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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

COMPUTER NETWORK LABORATORY

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Line Follower Robot: Using Arduino and IR Sensor

Name	Section	Roll no.	Enrolment no.
SHALINI JHA	A	45	12020002003070
SUPRIYO GHOSH	A	46	12020002003071
PREMANSHU GHOSH	A	47	12020002003073
ARPITA PATRA	A	48	12020002003074
NITISH KUMAR UPADHYAY	A	49	12020002003076

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Abstract:

Line Follower is one of the most important aspects of robotics. A Line Following Robot is an autonomous robot which is able to follow either a black line that is drawn on the surface consisting of a contrasting colour. It is designed to move automatically and follow the line.

The robot uses arrays of optical sensors to identify the line, thus assisting the robot to stay on the track. The array of four sensor makes its movement precise and flexible. The robot is driven by DC gear motors to control the movement of the wheels.

The aim of this project is to design a line follower to improve the sensing capability of any type of obstacle in its way and can also control speed with the help of speed regulator. This is done by using Arduino and IR sensor .

Keywords:

Speed regulator; DC gear motor; Arduino; IR Sensor

I. INTRODUCTION

Objective:

The basic principle of the line follower robot actually almost the same as the light follower robot, but instead of tracking the light the LFR sensor is used to track the line. Therefore by differentiating the line color and its surrounding (black over white or vice verse) any light sensitive sensor could be used to navigate the robot to follow this track.

The robot has sensors installed underneath the front part of the body and two DC motors drive wheels moving forward. A circuit inside takes input signal

from sensors and controls the speed of wheels' rotation. The control is done in such a way that when a sensor senses a black line, the motor slows down or even stops. Then the difference of rotation speed makes it possible to make turns.

Theory:

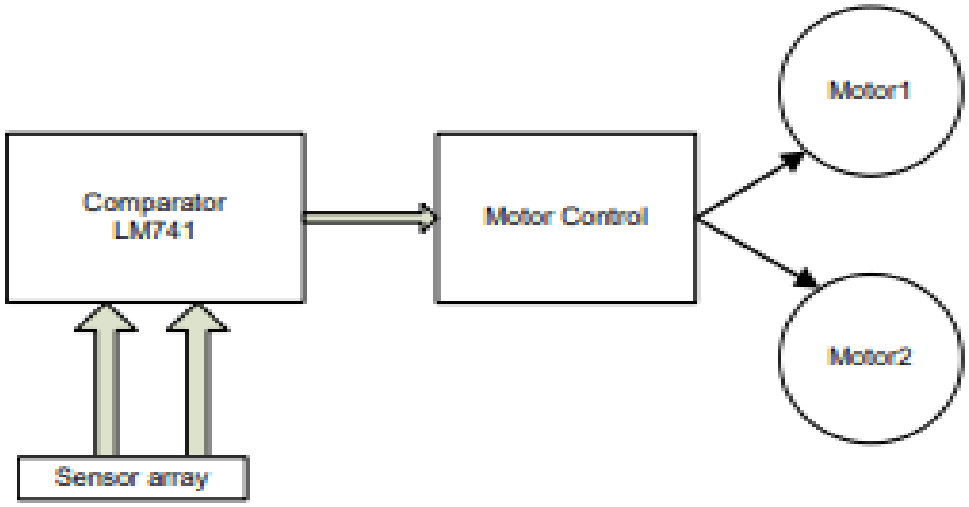
A line follower robot has a simple algorithm, although it has evolved in recent years. A line follower robot is designed to detect and follow a line drawn on the floor. This line follower is a concept can be used in many situations, because of its simplicity of design and implementation. The advantages of the concept are its flexibility and the fact that it is autonomous—in other words, it can be used for long periods without monitoring.

There are many applications for the line follower in our world today. It is used especially in industrial settings, performing tasks such as transportation, manipulation of different objects and as a replacement for conveyer belts.

II. DESIGN

The car consists of 5 channel IR sensors. This sensor senses the line color is reflective or not. Here reflection means the surface sends back the light. In this case, the reflective surface is the White surface. It means that that black tracks don't reflect any light back.

Block diagram:



Working Procedure:

The concept of the line follower robot is related to light. Here, we use the behaviour of light on the black and white surface. The white colour reflects all the light that falls on it, whereas the black colour absorbs the light.

In this line follower robot, we use IR transmitters and receivers (photodiodes). They are used to send and receive the lights. When IR rays fall on a white surface, it is reflected towards IR receiver, generating some voltage changes.

When IR rays fall on a black surface, it is absorbed by the black surface, and no rays are reflected; thus, the IR receiver doesn't receive any rays.

In this project, when the IR sensor senses a white surface, an Arduino gets 1 (HIGH) as input, and when it senses a black line, an Arduino gets 0 (LOW) as input. Based on these inputs, an Arduino Uno provides the proper output to control the bot.

III. IMPLEMENTATION

Materials Required:

- Arduino Uno
- 5 channel IR Tracking sensor Module
- L293D motor driver
- Gear motor with wheels
- TP4056 charging module
- Lithium-ion battery(3.7volt)
- Jumper cables

Arduino Code:

```
#define m1 4  //Right Motor MA1

#define m2 5  //Right Motor MA2

#define m3 2  //Left Motor MB1

#define m4 3 //Left Motor MB2

#define e1 9  //Right Motor Enable Pin EA

#define e2 10 //Left Motor Enable Pin EB


#define ir1 A0

#define ir2 A1

#define ir3 A2
```

```
#define ir4 A3
#define ir5 A4

void setup() {
  pinMode(m1, OUTPUT);
  pinMode(m2, OUTPUT);
  pinMode(m3, OUTPUT);
  pinMode(m4, OUTPUT);
  pinMode(e1, OUTPUT);
  pinMode(e2, OUTPUT);
  pinMode(ir1, INPUT);
  pinMode(ir2, INPUT);
  pinMode(ir3, INPUT);
  pinMode(ir4, INPUT);
  pinMode(ir5, INPUT);
}

void loop() {
  //Reading Sensor Values
  int s1 = digitalRead(ir1);  //Left Most Sensor
  int s2 = digitalRead(ir2);  //Left Sensor
  int s3 = digitalRead(ir3);  //Middle Sensor
  int s4 = digitalRead(ir4);  //Right Sensor
  int s5 = digitalRead(ir5);  //Right Most Sensor

  //if only middle sensor detects black line
  if((s1 == 1) && (s2 == 1) && (s3 == 0) && (s4 == 1) && (s5 == 1))
  {
    //going forward with full speed
    analogWrite(e1, 255);
    analogWrite(e2, 255);
    digitalWrite(m1, HIGH);
```

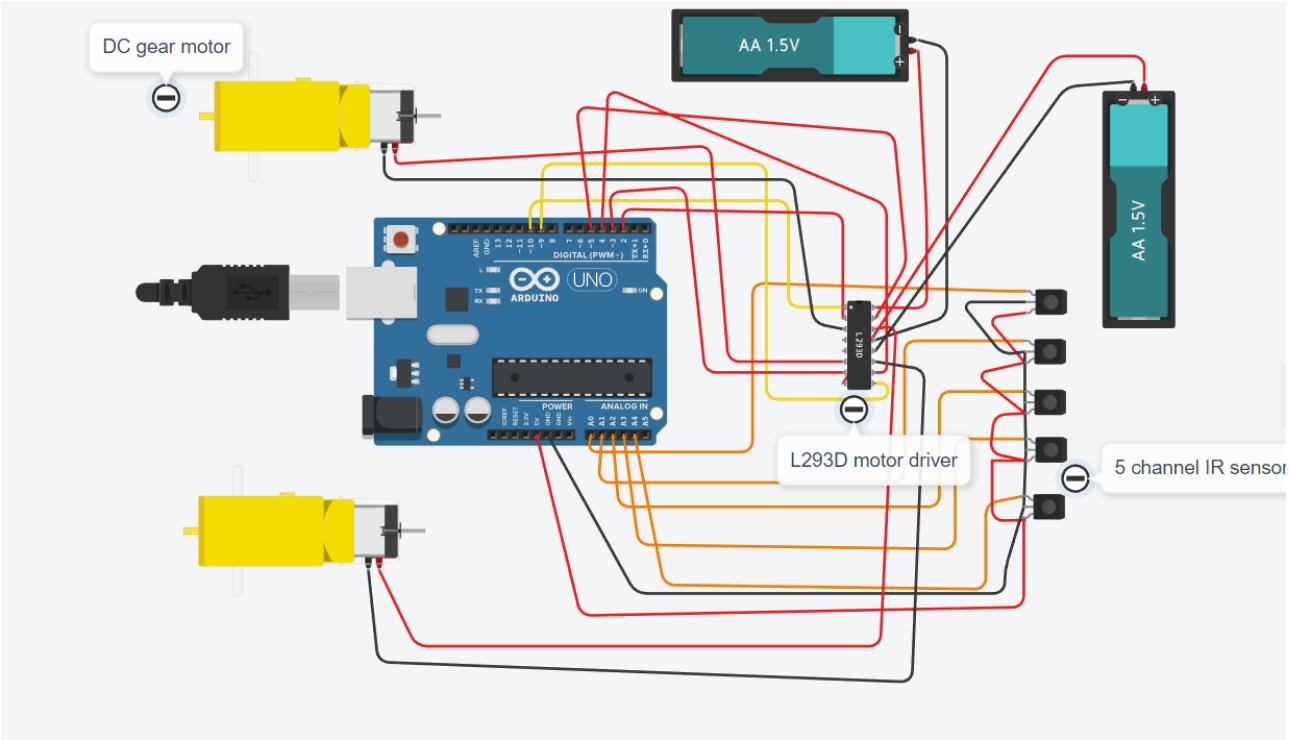
```
  digitalWrite(m2, LOW);
  digitalWrite(m3, HIGH);
  digitalWrite(m4, LOW);
}

//if only left sensor detects black line
if((s1 == 1) && (s2 == 0) && (s3 == 1) && (s4 == 1) && (s5 == 1))
{
  //going right with full speed
  analogWrite(e1, 255);
  analogWrite(e2, 255);
  digitalWrite(m1, HIGH);
  digitalWrite(m2, LOW);
  digitalWrite(m3, LOW);
  digitalWrite(m4, LOW);
}

//if only left most sensor detects black line
if((s1 == 0) && (s2 == 1) && (s3 == 1) && (s4 == 1) && (s5 == 1))
{
  //going right with full speed
  analogWrite(e1, 255);
  analogWrite(e2, 255);
  digitalWrite(m1, HIGH);
  digitalWrite(m2, LOW);
  digitalWrite(m3, LOW);
  digitalWrite(m4, HIGH);
}

//if only right sensor detects black line
if((s1 == 1) && (s2 == 1) && (s3 == 1) && (s4 == 0) && (s5 == 1))
{
```

```
  //going left with full speed
  analogWrite(e1, 255);
  analogWrite(e2, 255);
  digitalWrite(m1, LOW);
  digitalWrite(m2, LOW);
  digitalWrite(m3, HIGH);
  digitalWrite(m4, LOW);
}

//if only right most sensor detects black line
if((s1 == 1) && (s2 == 1) && (s3 == 1) && (s4 == 1) && (s5 == 0))
{
  //going left with full speed
  analogWrite(e1, 255);
  analogWrite(e2, 255);
  digitalWrite(m1, LOW);
  digitalWrite(m2, HIGH);
  digitalWrite(m3, HIGH);
  digitalWrite(m4, LOW);
}

//if middle and right sensor detects black line
if((s1 == 1) && (s2 == 1) && (s3 == 0) && (s4 == 0) && (s5 == 1))
{
  //going left with full speed
  analogWrite(e1, 255);
  analogWrite(e2, 255);
  digitalWrite(m1, LOW);
  digitalWrite(m2, LOW);
  digitalWrite(m3, HIGH);
  digitalWrite(m4, LOW);
}
```

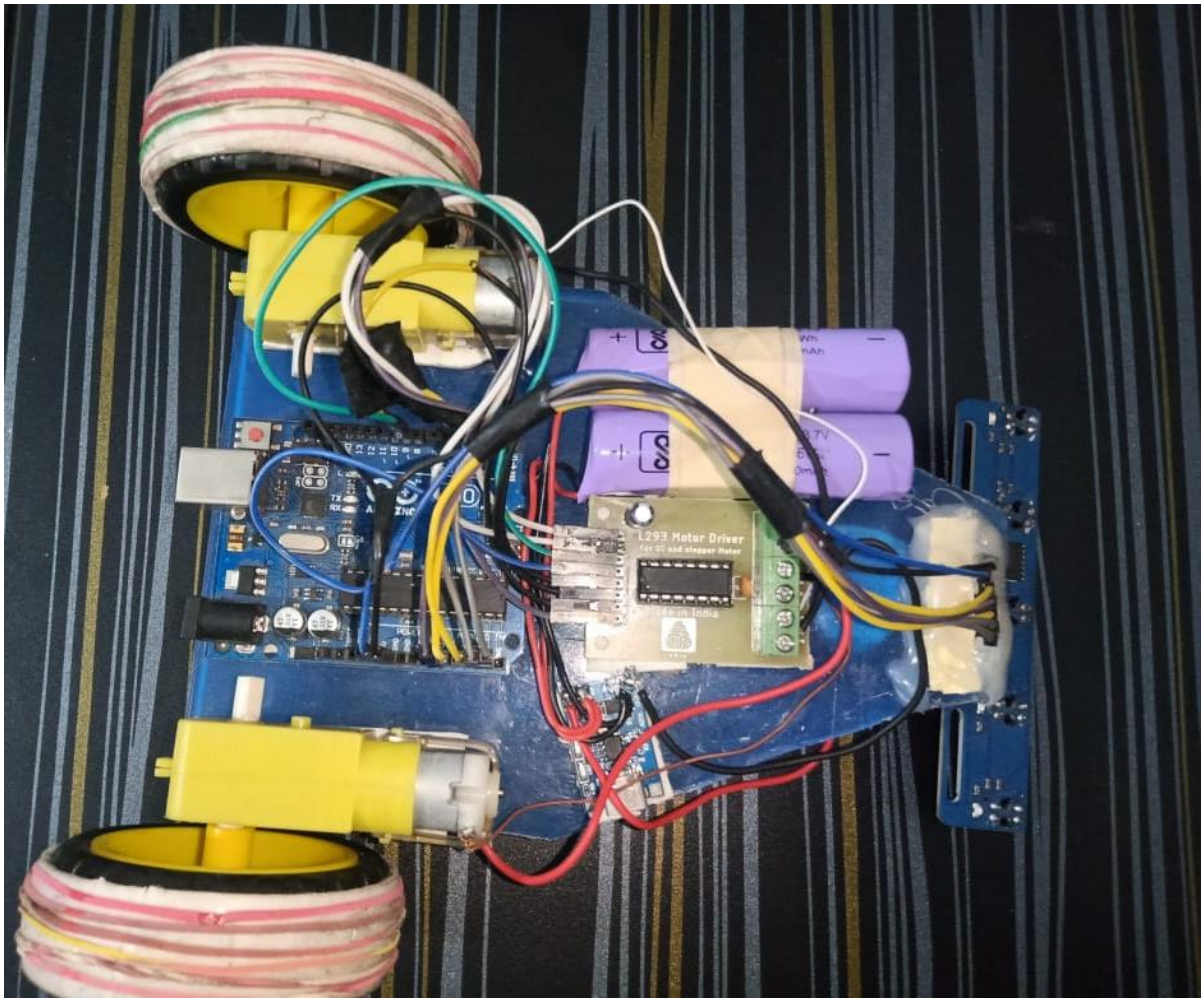
```
//if middle and left sensor detects black line
if((s1 == 1) && (s2 == 0) && (s3 == 0) && (s4 == 1) && (s5 == 1))
{
  //going right with full speed
  analogWrite(e1, 255);
  analogWrite(e2, 255);
  digitalWrite(m1, HIGH);
  digitalWrite(m2, LOW);
  digitalWrite(m3, LOW);
  digitalWrite(m4, LOW);
}

//if middle, left and left most sensor detects black line
if((s1 == 0) && (s2 == 0) && (s3 == 0) && (s4 == 1) && (s5 == 1))
{
  //going right with full speed
  analogWrite(e1, 255);
  analogWrite(e2, 255);
  digitalWrite(m1, HIGH);
  digitalWrite(m2, LOW);
  digitalWrite(m3, LOW);
  digitalWrite(m4, LOW);
}

//if middle, right and right most sensor detects black line
if((s1 == 1) && (s2 == 1) && (s3 == 0) && (s4 == 0) && (s5 == 0))
{
  //going left with full speed
  analogWrite(e1, 255);
  analogWrite(e2,255);
  digitalWrite(m1, LOW);
```

```
  digitalWrite(m2, LOW);
  digitalWrite(m3, HIGH);
  digitalWrite(m4, LOW);
 }

 //if all sensors are on a black line
 if((s1 == 0) && (s2 == 0) && (s3 == 0) && (s4 == 0) && (s5 == 0))
 {
  //stop
  digitalWrite(m1, LOW);
  digitalWrite(m2, LOW);
  digitalWrite(m3, LOW);
  digitalWrite(m4, LOW);
 }
}
```

Schematic:



Model:



IV. CONCLUSION

The Line follower robot works successfully to track on the black line. Above the white surface (art paper) there are some black lines in different directions. The robot still good enough to sense the line and follows the track.

Advantage:

- Robot movement is automatic.
- Used for long distance applications.
- Simplicity in building
- Cost effective

Disadvantage:

- Line follower robot follows a black line about 1 or 2 inches in width on a white surface.

- Line tracing robots are simple robots with an additional sensors placed on them.

- It always needs a path to run either white or black since the IR rays should reflect from the particular path.

- Slow speed and instability on different line thickness or hard angles.

V. BIBLIOGRAPHY

- www.google.com (model idea)
- www.arduino.cc (Arduino IDE for coding)