B.TECH MINI PROJECT

Kalyani Government Engineering College

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Submitted By –

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Electronics and communication Engineering 3rd Year

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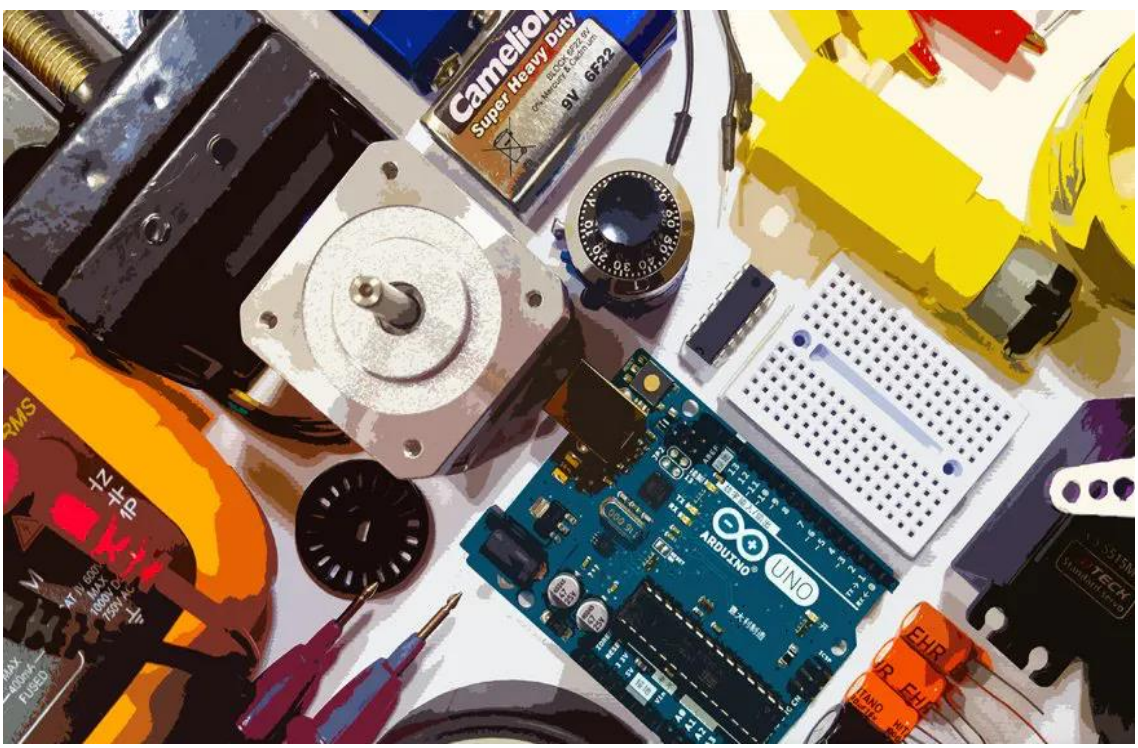
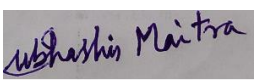
TOPIC

MOTOR CONTROL USING ARDUINO UNO



CERTIFICATE

This is to certify that the project report entitled **Motor Control Using Arduino UNO** submitted by **RUDRAPRASAD DEBNATH** to the **Kalyani Government Engineering College** in partial fulfillment for the award of the degree of **B. Tech** in **Electronics and Communication Engineering** is a bona fide record of project work carried out by him under my supervision. The contents of this report, in full or in parts, have not been submitted to any other Institution or University for the award of any degree or diploma.



Rudraprasad Debnath

Student's Signature

Signature of Supervisor

INTRODUCTION

Driving electromotors needs a high current. In addition, spinning direction and speed are two important parameters to be controlled. These requirements can be handled by using a microcontroller (or a development board like Arduino).

This project is properly based on Arduino UNO - an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. Arduino UNO has PWM pins on which we can control the speed of a DC motor. We have used the analogWrite() function on the digital PWM pins to control the speed of the used DC motor. We have also used an IR sensor and an IR remote to control the speed of the motors. The speed of the motors can be controlled independently depending on the pressed button of the IR remote.

Aim: To design a system with two motors and control their speed according to the input given by an IR Remote and display commands on an LCD display.

PROJECT PLANNING

Hardware Used:

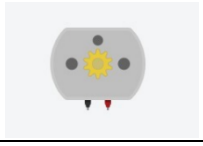
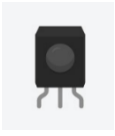
1) Laptop – ASUS Vivobook 14

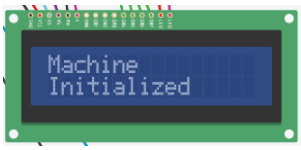
2) RAM – 8 GB, 512 SSD

Software Used:

1) Autodesk Tinkercad Circuit Simulator

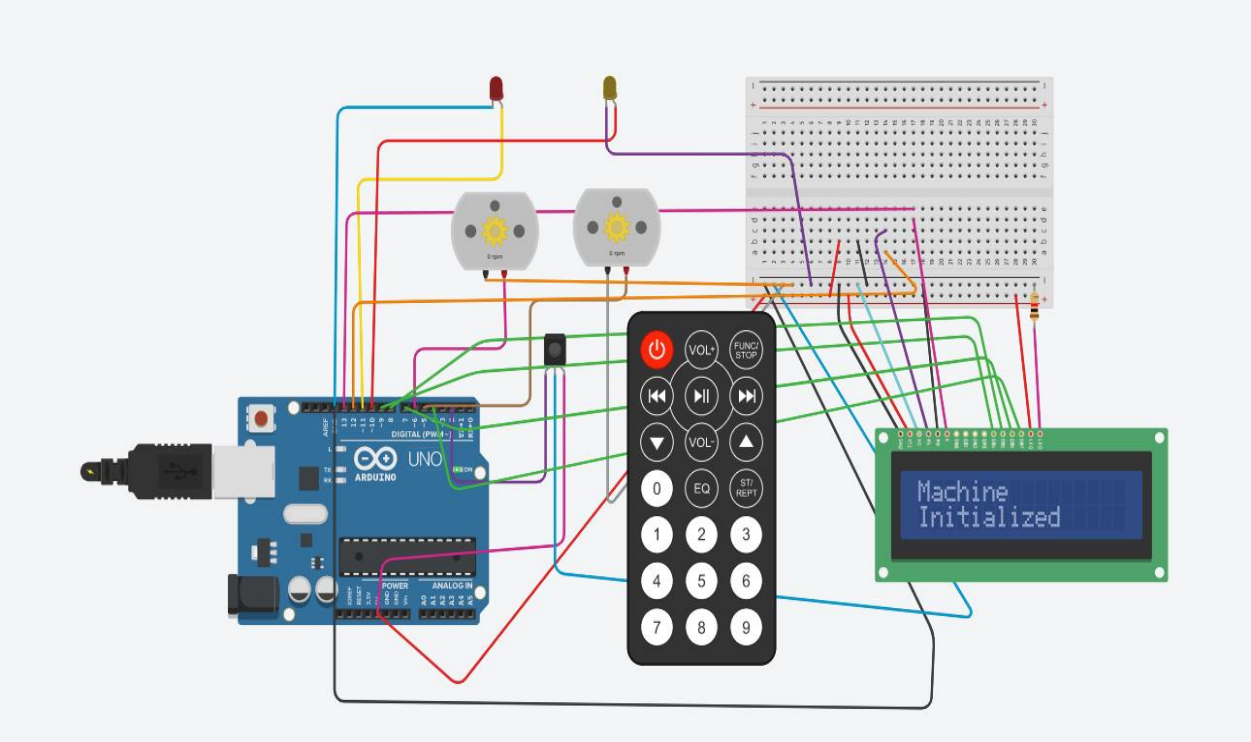
Virtual Components Used:

1. Arduino UNO	
2.Small Breadboard	
3. DC Motors	
4. IR Sensor	
5. IR Remote	
6. LEDs	

7. 16x2 LCD Display	

PROJECT DESIGN

1. Circuit Diagram:



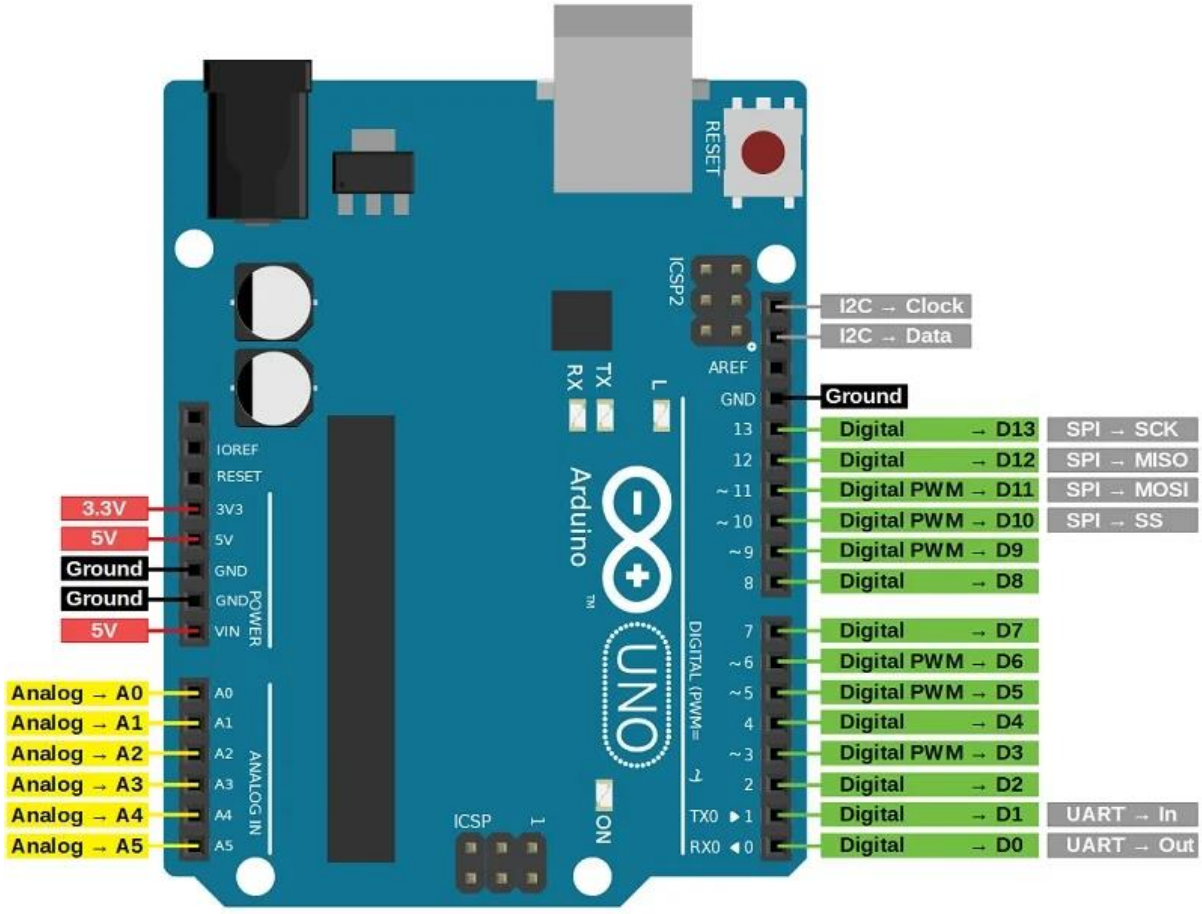
3.Components used in Circuit:

i) Arduino UNO: This is the latest revision of the basic Arduino USB board. It connects to the computer with a standard USB cable and contains everything else you need to program and use the board. It can be extended with a variety of shields: custom daughter-boards with specific features.

It is similar to the Duemilanove, but has a different
USB-to-serial chip the ATMega8U2, and newly
designed labeling to make inputs and outputs easier to identify.

Arduino Uno Rev. 3 Microcontroller Board is based on the Microchip Technology ATmega328 8-bit Microcontroller (MCU). Arduino Uno features 14 digital input/output pins (six of which can be used as PWM outputs), six analog inputs, and a 16MHz quartz crystal. Uno also includes a USB connection, a power jack, an In-Circuit Serial Programming (ICSP) header, and a reset button. This Arduino MCU board contains everything the user needs to support the MCU. The user can get started by connecting the Uno to a computer with the USB cable or by powering it with an AC/DC adapter or battery. The Uno can be programmed with Arduino Software (Integrated Development Environment). The ATmega328 on the Uno comes preprogrammed with a bootloader that allows the user to upload new code to the MCU without the use of an external hardware programmer.

Pin description ----



How to power up Arduino UNO?

There are a couple of ways in which you can power the UNO board. The first and easy way is using the Type-B USB Connector. The next way is to provide an unregulated supply in the range of 6V to 20V to VIN pin of the UNO (Pin number 26).

You can also supply the unregulated supply through the 2.1mm DC Jack, in which case, you can access the supplied voltage through the VIN Pin.

What are Different Memories of Arduino UNO?

Strictly speaking, this is specific to the MCU i.e., ATmega328P, used on the Arduino UNO Board. There are three different memories available in ATmega328P. They are:

- 32 KB of Flash Memory
- 2 KB of SRAM
- 1 KB of EEPROM
- 0.5 KB of the Flash Memory is used by the bootloader code.

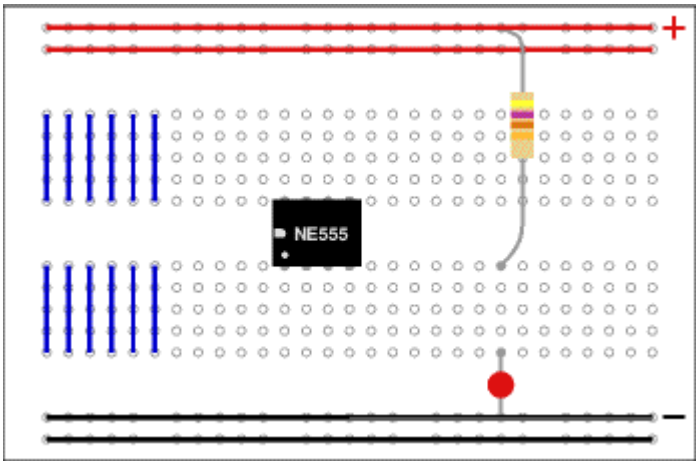
In this project, we have used the **PWM** pins of Arduino UNO to control the speed of the DC Motors.

ii) Breadboard: A breadboard is used to make up **temporary circuits** for testing or to try out an idea. No soldering is required so it is easy to change connections and replace components. Parts are not damaged and can be re-used afterwards.Almost all the Electronics Club website projects started life on a breadboard to check that the circuit worked as intended.The photograph shows a typical small breadboard which is suitable for beginners building simple circuits with one or two ICs (chips).

Breadboards have many tiny sockets (called 'holes') arranged on a 0.1" grid. The leads of most components can be pushed straight into the holes. ICs are inserted across the central gap with their notch or dot to the left.

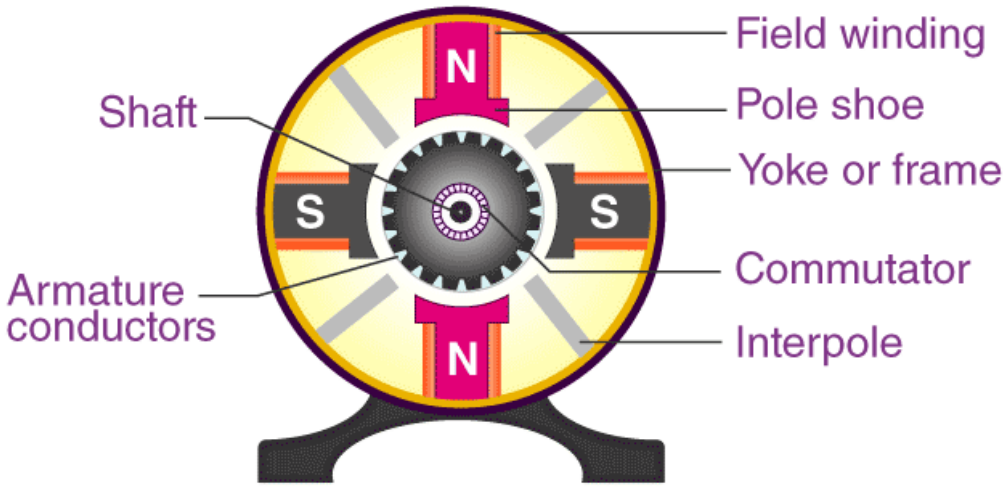
Wire links can be made with single-core plastic-coated wire of 0.6mm diameter (the standard size), this is known as 1/0.6mm wire. I suggest buying a pack with several colours to help identify connections, red for +Vs wires, black for 0V, and so on.

The top and bottom rows are linked **horizontally** all the way across as shown by the **red** and **black** lines on the diagram. The power supply is connected to these rows, + at the top and 0V (zero volts) at the bottom.



The other holes are linked **vertically** in blocks of 5 with no link across the centre as shown by the **blue** lines on the diagram. Notice how there are separate blocks of connections to each pin of ICs.

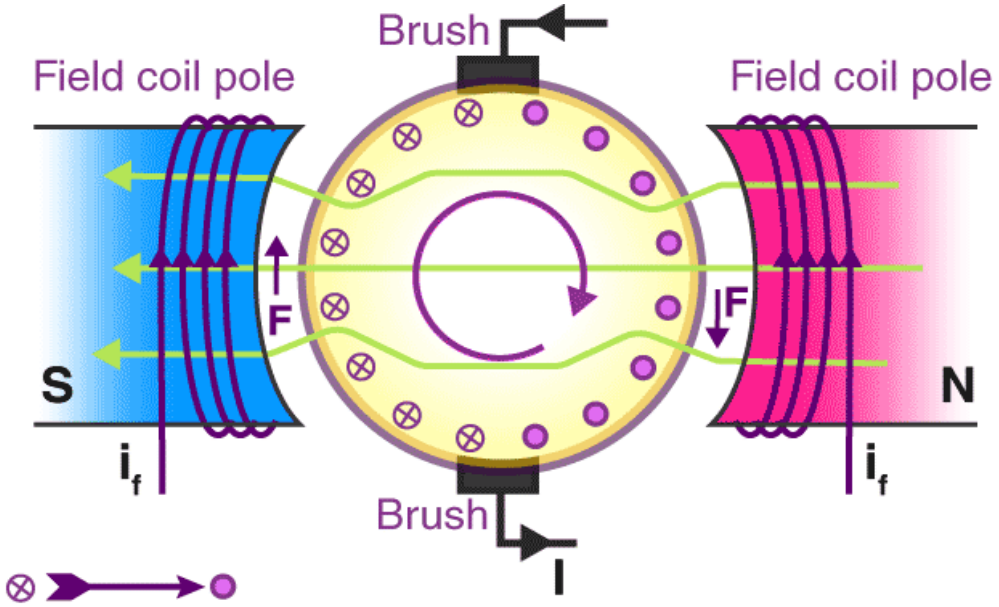
iii) DC Motors: A DC motor is an electrical machine that converts electrical energy into mechanical energy. In a DC motor, the input electrical energy is the direct current which is transformed into the mechanical rotation.



DC motor construction parts

From the above definition, we can conclude that any electric motor that is operated using direct current or DC is called a DC motor. We will understand the DC motor construction and how a DC motor converts the supplied DC electrical energy into mechanical energy in the next few sections.

Working of DC Motor: A magnetic field arises in the air gap when the field coil of the DC motor is energised. The created magnetic field is in the direction of the radii of the armature. The magnetic field enters the armature from the North pole side of the field coil and "exits" the armature from the field coil's South pole side.



Production of torque in a DC motor

Types of DC motor

DC motors have a wide range of applications ranging from electric shavers to automobiles. To cater to this wide range of applications, they are classified into different types based on the field winding connections to the armature as:

- Self Excited DC Motor
- Separately Excited DC Motor

Now, let us discuss the various types of DC Motors in detail.

Applications of DC Motor

The applications of different types of DC motors are listed below:

Shunt DC Motors

Owing to the fairly constant speed and medium starting torque of shunt DC motors, they are used in the following applications:

1. Centrifugal and reciprocating pumps
2. Lathe machines
3. Blowers and Fans
4. Drilling machines
5. Milling machines
6. Machine tools

Series DC Motors

Owing to the high starting torque and variable speed of series DC motors, they are used in the following applications:

- Conveyors
- Hoists, Elevators
- Cranes
- Electric Locomotives

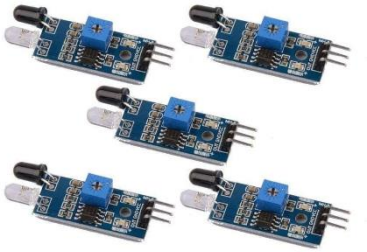
Cumulative Compound DC motors

Owing to the high starting torque of cumulative compound DC motors, they are used in the following applications:

- Shears
- Heavy Planers
- Rolling mills
- Elevators

DC series motor runs on single-phase AC supply. This is because the torque, which varies as the product of the armature and field current, is always positive. Thus, a positive average torque causes the motor to rotate.

iv) IR Sensor: R technology is used in daily life and also in industries for different purposes. For example, TVs use an IR sensor to understand the signals which are transmitted from a remote control. The main benefits of IR sensors are low power usage, their simple design & their convenient features. IR signals are not noticeable by the human eye.



An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.

Working Principle:

The working principle of an infrared sensor is similar to the object detection sensor. This sensor includes an IR LED & an IR Photodiode, so by combining these two can be formed as a photo-coupler otherwise optocoupler. The physics laws used in this sensor are planks radiation, Stephan Boltzmann & weins displacement.

IR LED is one kind of transmitter that emits IR radiations. This LED looks similar to a standard LED and the radiation which is generated by this is not visible to the human eye. Infrared receivers mainly detect the radiation using an infrared transmitter. These infrared receivers are available in photodiodes form. IR Photodiodes are dissimilar as compared with usual photodiodes because they detect simply IR radiation. Different kinds of infrared receivers mainly exist depending on the voltage, wavelength, package, etc.

Once it is used as the combination of an IR transmitter & receiver, then the receiver's wavelength must equal the transmitter. Here, the transmitter is IR LED whereas the receiver is IR photodiode. The infrared photodiode is responsive to the infrared light that is generated through an infrared LED. The resistance of photo-diode & the change in output voltage is in proportion to the infrared light obtained. This is the IR sensor's fundamental working principle.

Once the infrared transmitter generates emission, then it arrives at the object & some of the emission will reflect back toward the infrared receiver. The sensor

output can be decided by the IR receiver depending on the intensity of the response.

Types of Infrared sensor:

Active IR Sensor

This active infrared sensor includes both the transmitter as well as the receiver. In most of the applications, the light-emitting diode is used as a source. LED is used as a non-imaging infrared sensor whereas the laser diode is used as an imaging infrared sensor.

Passive IR Sensor:

The passive infrared sensor includes detectors only but they don't include a transmitter. These sensors use an object like a transmitter or IR source. This object emits energy and detects through infrared receivers. After that, a signal processor is used to understand the signal to obtain the required information.

Advantages:

The **advantages of IR sensor** include the following

- It uses less power
- The detection of motion is possible in the presence or absence of light approximately with equal reliability.
- They do not need contact with the object for detection
- There is no data leakage because of the ray direction
- These sensors are not affected by oxidation & corrosion
- Noise immunity is very strong

Disadvantages

The disadvantages of IR sensor include the following

- Line of sight is required
- Range is limited
- These can be affected by fog, rain, dust, etc
- Less data transmission rate

IR Sensor Applications:

IR sensors are classified into different types depending on the applications. Some of the typical applications of different types of sensors. The speed sensor is used for synchronizing the speed of multiple motors. The temperature sensor is used

for industrial temperature control. PIR sensor is used for an automatic door opening system and the Ultrasonic sensor is used for distance measurement. IR sensors are used in various Sensor based projects .

v) IR Remote:

The first remote controllers were developed in the early 1990s, and the first remotes were connected with wires to devices. Nowadays remotes use infrared control and thus are capable of controlling several things at a time. The remotes are not only used for entertainment, but also for industries, military requirements, and recreation. Infrared remote controls were developed in the late 1970s. These remote controls use infrared light and photo receptors and different light frequencies for different functions. These remotes also use invisible light beams to send signals to electronic devices.

IR remote controls today can control several devices at a time as the working abilities of these remotes is such that a light beam is emitted out by the remote control and is received by a photo transistor. These remotes receive signals and transmit signals to devices via radio waves. These remotes can control several appliances, equipments and gadgets like, radios, TVs, video games, CD/ DVD players, and also applicable in Space(NASA). The Infrared remote control-basics operation and applications are explained below.

Working:

IR remotes use LED lights to transmit their infrared signals. This results in a few limitations of the technology. Since light is used to transmit the signal, IR remotes require line-of-sight, which means you need an open path between the transmitter and receiver. This means that IR remotes won't work through walls or around corners. They also have a limited range of about 30 feet.

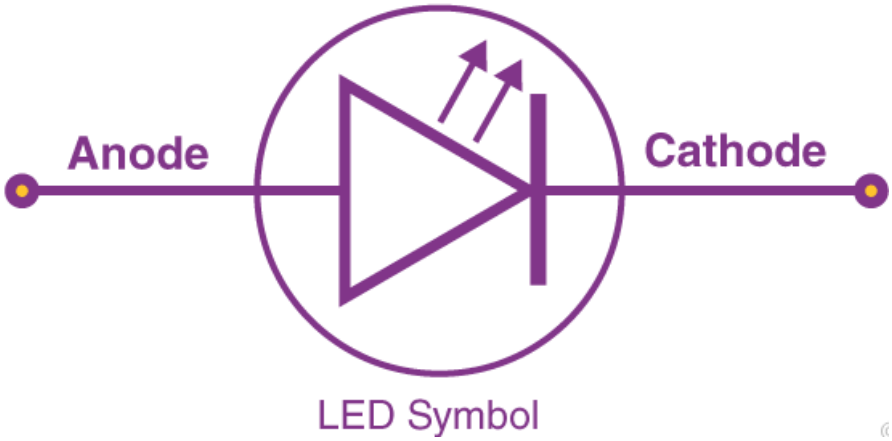
vi) LED(Light Emitting Diodes):

Light-emitting diodes, or LEDs, are widely used as a standard source of light in electrical equipment. It has a wide array of applications ranging from your mobile phone to large

advertising billboards. They find applications in devices for showing what the time is and for displaying different types of data. In this post, the main focus would be on learning a lot about LEDs, such as its operations and functions.

A light releasing diode is an electric component that emits light when the electric current flows through it. It is a light source based on semiconductors. When current passes through the LED, the electrons recombine with holes emitting light in the process. It is a specific type of diode having similar characteristics as the p-n junction diode. This means that an LED allows the flow of current in its forward direction while it blocks the flow in the reverse direction. Light-emitting diodes are built using a weak layer of heavily doped semiconductor material. Based on the semiconductor material used and the amount of doping, an LED will emit a colored light at a particular spectral wavelength when forward biased.

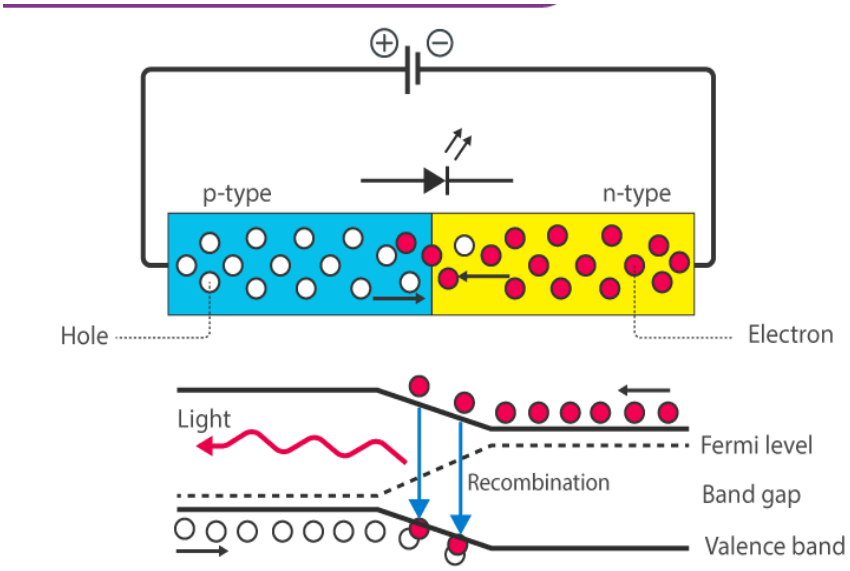
LED Symbol:



Working:

The holes lie in the valence band, while the free electrons are in the conduction band. When there is a forward bias in the p-n junction, the electron which is a part of the n-type semiconductor material would overrun the p-n junction and join with the holes in the p-type semiconductor material. Therefore, regarding the holes, the free electrons would be at the higher energy bands.

When this movement of free electron and hole takes place, there is a change in the energy level as the voltage drops from the conduction band to the valance band. There is a release of energy due to the motion of the electron. In standard diodes, the release of energy in the manner of heat. But in LED the release of energy in the form of photons would emit light energy. The entire process is known as electroluminescence, and the diodes are known as a light-emitting diode.
In LED, energy discharged in light form hinges on the forbidden energy gap. One could manipulate the wavelength of the light produced. Therefore, from its wavelength, the light color and its visibility or cannot be controlled. The color and wavelength of the light emitted can be determined by doping it with several impurities.



Uses of LED:

LEDs find applications in various fields, including optical communication, alarm and security systems, remote-controlled operations, robotics, etc. It finds usage in many such areas because of its long-lasting capability, low power requirements, swift response time, and fast switching capabilities. Below are a few standards LED uses:

-
  - Used for TV back-lighting
  - Uses in displays
  - Used in automotive

- LEDs used in the dimming of lights

vii) LCD:

LCD is defined as the diode that uses **small cells** and the **ionised gases** for the **production of images**. The LCD works on the **modulating property of light.** The light modulation is t**he technique of sending and receiving the signal** through the **light**. The **liquid crystal consumes** a small amount of energy because they are the **reflector and the transmitter of light.** It is normally used for **seven segmental display.**

Types:

Transmittive Type – In transmitter cell both the glass sheets are transparent so that the light is scattered in the forward direction when the cell becomes active.

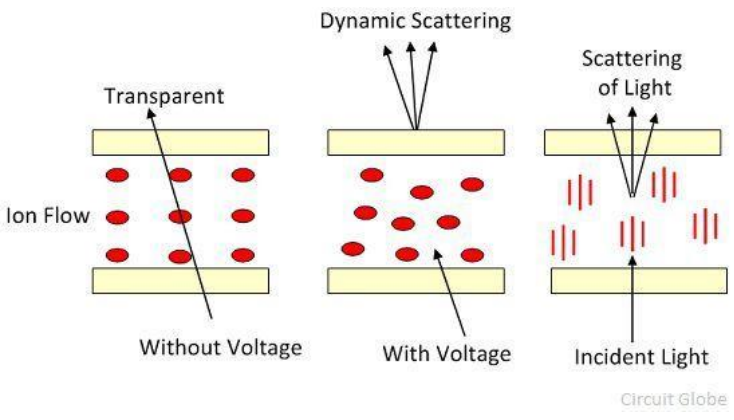
Reflective Type – The reflective type cell consists the reflecting surface of the glass sheet on one end. The light incident on the front surface of the cell is scattered by the activated cell.

Working Principle of LCD

The working principle of the LCD is of two types. They are the dynamic scattering type and the field effects type. Their details explanation is shown below.

Dynamic Scattering

When the potential carrier flows through the light, the molecular alignment of the liquid crystal disrupts, and they produce disturbances. The liquid becomes transparent when they are not active. But when they are active their molecules turbulence causes scattered of light in all directions, and their cell appears bright. This type of scattering is known as the dynamic scattering. The construction of the dynamic scattering of the liquid crystal cell is shown in the figure



Field Effect Type:

The construction of liquid crystals is similar to that of the dynamic scattering types the only difference is that in field effect type LCD the two thin polarising optical fibres are placed inside the each glass sheet. The liquid crystals used in field effect LCDs are of different scattering types that operated in the dynamic scattering cell.

The field affects type LCD uses the nematic material which twisted the unenergised light passing through the cell. The nematic type material means the liquid crystals in which the molecules are arranged in parallel but not in a well-defined plane. The light after passing through the nematic material passing through the optical filters and appears bright. When the cell has energised no twisting of light occurs, and the cell appears dull.

Advantages of LCD:

The following are the advantages of LCD.

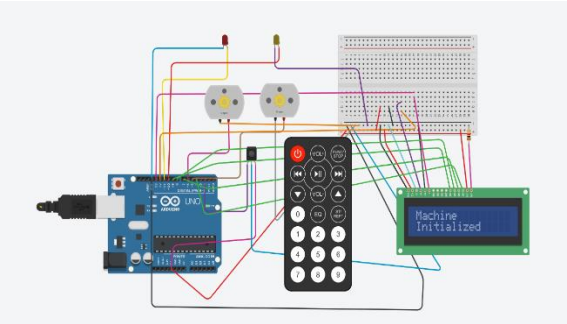
1. The power consumption of LCD is low. The seven segmental display of LCD requires about 140μW which is the major advantages over LED which uses approximately 40mW per numeral.
2. The cost of the LCD is low.

Disadvantages of LCD:

The following are the disadvantages of LCD.

1. The LCD is a slow device because their turning on and off times are quite large. The turn-on time of the LCD is millisecond while there turn off time is ten milliseconds.
2. The LCD requires the large area.
3. The direct current reduces the lifespan of LCD. Therefore, the LCD uses with AC supply, having the frequency less than 500Hz.

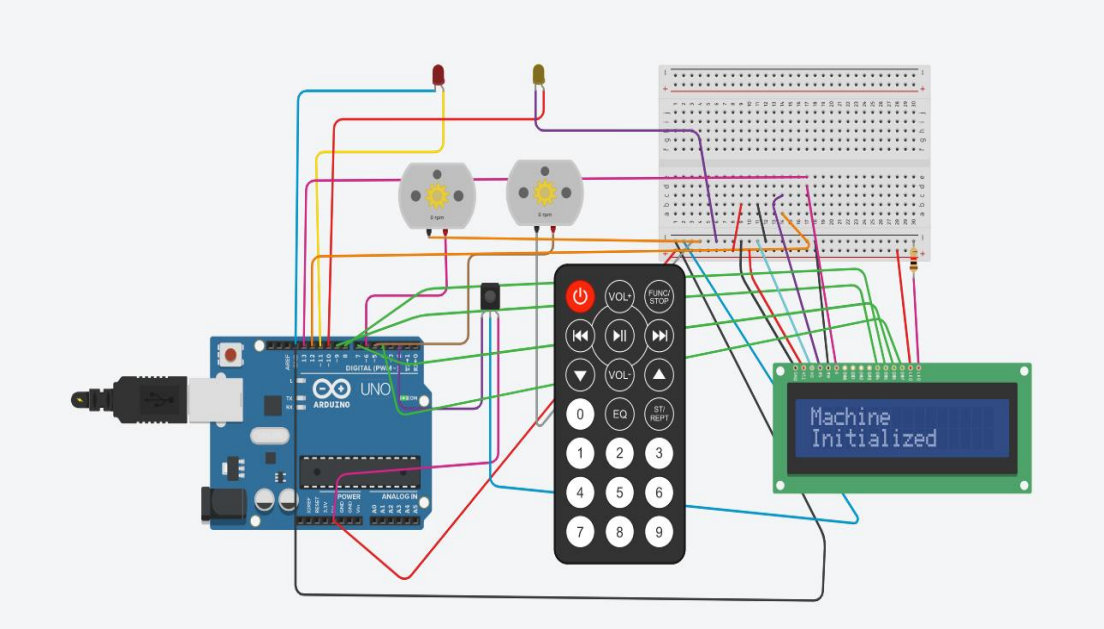
Implementation of the Project



The aim of this project is to design a system consisting of two DC motors to control their speed according to the input given by an IR remote. One motor can be considered as a high-speed machine that is to be handled with care by maximum two people. But there is also a safe mode for the machine where it rotates with a low speed. More than two people can handle it during the safe mode. The 2nd DC motor can be considered as a slide door that closes during the high-speed mode and opens during the safe mode or when the machine is off.

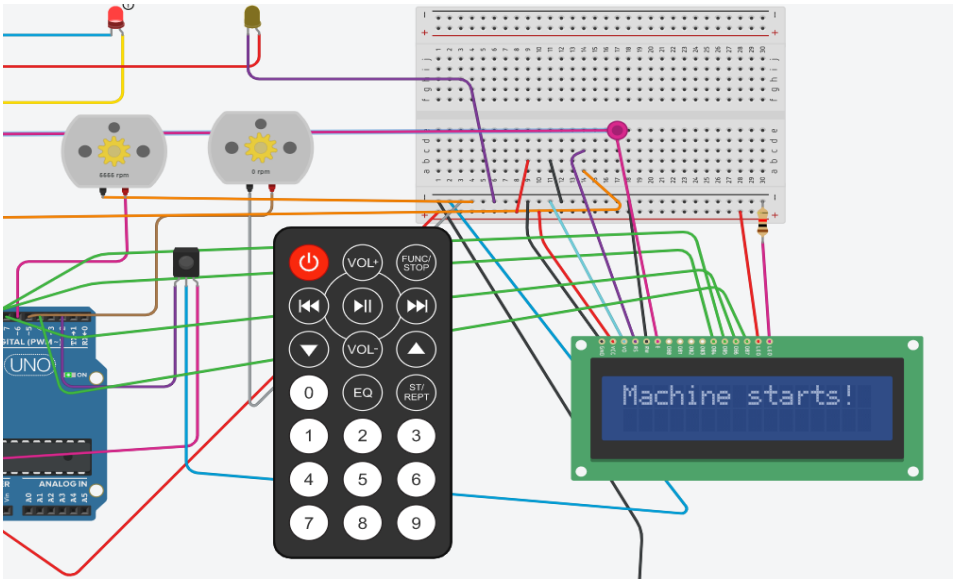
The system has three modes –

i) Power on mode: This mode goes on when we press the power button of the IR remote. A text as "Machine Initialized" is displayed on the LED display when we the power button is pressed. But no machine is turned on during this mode until the command is given.



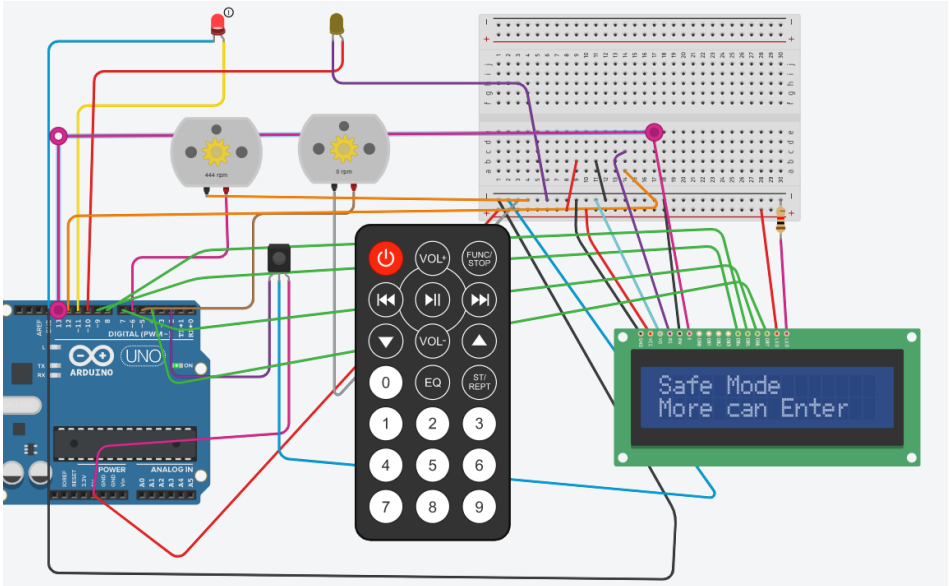
The machine is ready to be operated when this mode is on.

ii) High Speed mode: In this mode at first the door closes and after a while the machine starts rotating at high speed. More than two people can't enter the machine room while this mode is on.



An LED on the high-speed machine is kept on while the machine is on.

iii) Safe Mode: In this mode, the machine rotates with a speed much lesser than the high-speed mode. The door also opens during this mode and more that two people are allowed to enter the machine room during this mode.



Code for simulation of the system in

Autodesk Tinkercad

We have used Autodesk Tinkercad software to simulate the system virtually. The code is given here –

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

LiquidCrystal lcd(12, 13, 9, 8, 7, 4);

const int RECV_PIN = 2;
const int m1 = 6;
const int m2 = 5;
const int led1 = 11;
const int led2 = 10;
unsigned int power = 255;
unsigned int sw1 = 2295;
unsigned int sw2 = 34935;
unsigned int sw3 = 18615;
int estadoConfiguracion = 0;
int onstate = 0;

IRrecv irrecv(RECV_PIN);

decode_results results;

void openCloseDoor(){
   analogWrite(m2, 20);
   digitalWrite(led2, HIGH);
   delay(200);
   analogWrite(m2, 0);
   digitalWrite(led2, LOW);
  lcd.clear();
  lcd.setCursor(2,0);
  lcd.print("Door moved");

}
void initialize(){
      Serial.print("ON ");
      analogWrite(m2, 0);
      analogWrite(m1, 0);
      digitalWrite(led1, HIGH);
      delay(50);
      digitalWrite(led1, LOW);
      digitalWrite(led2, HIGH);
      delay(50);
```

```
      digitalWrite(led2, LOW);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Machine");
  lcd.setCursor(0,1);
  lcd.print("Initialized");
}

void stop(){
      Serial.print("OFF ");
      analogWrite(m2, 0);
      analogWrite(m1, 0);
      digitalWrite(led1, HIGH);
      delay(50);
      digitalWrite(led1, LOW);
      digitalWrite(led2, HIGH);
      delay(50);
      digitalWrite(led2, LOW);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Machine");
  lcd.setCursor(0,1);
  lcd.print("Stopped");
}

void startMachine(){
   analogWrite(m1, 255);
   digitalWrite(led1, HIGH);
  lcd.clear();
 lcd.setCursor(0,0);
  lcd.print("Machine starts!");
  delay(1000);
  lcd.clear();
   lcd.setCursor(0,0);
  lcd.print("Machine going!");


}
void stopMachine(){
  lcd.setCursor(0,0);
  lcd.print("Machine starts!");
   analogWrite(m1, 0);
   digitalWrite(led1, LOW);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Machine stops");
}
```

```
void safeMode(){

  analogWrite(m1, 20);
  digitalWrite(led1, HIGH);
  openCloseDoor();
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Safe Mode");
  lcd.setCursor(0,1);
  lcd.print("More can Enter");
}
void setup()
{
  lcd.begin(16, 2);
  Serial.begin(9600);
  irrecv.enableIRIn(); // Start the receiver
 // irrecv.blink13(true);
  Serial.begin(9600);
  pinMode(m1, OUTPUT);
  pinMode(m2, OUTPUT);
  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);

  // put your setup code here, to run once:
}


void loop() {

 // Serial.println(irrecv.decode(&results));


  if (irrecv.decode(&results)) {
    unsigned int value = results.value;

    if (results.decode_type == NEC) {
      Serial.print("NEC: ");
    }
    Serial.println(value);

    if(value == power && onstate == 0){

      initialize();
      onstate = 1;

    }else if(value == sw1 && onstate == 1){
      Serial.print("OFF ");
      openCloseDoor();
      delay(200);
```

```
      startMachine();

    }else if(value == sw2 && onstate == 1){
      Serial.print("OFF ");
      stopMachine();
      delay(200);
      openCloseDoor();

    }else if(value == sw3 && onstate == 1){
      safeMode();

    }else if(value == power && onstate == 1){
      stop();
      onstate = 0;
    }

    irrecv.resume();
    }
}
```

Precautions: a) The LCD display must be handled with care and terminals should be connected properly so that no burnout occurs.

b) Input current to the DC motors should be kept under safe limit.

c) The connecting wires should be properly connected to the pins of Arduino UNO so that there is no loose connection.

References

1) www.google.com

2) www.wikipedia.com

3) www.electronicshub.com

4) www.geeksforgeeks.org

5) www.byjus.com

6) www.elprocus.com