Line Follower Robot

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SCOPE

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LINE FOLLOWER ROBOT

ABSTRACT

The line follower robot is a robot that can detect or follow a visible black line embedded on a white surface. The line is sensed by the multiple infrared sensors placed on the robot to detect the line. This paper will discuss the working, its implementation and the principle of the line follower robot.

KEYWORDS

Line follower robot, IR sensor, Arduino Uno, L298N Motor Driver Module.

INTRODUCTION

Robots have come a long way in recent years. We can gradually witness how our knowledge on how to design and manufacture robots have increased. With the advancement in technology over the coming years robots which were then very complex to build are now very simple. The very reason why robots were invented was to make our work much easier. Line follower robots aim to do exactly the same.

A line follower robot is a robot designed to follow a path. The path can be visible like a black line on a white surface. The line follower's basic functions include collecting line position with sensors positioned on the robot's front end and directing the robot to trace the line with a steering mechanism.

LITERATURE REVIEW

The Line follower robot is a mobile machine that can detect and follow the line drawn on the floor. Generally, the path is predefined and can be either visible like a black line on a white surface with a high contrasted color or it can be invisible like a magnetic field. Therefore, this kind of Robot should sense the line with its Infrared Ray (IR) sensors installed under the robot. After that, the data is transmitted to the processor by specific transition buses. Hence, the processor is going to decide the proper commands and then it sends them to the driver and thus the path will be followed by the line follower robot [1].

According to [2] Automatic parking technology is becoming a popular research topic as it can complete parking operations safely and quickly without a driver and can improve driving comfort, while greatly reducing the probability of parking accidents. This can be achieved by designing a line following Robot using IR sensors, which will move in a particular direction specified by the user to navigate the robot through a black line marked on the white surface. The robot should also have sufficient intelligence to cover the maximum area of space provided.

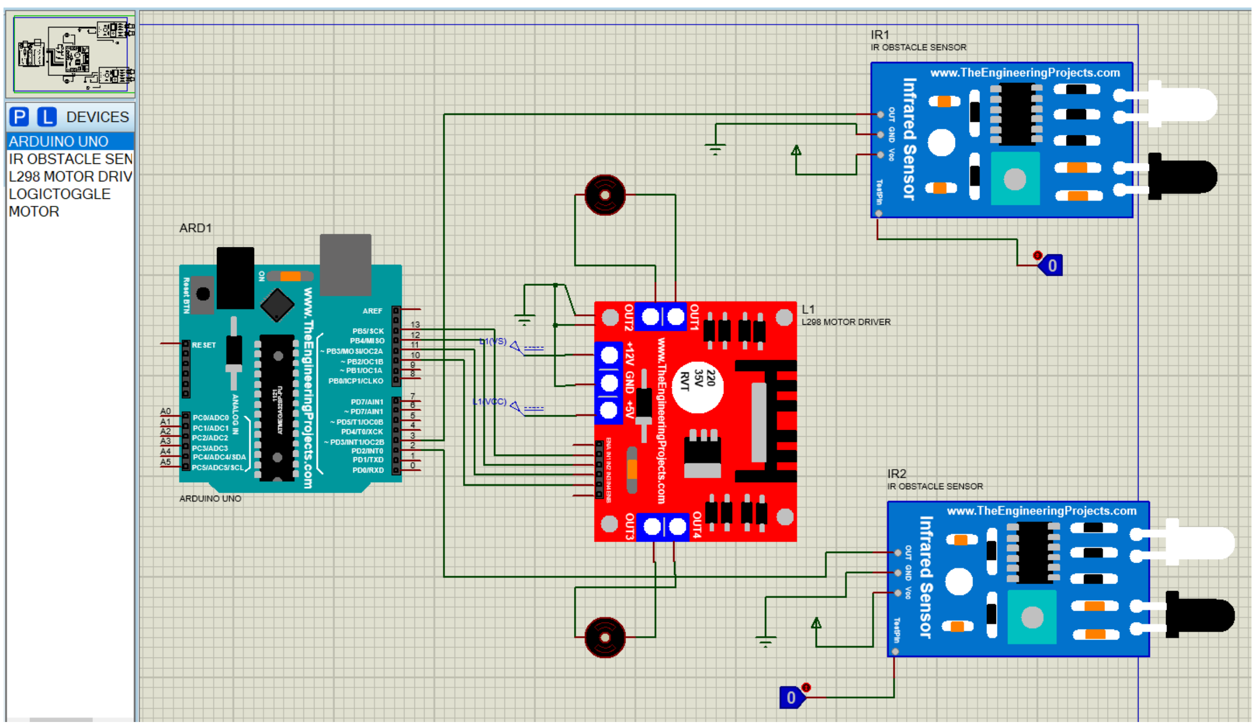
In [3] the paper concentrates on building an autonomous robot with self-balancing and line following capability. The robot using a PID control loop will be able to maintain balance on two wheels by constantly reading the IMU data and adjusting itself to the pre-defined set-point. The robot follows a white/black line using IR sensors. The sensor data is continuously red, and it adjusts itself by changing motor rotation and direction. The ultrasonic and the camera module helps in detecting the obstacle and taking necessary actions.

SIMULATION

To go forward with our hardware project we have verified it with software simulations using Proteus.

With the help of Proteus we have been able to simulate the various scenarios the robot would face in real time. Software simulation not only help to validate our hardware project as well as understand any difficulties we would face while undergoing the hardware implementations.

The below screenshot shows the circuit diagram of our project in Proteus.



Few of the main scenarios we have taken into account for the robot to move are the directions the wheel needs to turn while making a turn. In the above screenshot the direction of the motors represent the direction in which the wheels will turn. For example if the robot has to take a left turn then the left wheel will have to move anti-clockwise and the right wheel will have to move clockwise. Similarly when the robot will have to take a right turn then the right wheel will have to move anticlockwise and the left wheel will have to move clockwise.

SIMULATION CODE

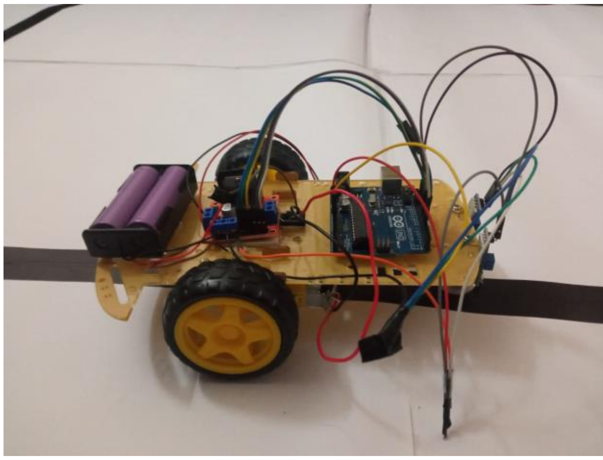
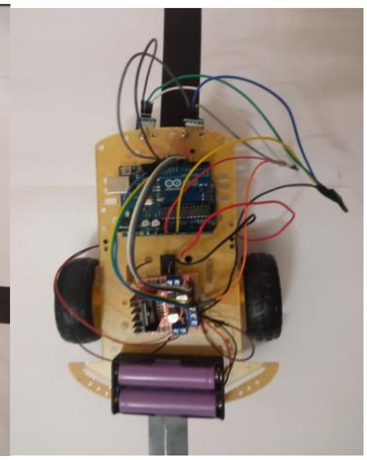
```
void setup()
{
     pinMode(2,INPUT);
     pinMode(3,INPUT);
     pinMode(10,OUTPUT);
     pinMode(11,OUTPUT);
     pinMode(12,OUTPUT);
     pinMode(13,OUTPUT);
}
void loop()
{
    int v=digitalRead(2);
    int s=digital
if(v==1 and s==0)
{
   digitalWrite(13,0);
   digitalWrite(12,1);
   digitalWrite(11,1);
   digitalWrite(10,0);
}

if(v==0 and s==1)
{
   digitalWrite(13,1);
   digitalWrite(12,0);
   digitalWrite(11,0);
   digitalWrite(10,1);
}

if(v==0 and s==0)
{
   digitalWrite(13,0);
   digitalWrite(12,1);
   digitalWrite(11,0);
   digitalWrite(10,1);
}
Read(3);

if(v==1 and s==1)
{
   digitalWrite(13,1);
   digitalWrite(12,0);
   digitalWrite(11,1);
   digitalWrite(10,0);
}
```

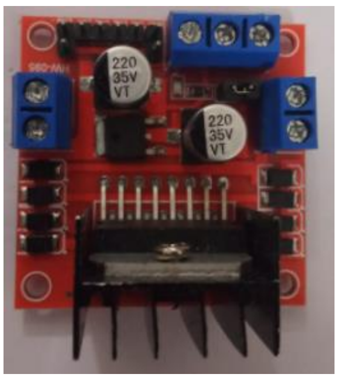
DESIGN OF ROBOT AND PATH

COMPONENTS USED

1. Arduino Uno

2. L298N Motor Driver Module

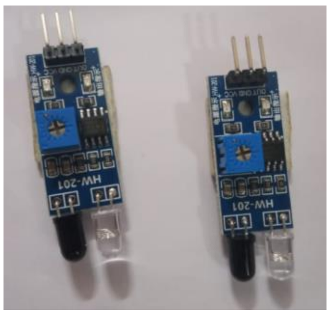


3. BO Motors

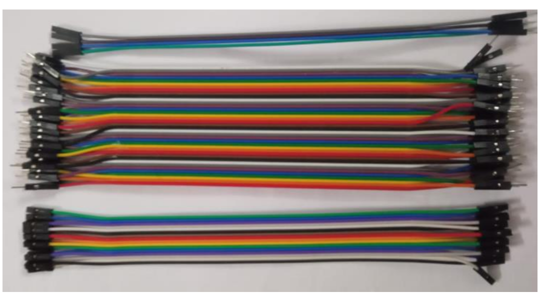
4. 2 Wheel Car Chassis

5. 2 Li ion Batteries

6. 2 IR Sensors



7. Jumper wires



SYSTEM ARCHITECTURE

Connections between Arduino Uno and L298N Motor Driver:

L298N Motor Driver	Arduino Uno
IN1 IN2 IN3 IN4 ENA ENB 5V	D7 D6 D9 D10 D6 D5 5V

GND	GND

Connections between IR Sensors and L298N Motor Driver:

IR Sensors	L298N Motor Driver
Left Sensor: VCC GND	 5V GND
Right Sensor: VCC GND	 5V GND

Connections between IR Sensors and Arduino Uno:

IR Sensors	Arduino Uno
Left Sensor: OUT GND VCC	 D12 GND 5V
Right Sensor: OUT GND VCC	 D11 GND 5V

CODE:

```
#define IR_SENSOR_RIGHT 11
#define IR_SENSOR_LEFT 12
#define MOTOR_SPEED 200

int enableRightMotor=6;
int rightMotorPin1=7;
int rightMotorPin2=8;
```

```
int enableLeftMotor=5;
int leftMotorPin1=9;
int leftMotorPin2=10;

void setup()
{
  TCCR0B = TCCR0B & B11111000 | B00000010 ;

  // put your setup code here, to run once:
  pinMode(enableRightMotor, OUTPUT);
  pinMode(rightMotorPin1, OUTPUT);
  pinMode(rightMotorPin2, OUTPUT);

  pinMode(enableLeftMotor, OUTPUT);
  pinMode(leftMotorPin1, OUTPUT);
  pinMode(leftMotorPin2, OUTPUT);

  pinMode(IR_SENSOR_RIGHT, INPUT);
  pinMode(IR_SENSOR_LEFT, INPUT);
  rotateMotor(0,0);
}

void loop()
{
  int rightIRSensorValue = digitalRead(IR_SENSOR_RIGHT);
  int leftIRSensorValue = digitalRead(IR_SENSOR_LEFT);

  if (rightIRSensorValue == LOW && leftIRSensorValue == LOW)
  {
    rotateMotor(MOTOR_SPEED, MOTOR_SPEED);
  }
  else if (rightIRSensorValue == HIGH && leftIRSensorValue == LOW )
  {
      rotateMotor(-MOTOR_SPEED, MOTOR_SPEED);
  }
  else if (rightIRSensorValue == LOW && leftIRSensorValue == HIGH )
  {
      rotateMotor(MOTOR_SPEED, -MOTOR_SPEED);
  }
  else
  {
    rotateMotor(0, 0);
  }
}

void rotateMotor(int rightMotorSpeed, int leftMotorSpeed)
{
  if (rightMotorSpeed < 0)
  {
    digitalWrite(rightMotorPin1,LOW);
    digitalWrite(rightMotorPin2,HIGH);
  }
```

```
  else if (rightMotorSpeed > 0)
  {
    digitalWrite(rightMotorPin1,HIGH);
    digitalWrite(rightMotorPin2,LOW);
  }
  else
  {
    digitalWrite(rightMotorPin1,LOW);
    digitalWrite(rightMotorPin2,LOW);
  }
  if (leftMotorSpeed < 0)
  {
    digitalWrite(leftMotorPin1,LOW);
    digitalWrite(leftMotorPin2,HIGH);
  }
  else if (leftMotorSpeed > 0)
  {
    digitalWrite(leftMotorPin1,HIGH);
    digitalWrite(leftMotorPin2,LOW);
  }
  else
  {
    digitalWrite(leftMotorPin1,LOW);
    digitalWrite(leftMotorPin2,LOW);
  }
  analogWrite(enableRightMotor, abs(rightMotorSpeed));
  analogWrite(enableLeftMotor, abs(leftMotorSpeed));
}
```

RESULTS AND DISCUSSION

When the two Infrared sensors connected at both sides of the line follower robot senses white surface, then the two motors rotate clockwise and the robot moves forward.

When one of the Infrared sensors (say the one located at the right side) senses a black path while the other one (left one) senses a white surface, then there is a right turn, hence the robot turns right. To make the robot move right, the right motor rotates anticlockwise and the left motor rotates clockwise hence the robot takes a right turn.

When the left Infrared sensor senses a black path while the other one (right one) senses a white path, then there is a left turn, hence the robot moves left. To make the robot move left, the left motor rotates anticlockwise and the right motor rotates clockwise, hence the robot takes a left turn.

Similarly, when both the Infrared sensors sense a black line, both the motors stop rotating and the robot stops to move.

APPLICATIONS

The line follower robot with its obstacle detection mechanism can be used in many applications such as for delivery across the world. It can be used in industries or factories to automate the transport of parcels or goods from one place to another, using the crane system. Manufacturing plants can be fully automated with the help of these robots.

In terms of infected patients, specifically, virus-infected patients, it is always risky to reach them as a first person. But it is also important to offer them their medicinal products on time at the same time. A line follower robot can come handy in these kinds of situations. As it can treat certain patients without the supervision or control of any human being. It can easily follow the lines through the cabins and reach medicines to the infected patients to their cabin and return safely.

In restaurants or hotels, the line follower robot can be used to serve foods to the customers' table. So, the waiters don't have to carry the food anymore. By simply inputting the table number in the robot, it will be able to carry it to the customer, following the path. [4]

FUTURE SCOPE

Our project is about a simple line following robot which is capable of following a black line on a white surface. By using an ultrasonic sensor we can detect obstacles placed on the black line and even bypass them. An accelerometer can be placed on the line follower robot to check and control the speed of the robot. A WI-FI module can be integrated with it so we can also monitor it through our computers [5].

CONCLUSION

It is very clear that the concept like that of the line follower robot can be used in various applications if it is refined a bit more so that it could be suited more especially in large scale industry based applications. With the current rate of advancement in technology we could easily see larger, faster and very accurate line follower robots with multiple sensors easily embedded in the transportation sector, manufacturing, etc.

REFERENCES

[1] A line follower robot from design to implementation: Technical issues and problems: Conference: Computer and Automation Engineering (ICCAE), 2010 The 2nd International Conference on Volume 1.

[2] Younus, M., Gadekar, P. and Walse, A., 2019. Line Follower Using Arduino And Its Applications. International Journal of Applied Engineering Research ISSN 0973-4562, 14(13), pp.156-157.

[3] Milan, P., S B, S. and Das, S., 2021. A Review on Self-Balancing Line follower Robot. *International Journal of Engineering Research & Technology (IJERT)*, 10(1), pp.286-288.

[4] Barua, V., Arif, M., Uddin, S., Das, M., Shafiul, M., Nahar, N. and Pathak, A., 2020. An Ultrasonic Line Follower Robot to Detect Obstacles and Edges for Industrial and Rescue Operations. *International Journal of Computer Applications*, 176(31), pp.31-37.

[5] Singh, S. and Kumar, P., 2017. Advance Line Following Robot. *International Journal of Engineering and Advanced Research Technology (IJEART)*, 3(3), pp.24-25.

WORKING OF ROBOT

https://drive.google.com/file/d/1rqb9aC-cSn1JEalMth20xNH8XzUqiKYQ/view?usp=sharing