

Lab Report: Project 9 – Motorized Pinwheel

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Spring 2025 TESI 3300

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Lab 9 – Motorized Pinwheel

03/09/25

Abstract

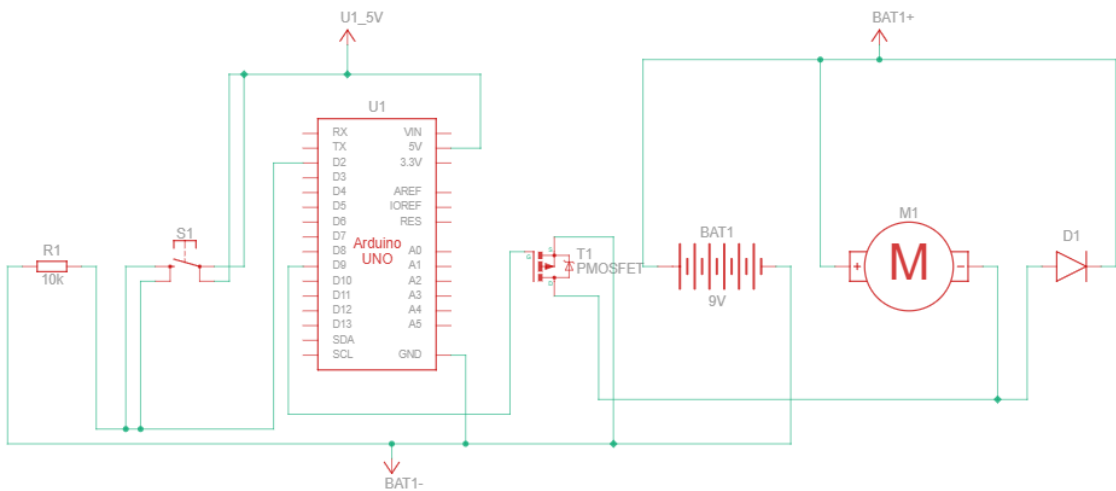
The purpose of this lab was to create a motorized pinwheel using an Arduino Uno, a DC motor, a transistor, and a pushbutton. The project demonstrated how to use a transistor to safely control a higher-current device like a motor, using a low-current Arduino signal. This lab also introduced the use of flyback diodes for protecting circuits against voltage spikes. The project helped reinforce basic concepts of switching, motor control, and physical component mounting challenges.

Materials

- Arduino Uno Board
- Breadboard
- DC Motor
- NPN Transistor (e.g., TIP120)
- Flyback Diode
- Pushbutton
- 220Ω Resistor
- Jumper Wires
- USB Cable
- Coffee Cup Lid (for pinwheel mount)
- Superglue

Procedure

Circuit Diagram



Steps

1. Connected the Arduino's 5V and GND pins to the power and ground rails of the breadboard.
2. Connected the base of the NPN transistor to a digital output pin through a 220Ω resistor.
3. Connected the collector of the transistor to the negative side of the motor.
4. Connected the other side of the motor to the 5V rail.
5. Connected the emitter of the transistor to ground.
6. Added a flyback diode across the motor terminals for voltage spike protection.
7. Connected a pushbutton to control the motor activation.
8. Mounted the pinwheel using a coffee cup lid and superglue.
9. Uploaded the Arduino sketch and tested the circuit.

Code

```
1  const int switchPin = 2;
2  const int motorPin = 9;
3
4  int switchState = 0;
5
6  void setup() {
7
8      pinMode(motorPin, OUTPUT);
9
10     pinMode(switchPin, INPUT);
11 }
12
13 void loop() {
14
15     switchState = digitalRead(switchPin);
16
17
18     if (switchState == HIGH) {
19
20         digitalWrite(motorPin, HIGH);
21     } else {
22
23         digitalWrite(motorPin, LOW);
24     }
25 }
26
```

Discussion

1. What is a transistor? What are some various types of transistors?

A transistor is an electronic component that can act as a switch or amplifier. It controls the flow of current through one circuit by using a smaller current from another. Common types include NPN and PNP bipolar junction transistors (BJTs) and MOSFETs.

2. Describe the inner workings of a motor.

A motor works by sending an electric current through coils of wire, which creates a magnetic field. This magnetic field interacts with permanent magnets inside the motor, causing the motor shaft to rotate and convert electrical energy into mechanical motion.

3. How are a motor and generator similar? How are they different?

Both involve coils and magnets. A motor uses electrical energy to create mechanical movement, while a generator does the opposite: it uses mechanical movement to generate electrical energy.

4. A diode is able to control what of voltage in a circuit?

A diode controls the direction of voltage, allowing current to flow in only one direction and blocking reverse voltage that could damage circuit components.

Troubleshooting

1. **Issue 1:** Finding a mounting solution for the pinwheel was challenging because no one had a CD to use.

Solution: Used an old coffee cup lid and superglue to successfully mount the pinwheel.

2. **Issue 2:** The motor spun too fast, causing the pinwheel to fly off and knock over jumper cables.

Solution: Operated the motor carefully and only briefly pressed the button to control spin speed.

Conclusion

The motorized pinwheel circuit behaved as expected. The motor spun smoothly, and the pushbutton correctly turned the motor on and off. The main challenge was managing the motor speed to prevent the mounted pinwheel from becoming unbalanced and flying off. No code changes were necessary, and the basic motor control concept was demonstrated successfully. This lab reinforced the importance of proper mounting techniques and protecting circuits when dealing with motors.