

Technical Description and Working of Line Following Robot

Technical Description

A robot that follows a pre-defined path (black line on a white surface or vice versa) using **Infrared (IR) sensors**. It employs an **Arduino Uno microcontroller**, an **L293D motor driver**, **DC motors**, and **IR sensors** to detect and follow the line.

Key Components and Their Roles

1. **Arduino Uno:**
 - Acts as the brain of the robot.
 - Processes input from **IR sensors** and controls **motors** accordingly.
2. **IR Sensors (4 in Front):**
 - Detect the line by differentiating between **black and white surfaces**.
 - **Black surface** absorbs IR light → **sensor output LOW (0)**.
 - **White surface** reflects IR light → **sensor output HIGH (1)**.
3. **L293D Motor Driver:**
 - Controls the movement and direction of the **DC motors**.
 - Takes signals from **Arduino** and regulates motor power.
4. **DC Motors (2 Front Wheels):**
 - Propel the robot forward or steer left/right based on sensor input.
5. **Caster Wheel (Back):**
 - Provides stability and smooth movement.
6. **Power Supply (2 DC Batteries):**
 - Powers the **motors (9V or 12V)** and **Arduino (5V via regulator)**.

Working Principle

Step-by-Step Operation

1. IR Sensors Detect the Line:

- The robot moves along a track with a **black line on a white surface**.
- **IR sensors continuously read the surface** and send signals to **Arduino**.

2. Arduino Processes Sensor Data:

- Based on **which sensors detect black or white**, the Arduino **decides the motor action**.

3. Motor Control Based on Sensor Input:

- **Forward Movement:** If both middle sensors detect the line, the robot moves straight.
- **Left Turn:** If the left-side sensors detect black, the right motor speeds up while the left motor slows down or stops.
- **Right Turn:** If the right-side sensors detect black, the left motor speeds up while the right motor slows down or stops.
- **Sharp Turns:** If only the extreme left or right sensor detects the line, the robot turns sharply.
- **Stop Condition:** If no sensor detects black, the robot halts.

4. Continuous Adjustment:

- The robot **constantly adjusts its path** by comparing sensor readings and modifying motor speed.
- This is achieved using a **basic control algorithm** (if-else conditions) to maintain alignment with the line.

Control Algorithm

- The control strategy used is a **simple rule-based (if-else) logic**.

Summary

- **Sensors read the line → Arduino processes data → Motor driver moves motors accordingly.**
- The robot **corrects deviations by adjusting motor speeds**.
- **Simple logic-based algorithm ensures movement along the line.**