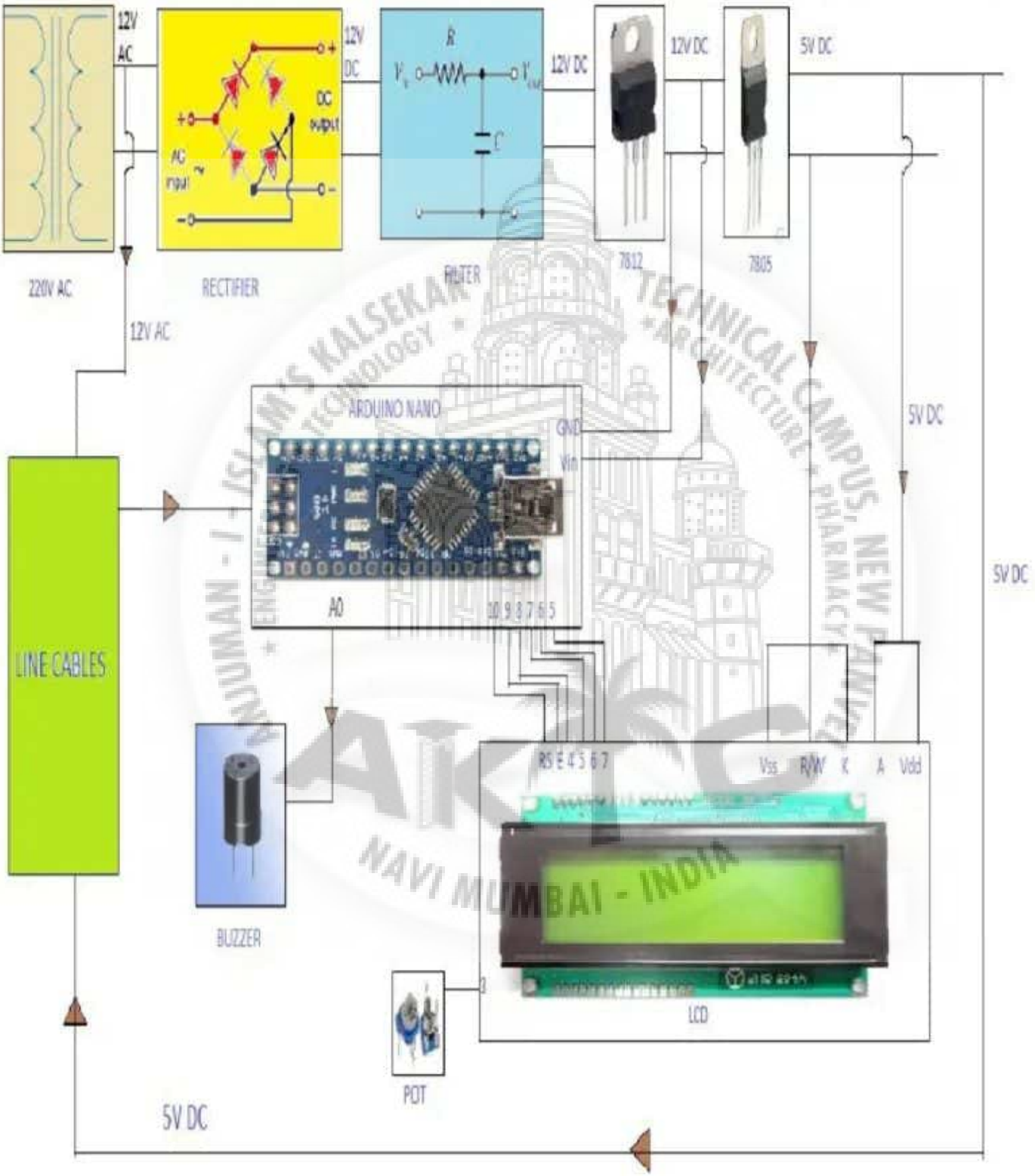


FIG 4.1a CIRCUIT DIAGRAM

4.3 OPERATION

The circuit uses standard power supply comprising of step down transformer from 220V to 12V and 4 diodes forming a bridge rectifier that delivers pulsating DC which is then filiterd by an electrolytic capacitor of about 470 uF -1000 uF .The filtered DC being unregulated , IC LM7812 (VOLTAGE REGULATOR) , is used to get 12V DC constant at its pin no 3 irrespective of Input DC varying from 9V -14V . The input DC shall be varying in the event of input AC at 220V section varies in the ratio of V1 / V2 = n1 / n2.

The regulated 12V DC is further filtered by a small electrolytic capacitor of 10uF for any noise so generated by the circuit.1 LED is connected of this 12V point in series with a resistor of 330 ohm to the ground that is negative voltage to indicate 12V power supply availability. The 5V point is used for other applications like supply to LCD etc.

4.4 CONNECTIONS

The output (12 V) of the power supply is fed to the cable lines and to the arduino pins – Pin number 30TH Vin and GND. Pin number 10 , 9 ,8 ,7 ,6 and 5 of arduino are interfaced with RS , E , 4 , 5 , 6 and 7 ,respectively, of LCD. Also pin number 3 of LCD is connected to potentiometer , which is used to set the contrast of LCD .The 5V supply is given to LCD to pin numbers 2 , 15 , Vss ,R/W' and K .The buzzer and buttons are connected to the analog pins of Arduino .

4.5 WORKING

The project uses set of wires to which POPO buttons are connected. Each wire represents the resistance of underground cable for a specific distance. The POPO buttons are intended to create a fault .This button moves from NORMALLY CLOSE to NORMALLY OPEN connections. Whenever we press the button ,fault is created , and the arduino which is already pre programmed senses the voltage changes and thus detects that fault has occurred .The LCD which is interfaced with the Arduino displays the fault occurring region. Also a buzzer system which is connected to the arduino creates an alarming signal under the faulty condition.

5. CODING

The basic structure of Arduino programming language is fairly simple and runs in at least two parts. The two required parts , or , functions , enclose block of statements.The code for this project is as under :

```
#include<LiquidCrystal.h>
LiquidCrystal lcd (10,9,8,7,6,5);

void setup() {

  Serial.begin(9600);
  lcd.begin(20,4);
  pinMode(2, INPUT);
  pinMode(3, INPUT);
  pinMode(12, OUTPUT);

  pinMode(A0, INPUT);
  pinMode(A1, INPUT);

  pinMode(A3, INPUT);
  lcd.setCursor(0, 0);
  lcd.print("***Fault Detector***");
  lcd.setCursor(0, 1);
  lcd.print("Roll No.: 39, 18");
  lcd.setCursor(10, 2);
  lcd.print("96, 36");
    delay(5000);
}

void loop() {
```

```
lcd.clear();



int x = digitalRead(2);
int y = digitalRead(3);
int z = digitalRead(4);
int a = digitalRead(A0);
int b = digitalRead(A1);
Serial.print(x);
Serial.print("    ");
Serial.print(y);
Serial.print("    ");
Serial.print(a);
Serial.print("    ");
Serial.print(b);
Serial.print("    ");
Serial.println(z);


if (z == 0)
{
 if (x == 0)
 {
   lcd.setCursor(0, 0);
   lcd.print("Line1:");
   lcd.setCursor(7, 0);
   lcd.print("Fault(A-B)");
   digitalWrite(12, 1);


 }
```

```
else if (y == 0)
{
  lcd.setCursor(0, 0);
  lcd.print("Line1:");
  lcd.setCursor(7, 0);
  lcd.print("Fault(B-C)");
  digitalWrite(12, 1);

}
else
{
  lcd.setCursor(0, 0);
  lcd.print("Line1:");
  lcd.setCursor(7, 0);
  lcd.print("No Fault");
  digitalWrite(12, 0);
}
if (a == 0)
{

  lcd.setCursor(0, 1);
  lcd.print("Sheath Open(A-B)");
  digitalWrite(12, 1);
  delay(500);
  digitalWrite(12, 0);
}
else if (b == 0)
{

  lcd.setCursor(0, 1);
```

```
    lcd.print("Sheath Open(B-C)");
    digitalWrite(12, 1);
    delay(500);
    digitalWrite(12, 0);
  }

  else
  {

    lcd.setCursor(0, 1);
    lcd.print("No Fault");

  }
  delay(500);
  digitalWrite(12, 0);
  delay(500);
}
else
{
  lcd.clear();
  lcd.print("Short Circuit");
  digitalWrite(12, 1);
  delay(500);
  digitalWrite(12, 0);
}

delay(500);
}
```

6. EXPERIMENTAL RESULTS

This circuit is intended to detect 3 types of faults :

- Open circuit fault
- Short circuit fault
- Earth fault

When there is a break in the conductor of a cable ,it is called open circuit fault. . The most common causes of these faults include joint failures of cables and, and failure of one or more phase of circuit breaker and also due to melting of a conductor in one or more phases. This fault is also called as series faults.

This type of fault is created by the series of buttons placed at distances. Whenever the switch is Pushed , the popo button switches from Normally closed to normally open, thereby no flow of current takes place through line .When this fault occurs the ardunio senses voltage changes and thus displays the fault location on LCD , also buzzer plays an alerting sound depicting fault condition.

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.

To create such type of fault a resistor is placed in parallel to line. In normal condition some amount of voltage flows through the resistor that is there is no fault. As soon as we press the button , that is creating fault, the switch moves from normally closed to normally open condition. At this moment whole voltage flows across the short circuit line and no voltage is seen passing through the resistor. The arduino senses this change and thus displays the fault occurring region on LCD and also the buzzer beeps.

An earth fault is an inadvertent contact between an energized conductor and earth or equipment frame. The return path of the fault current is through the grounding system and any personnel or equipment that becomes part of that system.

Earth fault is created by placing a resistor in series to the line. The resistor on the other end is connected to ground. In no fault condition no voltage is seen across the

resistor.When earth fault is created whole of the voltage is seen passing through this resistor and thus gets drained through ground. There is no return path for the faulty voltage . The ardunio is programmed in such a way that it detects this change and thus displays the faulty region on LCD. At the same time the buzzer creates an alarming sound.

7. ADVANTAGES

- Less Maintanence
- This method is applicable to all types of cables
- Can detect all faults using this methodology
- Cost effective
- Less complexity

8. CONCLUSION

It is a difficult task to identify the faults in underground cables. By using Arduino controller we can find out exact fault location. This circuit is fabricated to detect open circuit fault , short circuit fault and earth fault . Once faults occur in the cable, the display unit displays the exact fault location that displays which phase is affected in the cable and how long it is affected. A buzzer system is used to create an alerting signal which is helpful to humans. Buzzer system create a alerting sound signal, once if the fault occur in the underground cable.

9. FUTURE SCOPE

This prototype detects the exact location of various faults like earth short and open circuit fault in underground cables from feeder end. In future this project may be intended to detect even minute faults occurring in any region . Also this prototype can be extended to detect faults over large area.

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