**Project Synopsis**

**Title:** POV 8 LED-Based Display Using BLDC Motor and Arduino Uno/Nano

**1. Introduction**

A Persistence of Vision (POV) display is a visual illusion where rapidly moving lights create a pattern that appears stable to the human eye. In this project, a BLDC motor is used to rotate an array of 8 LEDs at high speed, creating the illusion of displaying static text or patterns. The project is divided into two main sections:

1. **BLDC Motor Speed Control:** This section involves an Arduino Uno, a BLDC motor, an ESC (Electronic Speed Controller), and a 10k potentiometer. The Arduino Uno regulates the motor speed, which is essential for stable POV display.
2. **POV Display Mechanism:** This section involves an Arduino Nano and 8 LEDs arranged in a row. The Arduino Nano controls the LEDs based on a custom code to display text (like "JS RANA") as the motor rotates.

**2. Components Used**

**(a) Arduino Uno**

* The Arduino Uno is an ATmega328P-based microcontroller board with 14 digital input/output pins, 6 analog inputs, and a 16 MHz quartz crystal.
* In this project, the Arduino Uno controls the speed of the BLDC motor using a potentiometer and an ESC.
* It reads the potentiometer value and maps it to the PWM signal to control the motor speed.

**(b) Arduino Nano**

* The Arduino Nano is a small, breadboard-friendly microcontroller board based on the ATmega328P.
* It is used to control the 8 LEDs and generate the pattern or text for the POV display.
* Its small size makes it suitable for compact installations.

**(c) BLDC Motor (1400KV)**

* A Brushless DC Motor (BLDC) is used for smooth and high-speed rotation, which is essential for POV effect.
* The 1400KV rating indicates that the motor will spin at 1400 RPM per volt supplied.
* BLDC motors are preferred for POV displays because they have no brushes, resulting in less friction and longer lifespan.

**(d) ESC (Electronic Speed Controller) – 30A**

* The ESC acts as a bridge between the Arduino Uno and the BLDC motor.
* It converts the PWM signal from the Arduino into a three-phase output to control the motor.
* The 30A rating ensures that the ESC can handle the high current demands of the BLDC motor.

**(e) Potentiometer – 10kΩ**

* A 10kΩ potentiometer is used to adjust the motor speed.
* It provides an analog signal to the Arduino, which is then mapped to control the ESC output.

**(f) LEDs – 8 Pieces**

* Eight LEDs are arranged in a straight line on a rotating structure.
* The Arduino Nano controls the timing and sequence of the LEDs to form a readable pattern or text.

**(g) Resistors**

* Resistors are used to protect the LEDs from excess current.
* Proper resistance values ensure that the LEDs operate at the correct brightness without overheating.

**(h) Battery – 9V**

* A 9V battery powers the Arduino Nano and the LED circuit.
* The battery provides enough voltage and current for smooth operation of the LEDs and Arduino.

**3. Software Used**

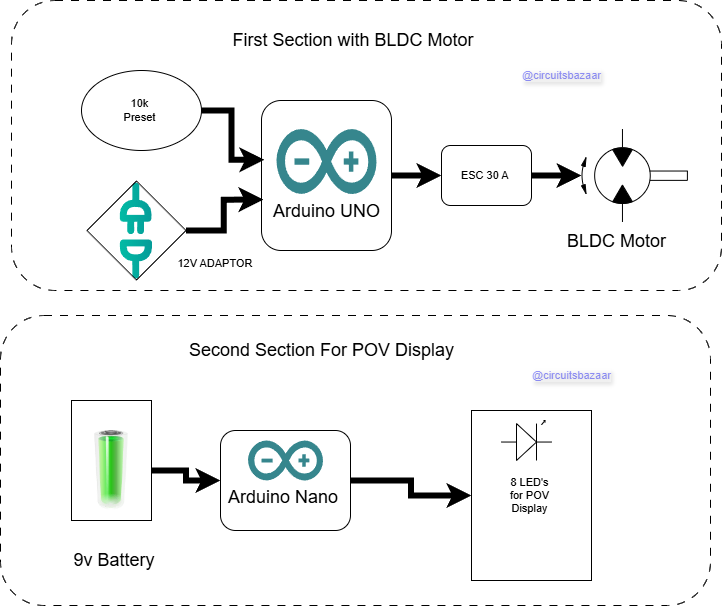
**(a) Arduino IDE**

* The Arduino IDE is used to write and upload the code to both the Arduino Uno and Arduino Nano.
* The code for motor speed control and LED pattern display is written in C/C++.

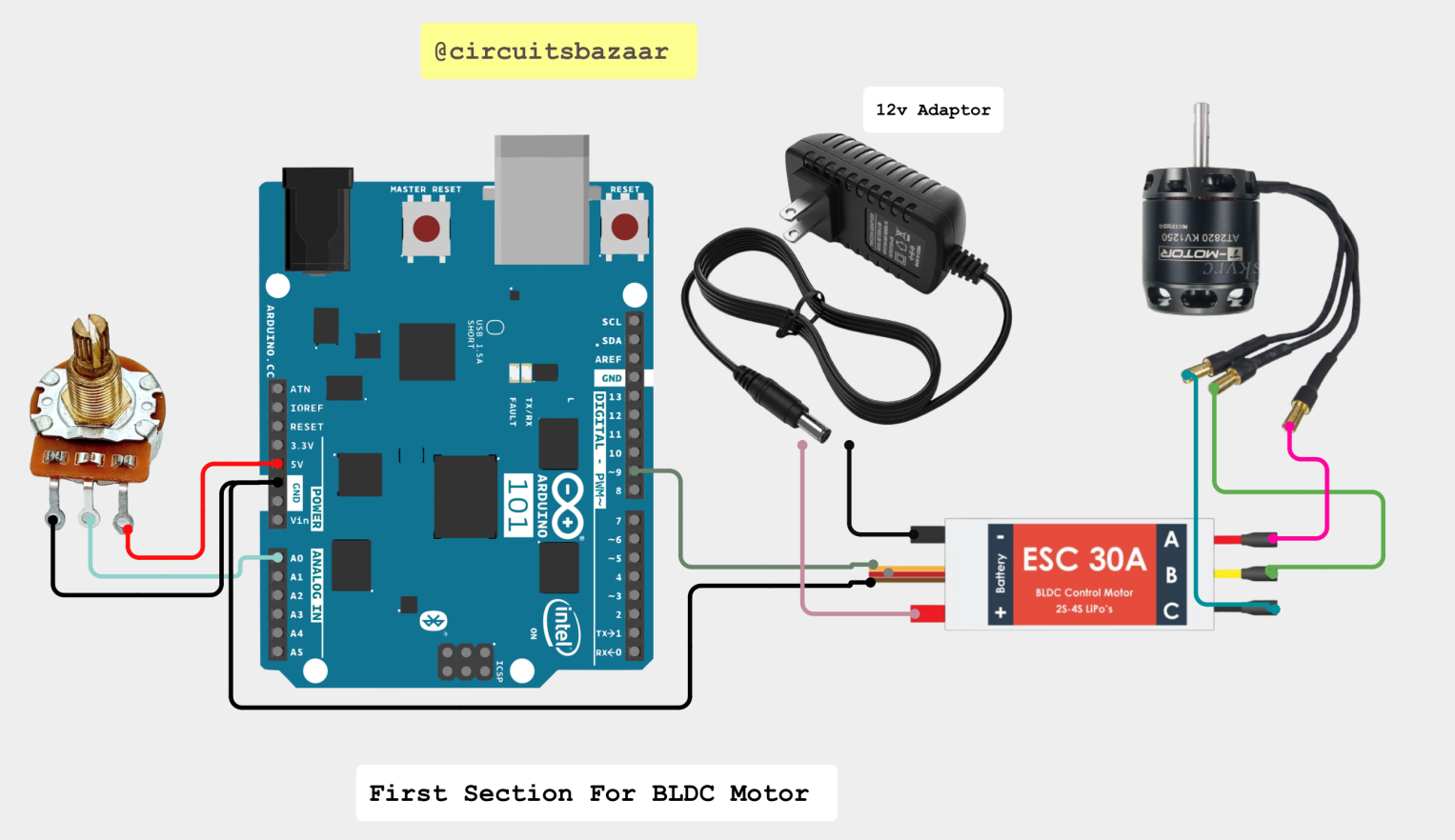
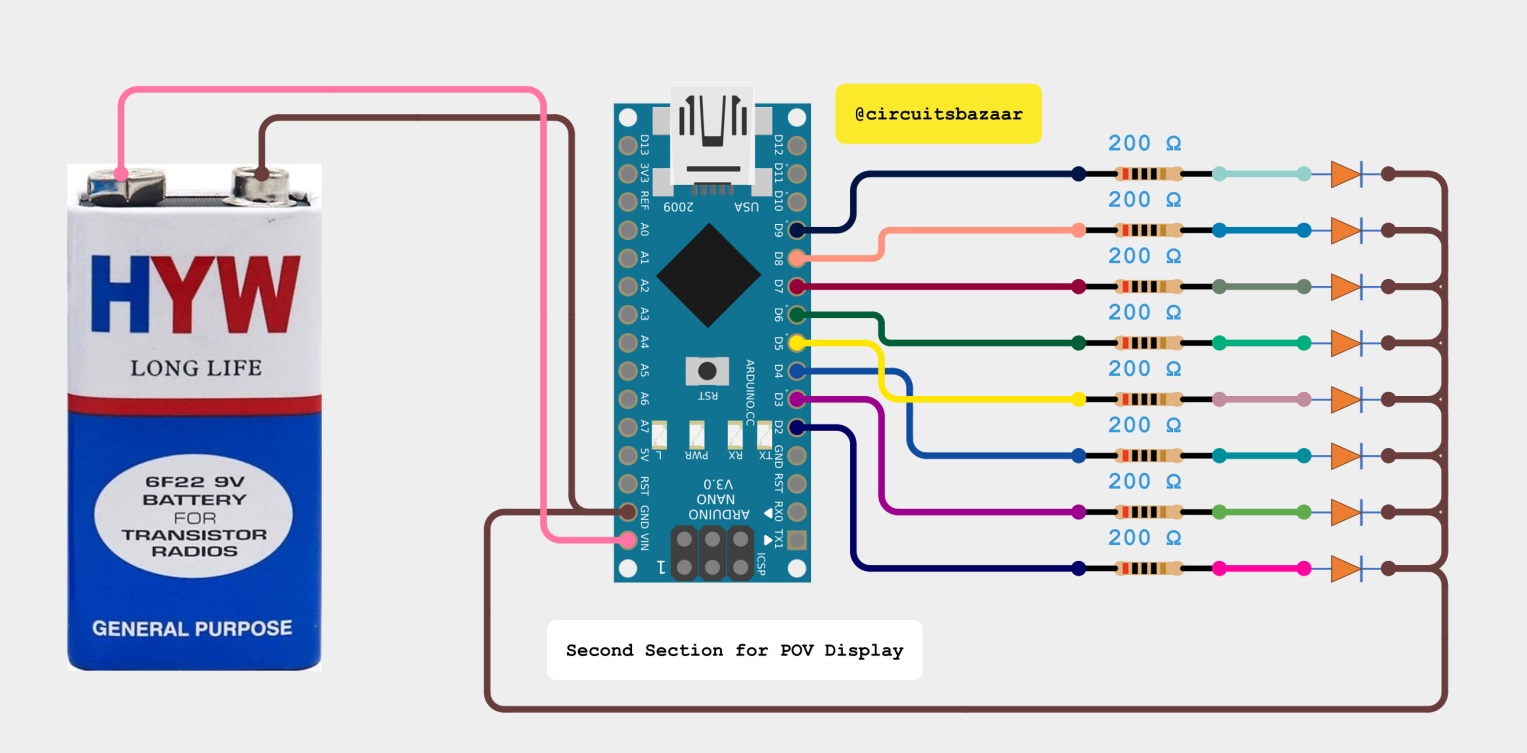
**(b) Serial Monitor**

* The Arduino Serial Monitor is used for debugging and testing.
* It helps to monitor the potentiometer values and motor speed.

**4. Block Diagram**



**5. Circuit Diagram**

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**6. Working Principle**

**(a) BLDC Motor Speed Control**

1. The potentiometer is connected to the analog input of the Arduino Uno.
2. The Arduino reads the potentiometer value (0-1023) and maps it to a PWM range of 1000 to 2000 microseconds.
3. This signal is sent to the ESC, which adjusts the motor speed based on the PWM signal.
4. The motor speed determines the refresh rate of the POV display.

**(b) POV Display Mechanism**

1. The Arduino Nano sends signals to the 8 LEDs based on a pre-defined pattern (representing letters or shapes).
2. The rapid rotation of the LEDs creates the illusion of a stable display due to the Persistence of Vision effect.
3. The code defines each character or pattern in a matrix format and sends signals to light up the LEDs in a precise sequence.

**7. Code Explanation**

**(a) BLDC Motor Speed Control Code**

* Reads potentiometer value, maps it to PWM signal, and sends to ESC.
* Adjusts motor speed based on potentiometer position.

#include <Servo.h>

Servo esc;

int potPin = A0;

int escPin = 9;

int potValue;

void setup() {

esc.attach(escPin);

}

void loop() {

potValue = analogRead(potPin);

int speed = map(potValue, 0, 1023, 1000, 2000);

esc.writeMicroseconds(speed);

delay(10);

}

**(b) LED Testing Code**

* Turns LEDs on and off sequentially to check proper functioning.

#define NUM\_LEDS 8

const int ledPins[NUM\_LEDS] = {2, 3, 4, 5, 6, 7, 8, 9};

void setup() {

for (int i = 0; i < NUM\_LEDS; i++) {

pinMode(ledPins[i], OUTPUT);

}

}

void loop() {

for (int i = 0; i < NUM\_LEDS; i++) {

digitalWrite(ledPins[i], HIGH);

delay(200);

digitalWrite(ledPins[i], LOW);

}

delay(500);

}

**(c) POV Display Code**

* Defines patterns for characters and lights up LEDs accordingly.
* Code includes alphabet mapping for displaying names or messages.

**8. Advantages**

✅ Compact and lightweight design  
✅ Highly energy-efficient  
✅ Can be used to display dynamic patterns or messages  
✅ Low-cost solution for visual displays

**9. Disadvantages**

❌ Requires precise motor calibration  
❌ Not suitable for outdoor use (wind and lighting issues)  
❌ Limited to simple patterns and text

**10. Applications**

➡️ Advertising displays  
➡️ Informative message boards  
➡️ School and college projects  
➡️ Creative visual art installations

**11. Future Scope**

🔹 Increase number of LEDs for higher resolution  
🔹 Add color LEDs for multicolor display  
🔹 Use wireless communication for dynamic message updates  
🔹 Integrate real-time data display using Bluetooth or Wi-Fi

**12. Conclusion**

This POV 8 LED-Based Display using a BLDC motor and Arduino is an innovative project combining electrical and programming skills. It demonstrates the concept of Persistence of Vision, creating visually appealing dynamic patterns. The project can be further enhanced with additional features like wireless updates, multicolor display, and higher LED resolution, making it a versatile and educational tool.