PID-controlled Line Follower Robot

Prepared by : ML Prasanna and T HariCharani

Andhra University College of Engineering for Women

Date : 19th March 2025

# Contents

1. Title Page
2. Table of Contents
3. Introduction
4. Components Used
5. Circuit Diagram
6. Working Principle
7. Code Explanation
8. Assembly Instructions
9. Testing and Calibration
10. Troubleshooting
11. Results and Observations
12. Future Improvements
13. Conclusion
14. References

### **Key Points to Highlight**

### Objective:

* + To design and build a line follower robot that can autonomously follow a black line on a white surface using IR sensors and PID control.

The primary objective of this project is to design and build an **autonomous line follower robot** capable of following a black line on a white surface using **IR sensors** and **PID control**. The robot will use an **Arduino Uno** as its microcontroller, an **L298N motor driver** to control the motors, and a **lithium-ion battery** for power. The project aims to:

1. **Implement Sensor-Based Navigation:**
   * IR sensors are used to detect the black line and guide the robot along the path.
2. **Develop PID Control Logic:**
   * Implement a Proportional-Integral-Derivative (PID) control algorithm to ensure smooth and accurate line following.
3. **Demonstrate Autonomous Operation:**
   * Showcase the robot's ability to navigate a predefined track without human intervention.
4. **Learn and Apply Robotics Concepts:**
   * Gain hands-on experience with microcontrollers, motor drivers, sensors, and control algorithms.
5. **Encourage Problem-Solving and Innovation:**
   * Troubleshoot and optimise the robot's performance, and explore potential improvements for future iterations.

This project serves as an excellent introduction to **embedded systems** and **autonomous robotics**, with applications in industrial automation, educational robotics, and autonomous vehicles.

### **Basic Version Components**

#### **1. Microcontroller:**

* **Arduino Uno**
  + A simple and widely used microcontroller for basic robotics projects.

#### **2. Motor Driver:**

* **L298N Motor Driver**
  + Used to control the speed and direction of the motors.

#### **3. Sensors:**

* **2 IR Sensors**
  + Used to detect the black line on a white surface.

#### **4. Motors:**

* **2 Geared DC Motors (100-200 RPM)**
  + Provide sufficient torque and speed for basic line following.

#### **5. Power Supply:**

* **Lithium-Ion Battery (7.4V or 11.1V)**
  + Powers the motors and Arduino via the L298N motor driver.

#### **6. Chassis and Wheels:**

* **Robot Chassis**
  + A simple chassis to mount all components.
* **2 Wheels**
  + Attached to the motors for movement.
* **1 Caster Wheel**
  + Provides balance and stability.

#### **7. Miscellaneous:**

* **Jumper Wires**
  + For connecting components.
* **Breadboard (Optional)**
  + For prototyping and easy connections.

### **Advanced Version Components**

#### **1. Microcontroller:**

* **ESP32**
  + A more powerful microcontroller with built-in Wi-Fi and Bluetooth capabilities.

#### **2. Motor Driver:**

* **L298N Motor Driver** or **L293D Motor Driver**
  + Used to control the motors. For higher current requirements, consider using a **BTS7960** or **VNH5019** motor driver.

#### **3. Sensors:**

* **2 IR Sensors**
  + For basic line detection.

#### **4. Motors:**

* **2 High-Speed Geared DC Motors (150-200 RPM)**
  + Provide higher speed and torque for advanced applications.

#### **5. Power Supply:**

* **Lithium-Ion Battery (12v)**
  + Provides sufficient power for high-speed motors and additional components.

#### **6. Chassis and Wheels:**

* **Robot Chassis**
  + A sturdy chassis to mount all components.
* **2 Wheels**
  + Attached to the motors for movement.
* **1 Caster Wheel**
  + Provides balance and stability.

#### **7. Data Logging and Storage:**

* **SD Card Module**
  + For logging sensor data and robot performance.

#### **8. Miscellaneous:**

* **Jumper Wires**
  + For connecting components.
* **Breadboard (Optional)**
  + For prototyping and easy connections.

### **Why Choose the Advanced Version?**

* **Enhanced Performance:**
  + High-speed motors and encoders provide better speed and precision.
* **Data Logging:**
  + SD card module allows you to log and analyse sensor data.
* **Wireless Control:**
  + ESP32 enables remote control and IoT integration.
* **Expandability:**
  + Additional sensors and features make the robot more versatile.

### **Circuit Diagram**

………………………………………..

