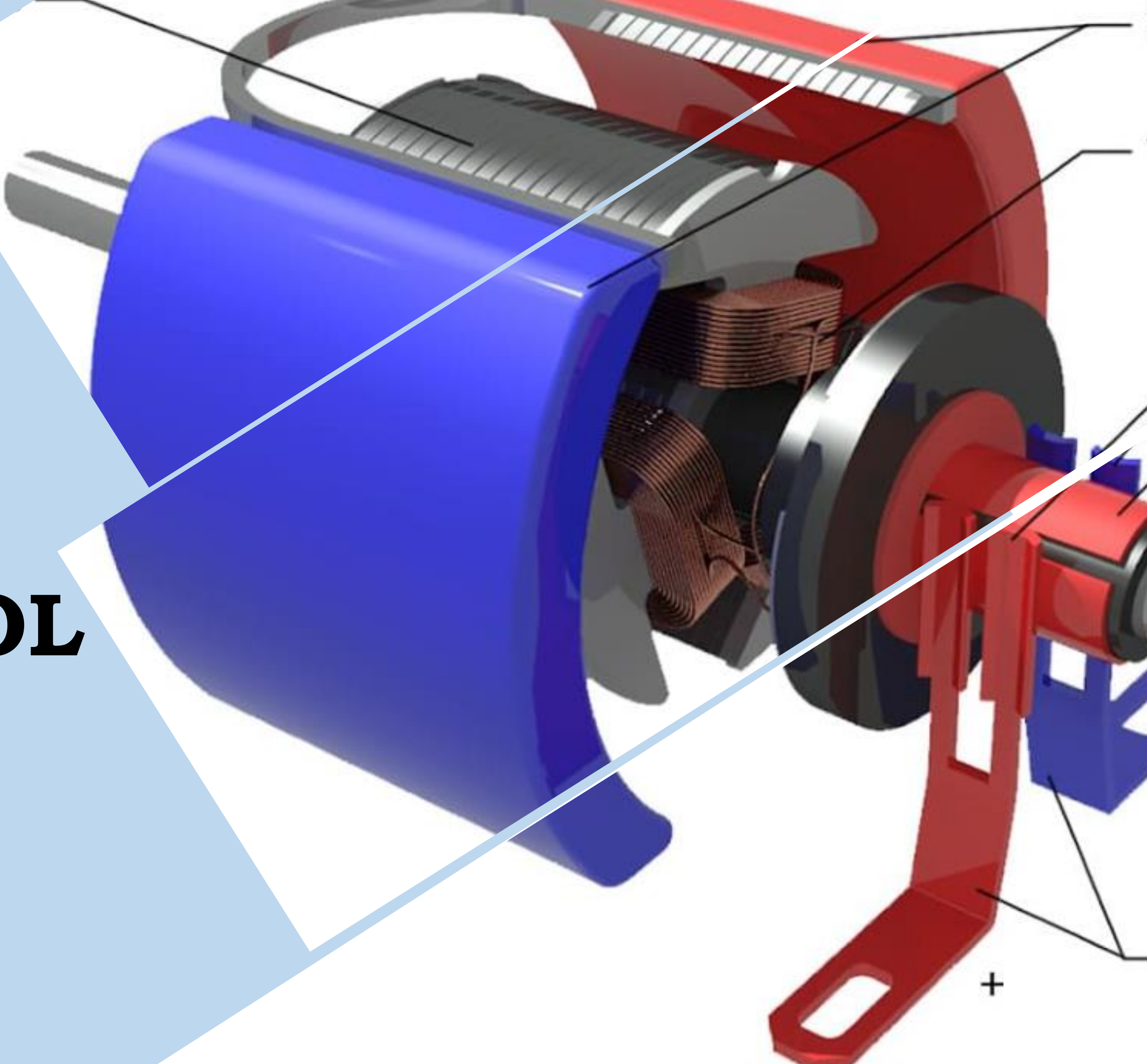
DC MOTOR SPEED CONTROL MODULE



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INTRODUCTION

- ## What is a DC Motor?

=> A DC motor is an electrical machine that converts electrical energy into mechanical motion. It operates on the principle of electromagnetic induction, where the interaction between a magnetic field and an electric current generates rotational motion.

- ## What do we mean by the speed of DC Motor?

=>The speed of a DC motor refers to the rate at which the motor's output shaft or rotor rotates. It is typically measured in revolutions per minute (RPM) and indicates how fast the motor is spinning. The speed of a DC motor can be controlled and adjusted to meet the requirements of a particular application. It is influenced by various factors, including the voltage supplied to the motor, the load it is driving, and the design of the motor itself.

In a basic sense, the speed of a DC motor is proportional to the voltage applied to it. If you increase the voltage supplied to the motor, its speed will generally increase, and if you decrease the voltage, the speed will decrease. However, it's important to note that the relationship between voltage and speed can be affected by factors such as the motor's design, its load, and the presence of any speed control mechanisms like PWM (Pulse Width Modulation) or feedback control systems.

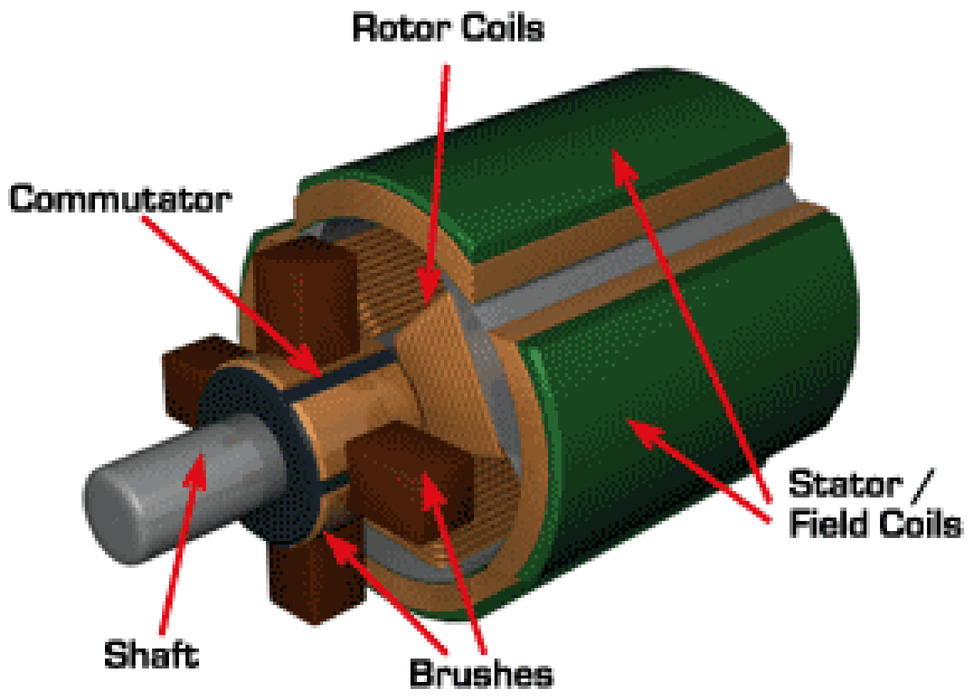


Fig 1 – DC Motor Rotation

TYPES OF DC MOTOR

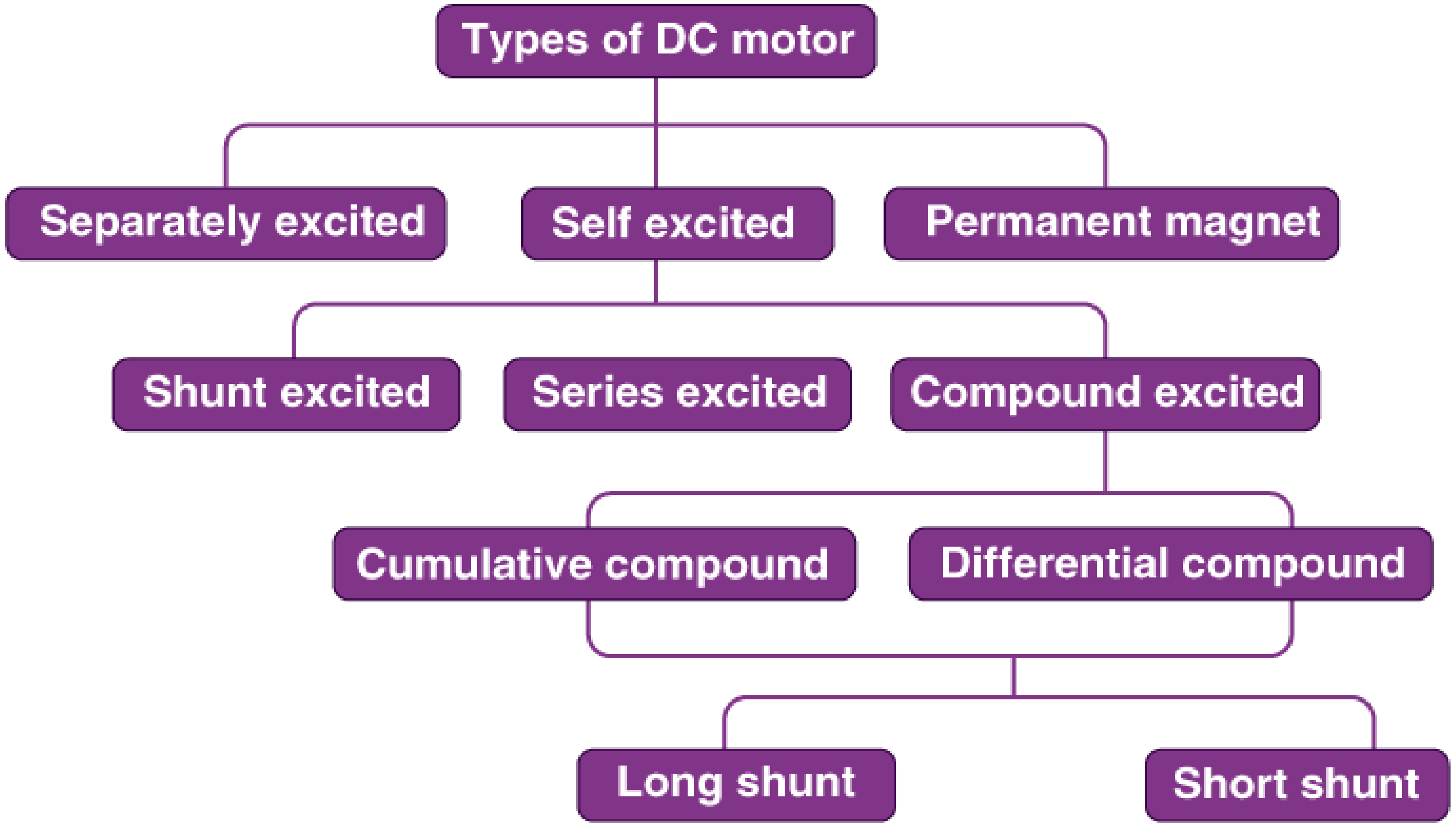


Fig 2 – Block Diagram of Types of DC Motor

MATHEMATICAL EQUATION

Speed Of A DC Motor

Back emf E_b of a DC motor is nothing but the induced emf in armature conductors due to rotation of the armature in magnetic field. Thus, the magnitude of E_b can be given by EMF equation of a DC generator.

$E_b = {}^{PØNZ}/_{60A}$

(where, P = no. of poles, Ø = flux/pole, N = speed in rpm, Z = no. of armature conductors, A = parallel paths)

E_b can also be given as,

$E_b = V - I_a R_a$

thus, from the above equations

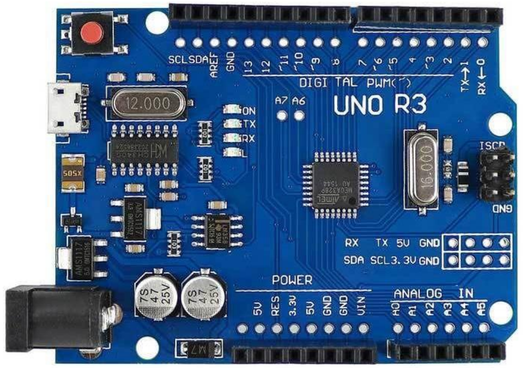
$N = {}^{E_b\,60A}/_{PØZ}$

but, for a DC motor A, P and Z are constants

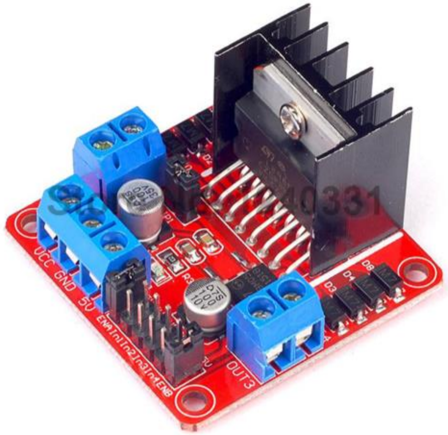
Therefore, $N \propto K\, {}^{E_b}/_{Ø}$ (where, K=constant)

This shows the **speed of a dc motor** is directly proportional to the back emf and inversely proportional to the flux per pole.

COMPONENTS REQUIRED



1. Arduino UNO

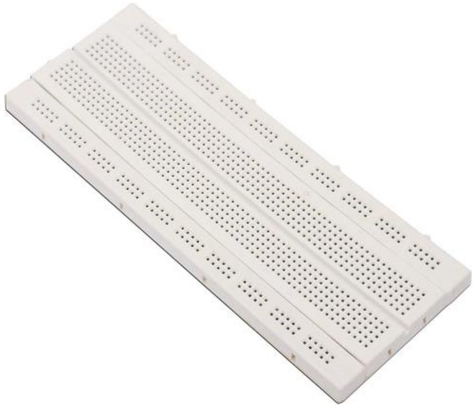


2. L298N Motor Driver

3. Potentiometer(10K)

4. Push Button

5. DC motor with Fan



6. Breadboard

7. Jumper Wires

Circuit Diagram

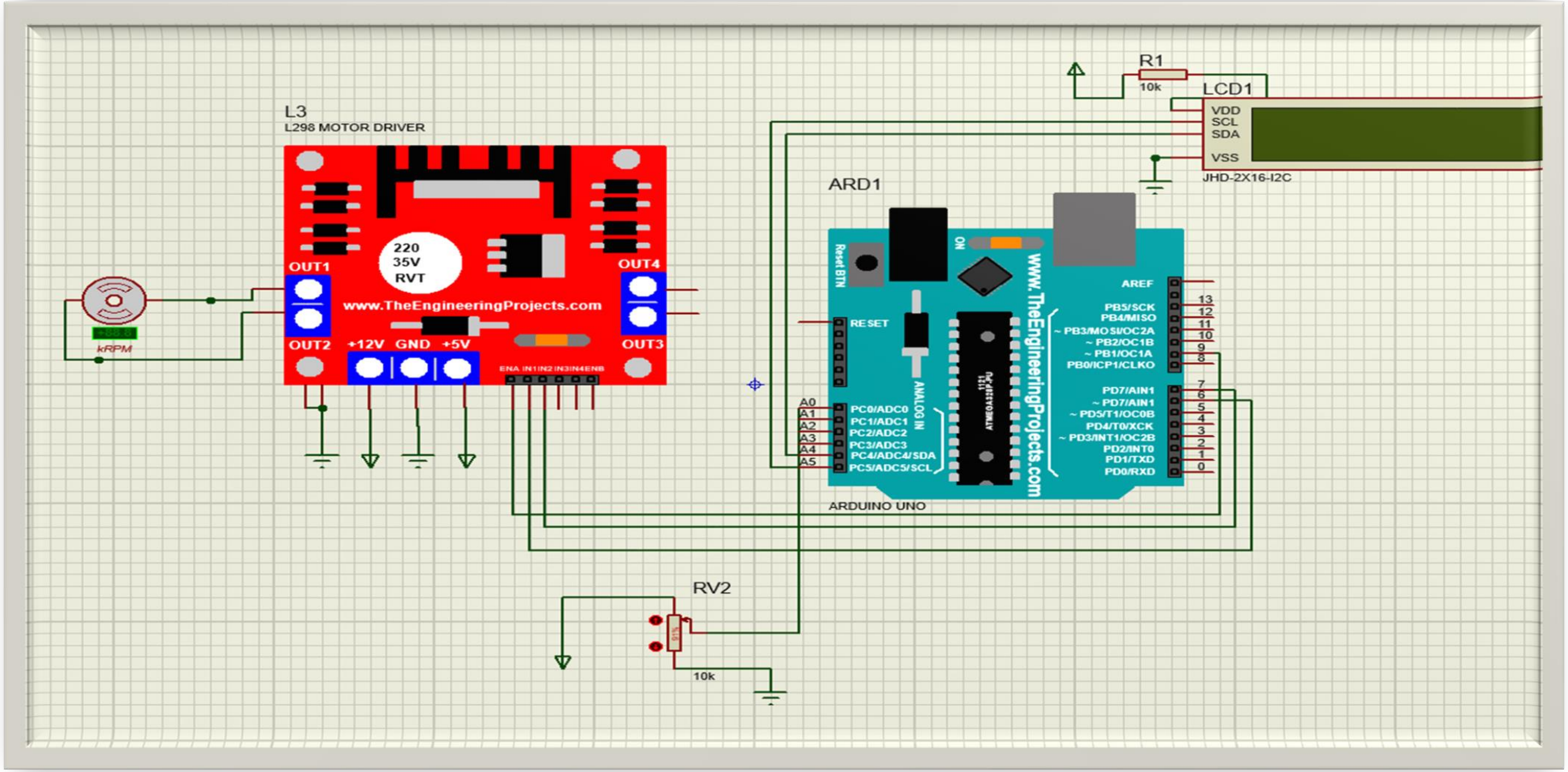


Fig 3 – Motor Speed Control Module

Program

```
#include <LiquidCrystal.h>

#include <Adafruit_LiquidCrystal.h>
// Motor control pins
#define enA 9
#define in1 6
#define in2 7
#define button 4

// LCD pin connections
const int rs = 8;    // Register Select pin
const int en = 5;    // Enable pin
const int d4 = 3;    // Data pin 4
const int d5 = 2;    // Data pin 5
const int d6 = 11;   // Data pin 6
const int d7 = 10;   // Data pin 7

int rotDirection = 0;
bool pressed = false;

// Initialize LCD with pin configurations
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
```

```
void setup() {
  Serial.begin(9600);
  pinMode(enA, OUTPUT);
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);
  pinMode(button, INPUT);

  // Set initial rotation direction
  digitalWrite(in1, LOW);
  digitalWrite(in2, HIGH);

  // Initialize LCD
  lcd.begin(16, 2);  // 16 columns and 2 rows
  lcd.print("Motor Control");
}

void loop() {
  int potValue = analogRead(A0); // Read
potentiometer value
  int pwmOutput = map(potValue, 0, 1023, 0 ,
255); // Map the potentiometer value from 0 to
255
```

Program

```
analogWrite(enA, pwmOutput); // Send
PWM signal to L298N Enable pin

  // Button debounce
  int reading = digitalRead(button);
  static int lastButtonState = LOW;
  static unsigned long lastDebounceTime =
0;
  unsigned long debounceDelay = 50;

  if (reading != lastButtonState) {
    lastDebounceTime = millis();
  }

  if ((millis() - lastDebounceTime) >
debounceDelay) {
    if (reading != pressed) {
      pressed = reading;

      if (pressed == HIGH) {
        // Button is pressed, change rotation
direction
```

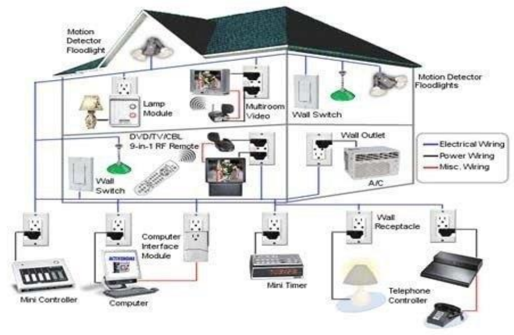
```
if (rotDirection == 0) {
          digitalWrite(in1, HIGH);
          digitalWrite(in2, LOW);
          rotDirection = 1;
        } else {
          digitalWrite(in1, LOW);
          digitalWrite(in2, HIGH);
          rotDirection = 0;
        }
      }
    }
  }

  lastButtonState = reading;

  // Update LCD with motor status
  lcd.setCursor(0, 1);
  lcd.print("Direction: ");
  Serial.print("Direction:   ");
```

Program

```
 lcd.print(rotDirection == 1 ? "Clockwise
" : "Counterclockwise");
  Serial.println(rotDirection == 1 ?
"Clockwise  " : "Counterclockwise");
  delay(1500);

  lcd.setCursor(0, 0);
  lcd.print("Speed:   ");
  Serial.print("Speed: ");

  lcd.print(pwmOutput);
  Serial.println(pwmOutput);

  delay(1500);

  // Add any additional functionality here

  // Delay for stability
  delay(20);
}
```

APPLICATIONS OF THIS PROJECT

1. **Industrial Automation.**
2. **HVAC Systems.**
3. **Electric Vehicles.**
4. **Home Automation.**
5. **Marine and Aerospace.**
6. **Water Treatment.**
7. **Agriculture.**
8. **Medical Devices.**



HOME AUTOMATION

Fig 5 – Applications of DC motors

CONCLUSION

In conclusion, the DC motor speed control project has been a significant endeavor, yielding valuable insights and practical applications for various industries and sectors. Throughout this project, we have successfully designed, implemented, and tested a robust system for precisely controlling the speed of DC motors. The outcomes and implications of this project are multifaceted and impactful.

First and foremost, the project has contributed to the advancement of industrial automation by providing a reliable method for managing conveyor belts, machine tools, pumps, fans, and other critical machinery. The ability to fine-tune motor speed ensures increased efficiency, reduced energy consumption, and enhanced productivity.

Moreover, the project has highlighted the importance of energy conservation, a crucial factor in today's world. The implementation of DC motor speed control in appliances, electric vehicles, and renewable energy systems aligns with global efforts to reduce energy consumption and lower carbon emissions.

Furthermore, the versatility of DC motor speed control is evident in applications ranging from home automation to medical devices, offering improved user experiences and patient care. The precision and flexibility of the system can't be understated. In summary, this DC motor speed control project underscores the significance of motor speed control technology in contemporary industrial and technological landscapes. It addresses efficiency, sustainability, and automation needs, thereby making it a valuable contribution to the fields it serves. As we move forward, the knowledge and experience gained from this project will continue to shape the future of various industries, promoting efficiency, sustainability, and progress.