Mechatronics System Integration (MCTA3203)

Week **5**: L298P Motor Driver Shield with GPIO (ver. **1.0**)

Controlling a DC Motor Using L298P Motor Driver Shield and GPIO

Objectives

- To understand the working of the L298P Motor Driver Shield.
- To control the speed and direction of a DC motor using GPIO pins.
- To implement PWM (Pulse Width Modulation) for speed control.
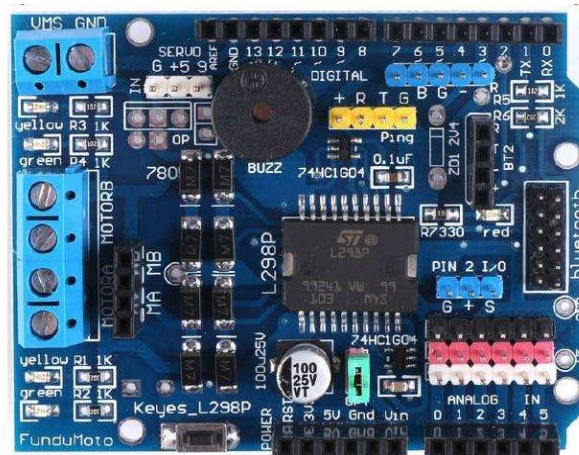- To write and upload code using Arduino IDE

Required Hardware

- Arduino UNO
- L298P Motor Driver Shield
- DC Motor (6V–12V)   1–2
- External Power Supply (9V/12V)
- Jumper Wires
- Breadboard

Theory

L298P Motor Driver Shield

- Based on L298P H-Bridge chip.
- Can drive 2 DC motors with direction and speed control.
- Uses digital GPIO pins for direction.
- Uses PWM-capable GPIO pins for speed.

Important Pins on L298P Shield

Function	Arduino Pin Mapping
Motor A Direction	D12 (IN1), D13 (IN2)
Motor B Direction	D10 (IN3), D11 (IN4)
Speed Control A	D3 (ENA - PWM)
Speed Control B	D5 (ENB - PWM)

Note: Actual pin mapping may vary based on shield model (confirm from the datasheet).

How Does PWM Control Speed?

PWM (Pulse Width Modulation) is a technique that switches the motor's power **ON** and **OFF rapidly** at a high frequency (usually hundreds to thousands of times per second). By adjusting the **duty cycle** — the percentage of time the signal is ON — we control how much **average voltage** is delivered to the motor.

Duty Cycle (%)	ON Time	OFF Time	Effect on Speed
0%	0%	100%	Motor OFF
50%	Half	Half	Medium Speed
100%	Full	0%	Full Speed

This average voltage determines the motor's speed:
- Higher duty cycle → higher average voltage → faster rotation
- Lower duty cycle → lower average voltage → slower rotation

Circuit Diagram
- Attach the L298P Shield on top of the Arduino board.
- Connect the DC motors to Motor A and Motor B terminals.
- Supply external power to the shield's screw terminal (GND and +12V).
- Ensure GND is common between shield and Arduino.
- Details can be checked in the **references**.

Arduino Code Example
Control Direction and Speed of One Motor

```
// Motor A pin definitions
const int ENA = 3;            // PWM pin for speed control
const int IN1 = 12;          // Direction
const int IN2 = 13;          // Direction

void setup() {
  pinMode(ENA, OUTPUT);
  pinMode(IN1, OUTPUT);
  pinMode(IN2, OUTPUT);
}

void loop() {
  // Move forward
  digitalWrite(IN1, HIGH);
  digitalWrite(IN2, LOW);
  analogWrite(ENA, 200);      // Speed: 0-255

  delay(2000);

  // Move backward
  digitalWrite(IN1, LOW);
  digitalWrite(IN2, HIGH);
  analogWrite(ENA, 200);

  delay(2000);

  // Stop
  analogWrite(ENA, 0);
```

```
    delay(1000);
}

void moveMotor(int EN, int IN1, int IN2, int speed, bool forward) {
  // ... will be useful for Task 5
}
```

⚠ Safety Precautions
- Never power motors directly from Arduino 5V pin.
- Always double-check wiring before powering the circuit.
- Disconnect power before making changes.

Experiment Steps
1. Assemble the circuit and plug in the L298P shield.
2. Connect the motors to Motor A/B terminals.
3. Upload the Arduino code using Arduino IDE.
4. Observe the motor rotating in forward and reverse directions.
5. Modify the PWM value to observe speed changes (complete the observaton table).

Observation Table

PWM Value	Direction	Observed Speed (RPM est.)[*]
255	Forward	??
128	Forward	??
255	Reverse	??
64	Reverse	??

[*]Use a tachometer or estimate based on number of rotations per time.

Task

1. Explain the function of the ENA and ENB pins.
2. Describe the reason PWM is used for speed control.
3. Describe the outcome when both IN1 and IN2 are set HIGH.
4. Explain how braking can be implemented using the L298P.
5. Modify the code to control two DC motors simultaneously.

Appendix

Pin Reference (Arduino UNO)

Shield Pin	Arduino Pin	Function
ENA	D3	PWM (Speed A)
IN1	D12	Motor A Direction 1
IN2	D13	Motor A Direction 2
ENB	D5	PWM (Speed B)
IN3	D10	Motor B Direction 1
IN4	D11	Motor B Direction 2

References

[1]   https://www.instructables.com/Tutorial-for-L298-2Amp-Motor-Driver-Shield-for-Ard/
         Tutorial for L298 2Amp Motor Driver Shield for Arduino
[2]   https://github.com/CytronTechnologies/L298P_MotorDriverShield
         L298P_MotorDriverShield
[3]   https://my.cytron.io/p-shield-l298p-motor-driver-with-gpio?r=1
         Shield L298P Motor Driver with GPIO
[4]   https://docs.cirkitdesigner.com/component/a25f6e70-294e-42fd-b77c-9e9349b76b9a/l298p-drive-shield
         How to Use L298P drive shield: Examples, Pinouts, and Specs