Department of Electrical & Electronic Engineering

Rajshahi University of Engineering & Technology

LAB Report

Course Code : **EEE 3100**

Course Title : **Electronics Shop Practice**

Experiment No. : 05

Experiment Name : Design and Implementation of an Autonomous IR-Guided Line Follower Robot Using Arduino for Intelligent Line Tracking Applications

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Experiment No.: 05

Experiment Name: Design and Implementation of an Autonomous IR-Guided Line Follower Robot Using Arduino for Intelligent Line Tracking Applications

Objective:

- To develop a robot that can accurately track and follow a line using IR sensors
- To implement an intelligent line tracking algorithm using Arduino
- To investigate the effects of different parameters such as sensor placement, line width, and surface type on the robot's performance.

Theory:

Autonomous robots are designed to perform tasks without human intervention. These robots use sensors and algorithms to navigate their environment, make decisions, and execute actions. One of the fundamental applications of autonomous robots is line following, where the robot navigates along a predefined path marked by a line. Infrared (IR) sensors are commonly used in line-following robots due to their simplicity and effectiveness. IR sensors emit infrared light and detect the reflection from surfaces. When the sensor is positioned over a line (typically black on a white surface), the reflection is minimal, indicating the presence of the line. Conversely, when the sensor is over a white surface, the reflection is high, indicating the absence of the line. The Arduino microcontroller is a popular choice for building autonomous robots due to its ease of use, affordability, and extensive community support. Arduino boards, such as the Arduino Uno, provide a range of digital and analog input/output pins, making them suitable for interfacing with various sensors and actuators. The line-following algorithm is the core of the robot's navigation system. It involves reading the sensor data, processing it to determine the robot's position relative to the line, and adjusting the motor speeds accordingly to keep the robot on the path. The motors are controlled using motor driver circuits, which allow the Arduino to regulate the speed and direction of the motors. Common motor drivers include the L293D and L298N, which can handle the current requirements of DC motors and provide directional control.

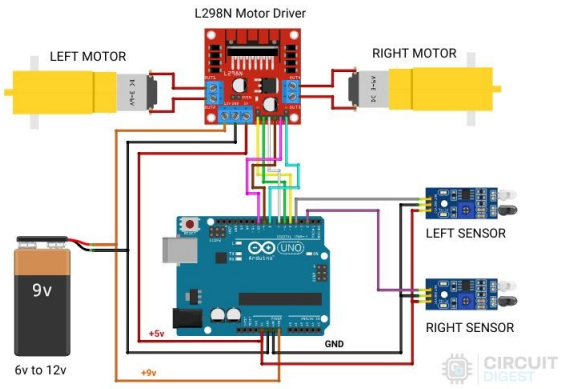

Fig-5.1: Autonomous IR-Guided Line Follower Robot Using Arduino

Required Apparatus:

Table 5.1: Table For Required Apparatus

Sl. No.	Components	Specification	Quantity
1.	Arduino	UNO $_{R3}$	1
2.	L298N Motor Driver IC	Dual H-Bridge	1
3.	DC Gear Motor	6V, 200 RPM	2
4.	Wheel	-	3
5.	Chassis	-	1
6.	Breadboard	-	1
7.	Power Adapter	5V DC output	1
8.	Jumper wires	-	-
9.	IR sensor	-	2

Circuit Diagram:

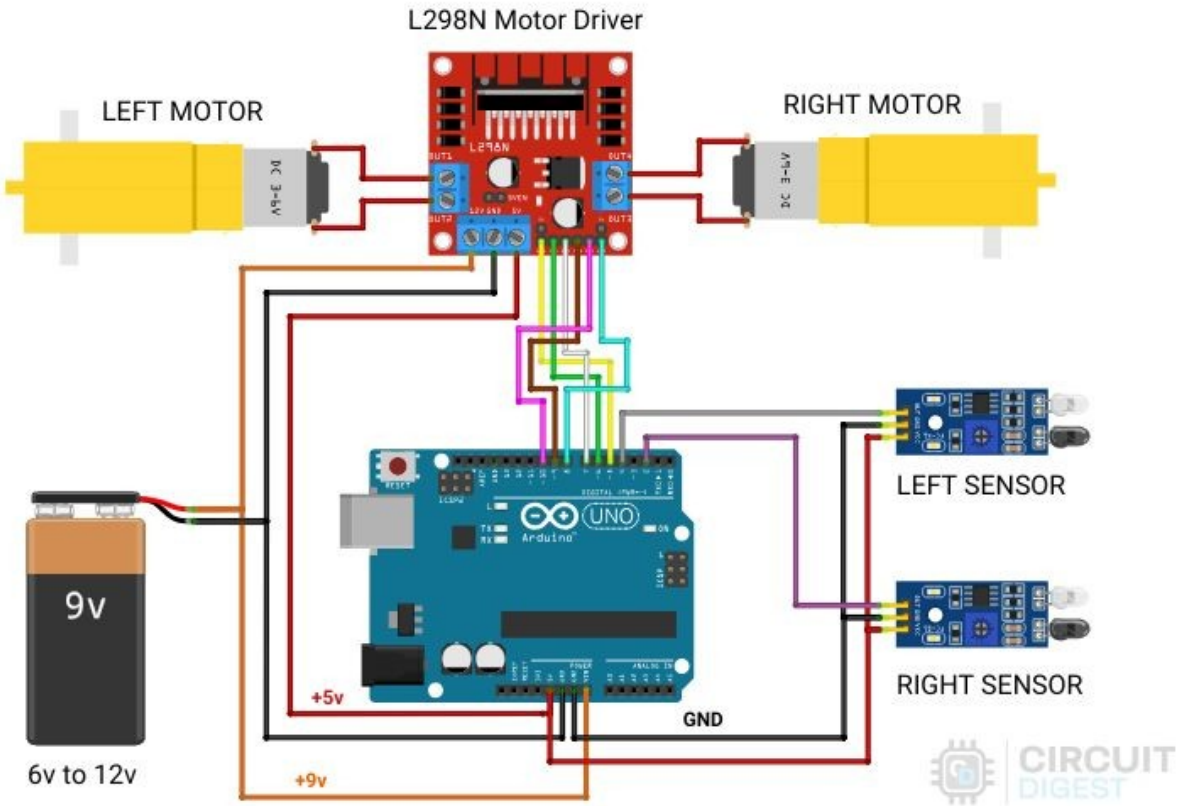

Fig.05.2: Circuit Diagram for an an Autonomous IR-Guided Line Follower Robot Using Arduino for Intelligent Line Tracking Applications

Experimental Setup:

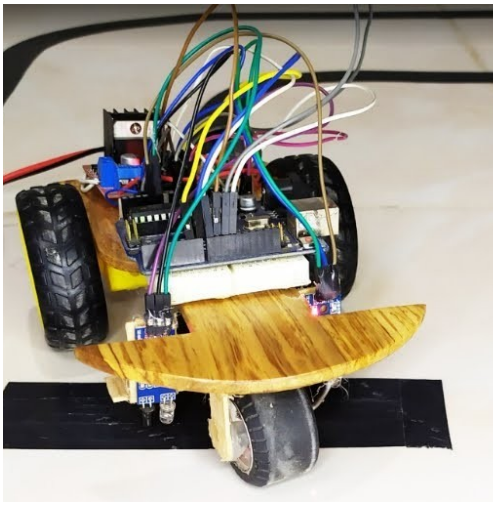

Fig.05.3: Experimental setup of the experiment on Design and Implementation of an Autonomous IR-Guided Line Follower Robot Using Arduino for Intelligent Line Tracking Applications

Code:

```
// Arduino Line Follower Robot Code
//More Information: https://circuitdigest.com/microcontroller-projects/arduino-uno-line-follower-robot
#define enA 5//Enable1 L293 Pin enA
#define in1 6 //Motor1  L293 Pin in1
#define in2 7 //Motor1  L293 Pin in1
#define in3 9 //Motor2  L293 Pin in1
#define in4 10 //Motor2  L293 Pin in1
#define enB 8 //Enable2 L293 Pin enB
#define R_S 4//ir sensor Right
#define L_S 2 //ir sensor Left
void setup(){
pinMode(R_S, INPUT);
pinMode(L_S, INPUT);
pinMode(enA, OUTPUT);
pinMode(in1, OUTPUT);
pinMode(in2, OUTPUT);
pinMode(in3, OUTPUT);
pinMode(in4, OUTPUT);
pinMode(enB, OUTPUT);
digitalWrite(enA, HIGH);
digitalWrite(enB, HIGH);
delay(1000);
}
digitalWrite(in2,   LOW);      //Right Motor backword Pin

void loop(){
if((digitalRead(R_S)               == 0)&&(digitalRead(L_S)      ==      0)) {forward();}    //if Right Sensor and Left Sensor are at White color then it will call forword function
if((digitalRead(R_S)               == 1)&&(digitalRead(L_S)      ==      0)) {turnRight();} //if Right Sensor is Black and Left Sensor is White then it will call turn Right function
if((digitalRead(R_S)               == 0)&&(digitalRead(L_S)      ==      1)) {turnLeft();}   //if Right Sensor is White and Left Sensor is Black then it will call turn Left function
if((digitalRead(R_S)               == 1)&&(digitalRead(L_S) == 1)){Stop();} //if Right Sensor and Left Sensor are at Black color then it will call Stop function
}
void forward(){  //forword
digitalWrite(in1,    HIGH);    //Right Motor forword Pin

digitalWrite(in2,   LOW);      //Right
```

```
digitalWrite(in3, LOW);  //Left Motor backword Pin
digitalWrite(in4, HIGH); //Left Motor forword Pin
}
void turnRight(){ //turnRight
digitalWrite(in1,   LOW);      //Right Motor forword Pin
digitalWrite(in2,    HIGH);    //Right Motor backword Pin
digitalWrite(in3, LOW);  //Left Motor backword Pin
   digitalWrite(in4,   HIGH);   //Left Motor forword Pin
}
void turnLeft(){ //turnLeft
digitalWrite(in1,    HIGH);    //Right Motor forword Pin
```

```
Motor backword Pin
digitalWrite(in3, HIGH); //Left Motor backword Pin
digitalWrite(in4, LOW);  //Left Motor forword Pin
}
void Stop(){ //stop
digitalWrite(in1, LOW); //Right Motor forword Pin
digitalWrite(in2, LOW); //Right Motor backword Pin
digitalWrite(in3, LOW); //Left Motor backword Pin
digitalWrite(in4, LOW); //Left Motor forword Pin
}
```

Experimental Procedure:

- Assembled the chassis, wheels, and motors.
- Connected the motors and L293D IC on a breadboard as per the circuit diagram.
- Connected L293D pins to Arduino Uno using jumper wires.
- Uploaded the Arduino code to the board.
- Connected 2 IR sensors.
- Powered the circuit using a 5V adapter.

Results:

In this experiment, the operation of design and Implementation of an Autonomous IR-Guided Line Follower Robot Using Arduino for Intelligent Line Tracking Applications using an Arduino Uno and an L298N motor driver IC. The motors operated as intended, with precise speed and direction control, responsive user inputs, and immediate stop functionality, demonstrating the effective use of PWM and H-Bridge for real-time motor control and verifying the effectiveness of the code in achieving directional and speed control of DC motors.

Discussions:

The experiment successfully demonstrated how line follower robots can be made using an Arduino Uno and an L298N motor driver. At first, the robot wasn't working. Then we had to change L298N motor driver and even Arduino. Then again it showed failure. Then we had to calibrate the IR sensors, which had slightly very difficult. Then we had to do some modifications to successfully perform this experiment. Maybe there were some issue with improper wirings, loose connections, faulty motor driver etc.

Justification of CO2 and PO(j):

In our setup, the left IR sensor's output is connected to Arduino pin 2, and the right IR sensor's output to pin 4. The motor driver L298N's control pins are connected as follows: enA to pin 5, in1 to pin 6, in2 to pin 7, in3 to pin 9, in4 to pin 10, and enB to pin 8. The motor driver's power (VCC) and GND are connected to the 9V battery and Arduino GND, respectively. Finally we inserted code to Arduino UNO by using a USB-B cable from laptop. It helped us to learn basics of robotics. We can used our this knowledge in various industrial sites, space research etc.

Conclusion:

The experiment effectively demonstrated a structured robotics system using Arduino and L298N motor driver, achieving both speed modulation and direction control. Despite many difficulties and faults, our experiment got a success. It helped us to get the way of higher research on robotics.

Reference:

1. https://circuitdigest.com/microcontroller-projects/arduino-uno-line-follower-robot