# Design and Implementation of Autonomous Line Follower Robot Using Microcontroller

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***Abstract*—This paper report to describes the technique for designing, controlling and improving our daily lives with the help of line follower (autonomous) robots.**

**In today's busy world , these autonomous bots can save both time and energy by helping in industries where instead of employing a human operator we can set our desired tasks to the robot which can easily follow the repetitive path from source to destination and vice versa.**

**It also finds in application in everyday household work such as floor cleaning and painting the walls.**

**So here is a brief idea about what a line follower (autonomous) robot is:**

**It is microcontroller based autonomous robot which detects and follows a path that can be invisible magnetic field or a visible path indicated by black line on a white surface(or vice versa).**

**The system senses the line. This work is done by sensors – IR sensors. The IR sensors are mounted at the front end of the robot. The data from these sensors will be given to the microcontroller (Arduino board) which in turn sends the signal to the motor driver that in turn drives the motor of the robot based upon the information of IR sensors.**

**This system hence can be used in a safe, efficient, time-saving way in industries as well as for daily purposes.**

***Keywords*—Microcontroller (Arduino UNO),Motor Driver (L293D),IR Sensors (3),DC Motors (2),Caster Wheel,Power Supply(9 volt).**

## I. INTRODUCTION

Line follower is a machine that follows a path. The path can be a black line on a white surface (or vice versa) or it can be invisible like magnetic field. In order to detect specific marks or lines, various schemes for sensing it are applied. The choice of the schemes depends upon sensing accuracy and flexibility. In industrial point of view lone following bots are used in semi to fully autonomous plants. The sensing of the line which it is following is to be done carefully so that the robot stays on course while constantly correcting its path using feedback mechanism there is a formation of closed loop system. Apart from following its line and path these robots should navigate junctions that is to decide which junction to follow and which it should not. This would require the robot to have 90 degrees turn. Sensor positioning also plays an important role optimizing the robots performance for the tasks mentioned before.

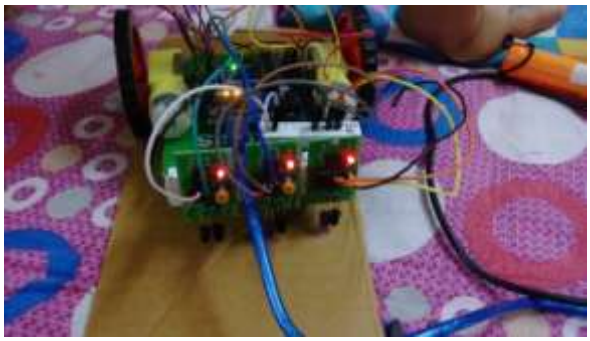


Fig: Properly Functioning Line Follower Robot

## II. OBJECTIVE

To design an automated line follower robot.

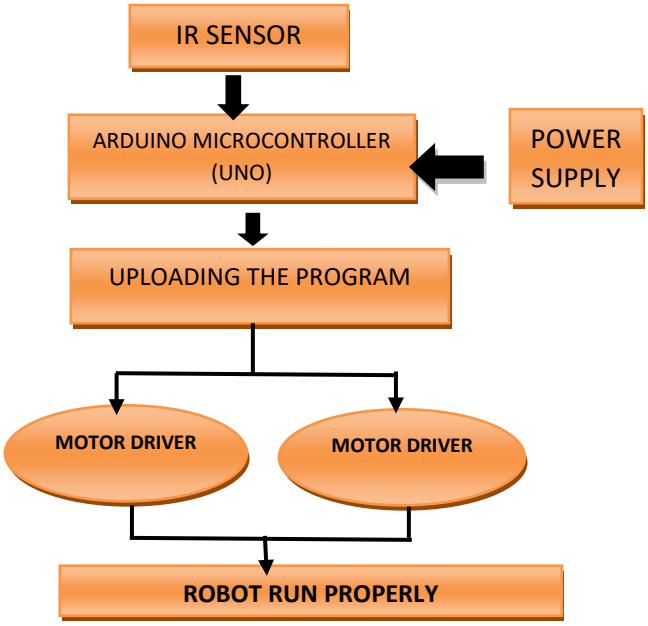



Fig: Block Diagram ofthe Overall Model

## III. CONSTRUCTION

Building a basic line follower robot involves following steps:

Designing the Hardware Part of Robot
Implementing the Control of Robot.

## IV. EQUIPMENT'S DETAILS

1. Microcontroller (Arduino UNO)
2. Motor Driver (L293D)
3. IR Sensors (3)
4. DC Motors (2)
5. Chassis
6. Wheels (2)
7. Caster Wheel
8. Male and Female Jumper Wires
9. Power Supply (9 volt)
10. Bread Board

## V. ABOUT EQUIPMENTS

*1. CHASSIS AND BODY—*

We can use materials like wood, plastic, aluminium giving care to the mechanical ability, flexibility and weight .In our designed robot we have used a plastic chassis since it is light weight, strong and the components can be easily attached like the wheels and motor.

*2. MOTOR AND WHEELS—*

We have used DC motors which provides a high torque and efficiency. DC motors are simple and easy to install onto the chassis. The motors rotate the robot clockwise or anticlockwise depending upon the program. The electrical energy is converted into mechanical energy by the motors which is used to drive the wheels. We have used two medium sized wheels and a caster wheel attached at the front for easier and smooth movement .This is the most common combination for wheeled robots.

Fig. motor and wheel

*3. L293D MOTOR DRIVER—*

It is a typical motor driver which controls the working speed and direction of the motor simultaneously. This driver consists of 16 pins which controls two DC motors. It works on the principle of H-bridge .This motor control circuit allows the voltage to flow in any direction.

When Enable 1 is HIGH, then left part of IC will work, otherwise it won't work.

When Enable 2 is HIGH, then right part of IC will work, otherwise it won't work.

If any of the pins INPUT 1, INPUT 2, INPUT 3, INPUT 4 is high then flow of current will be HIGH in OUTPUT 1, OUTPUT 2, OUTPUT 3, and OUTPUT 4 respectively.


Fig: Pin Configuration of L293D IC

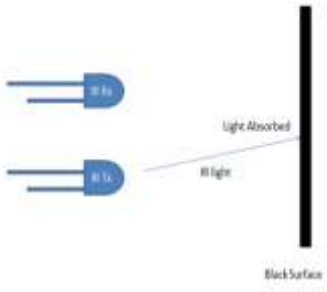
*4. MICROCONTROLLER-ARDUINO UNO—*

Arduino UNO is a microcontroller which receives the signal from the sensors and gives corresponding signal to motor driver IC .It continuously monitors data from the sensors and turns the robot as per the line detected by them with the help of motor drive that in turn controls the motor and wheels.

Fig. Arduino

*5. IR SENSORS—*

Infrared Sensors are used to find the path and direction. IR sensors contains a transmitter and receiver pair. We know white surfaces are good reflectors and black surfaces are poor reflectors .So if the receiver receives the reflection ray it means the robot is on white else if it doesn't receives it means the robot is on black. Thus the device works by measuring the amount of light that is reflected into the receiver.IR sensors works best when it is shielded from ambient light and the distance between the sensors and the surface is small(less than 10mm).



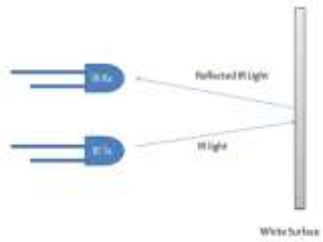


Fig: Reflection by black and white surfaces

## VI. IMPLEMENTING THE SOFTWARE

By adding logic to our controller we will be able to tackle all kinds of bends and turns in linear track. Here is a sample demo code:

```
#define LM1 2
#define LM2 3
#define RM1 5
#define RM2 6
#define L 8
#define M 9
#define R 10
#define LL 11
#define RR 12
int l,m,r;
void setup()
{
Serial.begin(9600);
pinMode(LM1,OUTPUT);       //left forward
pinMode(LM2,OUTPUT);        // left back
pinMode(RM1,OUTPUT);        //right forward
pinMode(RM2,OUTPUT);         //right back

pinMode(L,INPUT);
pinMode(M,INPUT);
pinMode(R,INPUT);
delay(3000);
}
void loop()
{
  l=digitalRead(L);
  m=digitalRead(M);
  r=digitalRead(R);
ll=digitalRead(LL);
rr=digitalRead(RR);
if(l==1 && m==0 && r==1) //  done =====> forward()
 {
fro();
 }
else if(l==1 && m==0 && r==0)  //   do  right turn ======>
 {
right();
 }
else if(l==0 && m==0 && r==1)    // do delay() only ======>
 {
  // i m tryint to ignor it
delay(400);
 }
else if(l==0 && m==1 && r==1)  // done  ======> left turn
 {
left();
 }

else if(l==0 && m==0 && r==0)  //do right turn
 {
right();
 }
else if(l==1 && m==1 && r==1)  // do return with left turn() ========>
 {
rev();
 }
else
 {
left();
delay(10);
fro();
delay(100);
right();
 }
}
//-----------------------------------------------
void fro()
{
digitalWrite(LM1,HIGH);
digitalWrite(LM2,LOW);
digitalWrite(RM1,HIGH);
digitalWrite(RM2,LOW);
}
void right()
{
digitalWrite(LM1,HIGH);
digitalWrite(LM2,LOW);
digitalWrite(RM1,LOW);
digitalWrite(RM2,LOW);
}
void left()
{
digitalWrite(LM1,LOW);
digitalWrite(LM2,LOW);
digitalWrite(RM1,HIGH);
digitalWrite(RM2,LOW);
}
void rev()
{
```

```
do{
   //left turn()
digitalWrite(LM1,LOW);
digitalWrite(LM2,HIGH);
digitalWrite(RM1,HIGH);
digitalWrite(RM2,LOW);
  }
while(l==1 && m==0 && r==1);
```

## VII. METHODOLOGY

At first gather all equipments and materials, then attach the two motors on either side (left and right) on the chassis of the robot containing wheels. The wires of both the motors are connected to the motor driver.Then place the Arduino on the surface of chassis and make a proper connection and on the front side of the robot attach the IR sensor taking care of the distance between the ground and sensor using jumper wires. The power source (9 volt battery) that is used to drive the robot.

Check if all the equipments are working properly. Finally upload the program which varies depending on the track. Now the autonomous line follower bot is ready to run.

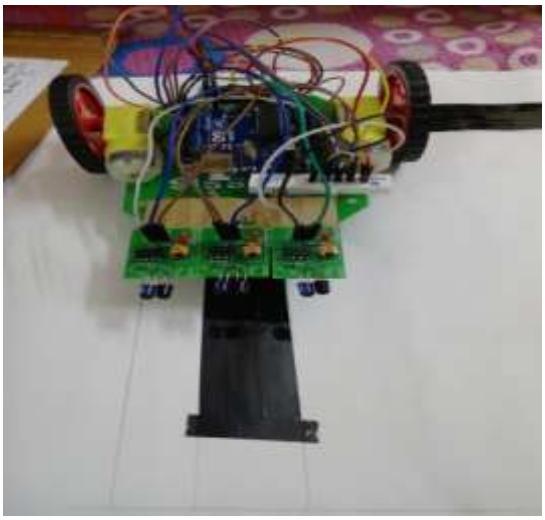


Fig: Assembled Robot

## VIII. APPLLICATION

1. Industrial automated equipment carriers.
2. Delivering medicines to patients at hospitals.
3. As path guides in museum and shopping malls.
4. In domestic purposes like floor cleaning, painting the wall.
5. Automated cars.

## IX. CONCLUTION

Our Line Follower robot has the capability to follow any curve or cycles. We have built a robot that is light weight with high speed motors and high sensibility sensor circuit. The weight of the designed robot is about 300grams. The robot makes use of two wheel in rear and a free wheel (caster wheel) on the front so that the robot can move with ease. The power supply is 9V. It has three IR sensors to detect the track. Microcontroller Arduino UNO and Motor Driver L293D is used to control direction and speed of the motors. The robot is self-operating and micro controlled.

## X. FUTURE SCOPE

This paper is all about line follower autonomous robot using Arduino microcontroller which follow a specific path. In future this project can be modified by connecting ultrasonic sensor which can be used in avoid obstacles. Adding a Bluetooth module and Camera module will enhance its efficiency and working by detecting obstacles that can be seen on thescreen. Now the user can control the robot via a smartphone application.

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