

Design to Implementation of A Line Follower Robot Using 5 Sensors

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Abstract: The main objective is to design a line follower robot is to carry products in the manufacturing process in industries. In this paper, we mainly focused on the design to work the line follower efficiently with lighter weight. The line follower robot designed with 5 sensors to make the robot move in even complex paths. This paper discussed the mechanical and technical issues with the line follower robot and applications in various fields. In the working model, we used black detector infrared sensors So that speed of response of the robot is high. This paper gives an brief idea about all the components used to prepare a line follower robot.

Keywords: Arduino UNO, 7805 voltage regulator, Infrared sensors (Black Detector), Battery 12V, Breadboard, Motor Driver.

1. INTRODUCTION

Line follower is a machine that can follow a path. The path can be black or white surface.

- In the early year about 1800 robots were built for entertainment purpose. They were named as robots only they operated based on linkages. Later automatic draw loom was invented by Joseph Maria in the year 1801 and draw loom was controlled by lifting of thread in fabric factories. This was the first robot to store a program and control a machine. After that there were introduced into robotics.
- The Artificial arms were developed by George Devol Jr in the year 1954 which lead to modern robots. In 1950 Issac Asimov gave laws for robots and these were:
 1. A robot may not harm or injure a human beings
 2. A robot must obey the orders of human beings except orders conflicting first law
 3. A robot must protect its own existence and it should obey first and second law

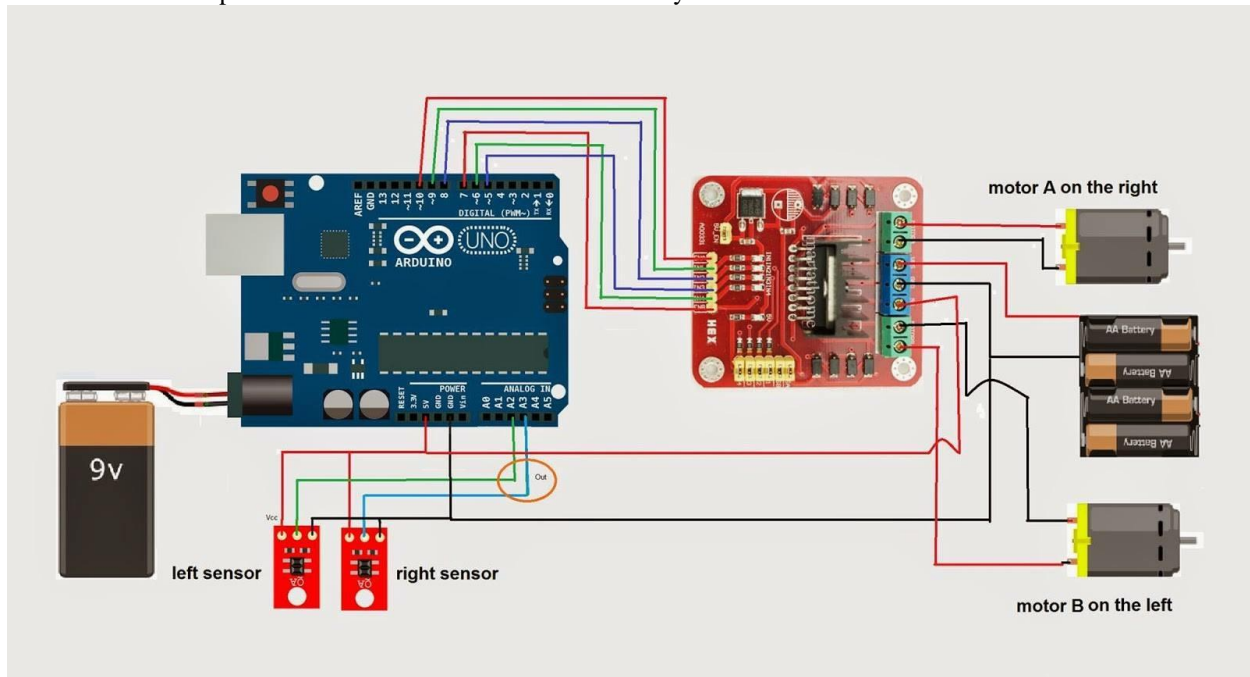


Fig 1.1. A simple diagram for the explanation

Fig 1.1 shows the sample connections

2. AREA OF APPLICATION:

They are used to deliver messages and medicines in a hospital. It can be suggested to run buses, mass transit systems and autonomous cars which navigating the freeway. They can be used in military as spy kids, shop floor, etc..

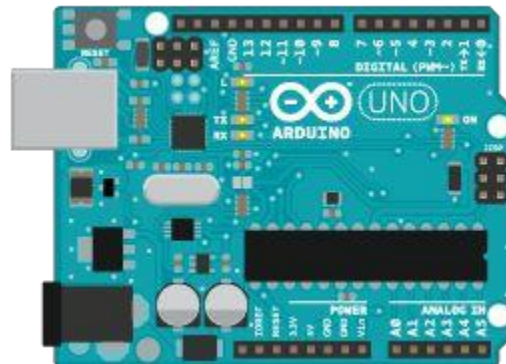
- Pakdaman, M., & Sanaatiyan, M. M. (2009, December) [1]. In this paper, author has designed a high speed follower with light weight and high sensitivity. Author mainly focused on the distance covered by the robot and different paths followed by the robot. The author has designed robot with eight infrared sensors and controlled the robot with micro-controller to increase accuracy.
- Islam, M. S., & Rahman, M. A. (2013) [2]. In this paper, author mainly focused on the load that carried by the robot. Author gave details about the cost analysis and power analysis. Author also given the detail view of circuits and applications of the line follower.
- Pakdaman, M., Sanaatiyan, M. M., & Ghahroudi, M. R. (2010, February) [3]. In this paper, author mainly focused on the technical and mechanical issues of the line follower robot and explained the program that should be followed by the robot and gave the details and description of the main parts of the line follower robot.
- Koppad, P., & Agarwal, V. (2014) [4]. In this paper, author focused on the effects of environment factors on the line follower robot and its application in various fields and details of comparator and motor drive or motor shield.
- Sonal, G., Raninga, P., & Patel, H. (2017, July) [5]. In this paper, author has mainly focused on the design of the RGB (red, green, blue) color line following and micro-controller coding for the robot and color sensor design.
- Juang, H. S., & Lurr, K. Y. (2013, June) [6]. In this paper, author has explained the design, construction and control two wheel self balancing robot on the principle of gyroscope. Author also considered the kinematic and electrical parameters experimentally to the design of the PID and LQR controller design and achieved it successfully.
- Dubey, P., & Dubey, A. (2015) [7]. In this paper, author explained how the robots are used in co-operative task and where the tasks in industries are divided into different modules and also focused on the design of simulator.
- Fujiwara, T., & Iwatani, Y. (2011, December) [8]. In this paper, author explained how the robot can be controlled by the hand gestures so that the line drawn are eliminated. Author give an analysis of hand and finger tip regulation and discussed the robustness of the market less gestures interface and the valuability of the operator value.

3. COMPONENTS DESCRIPTION:

3.1. Arduino:

- Arduino designs microcontroller based development boards are known as Arduino modules. They are open source prototyping platform which comes in development board packages.
- The common program approach is using Arduino IDE, which will be written in C program language.
-

Arduino Uno dev. board (Fritzing part graphic)



- Download Arduino Integrated Design Environment (IDE) here (Most recent update: 1.6.5): <https://www.arduino.cc/en/Main/Software>

3.2. Motor Driver:

- It acts as Interface between Arduino and motors which will be used to control motors. The most commonly used Motor Driver IC is L293D.
- Single L293D IC can control two DC motors because it consists of 16 pin IC which can control two DC motors in any direction at once.



L293D motor driver

3.3. 7805 voltage regulator:

- This voltage regulator is used to convert 12v to 5v. So, that the IR sensors will not be damaged.

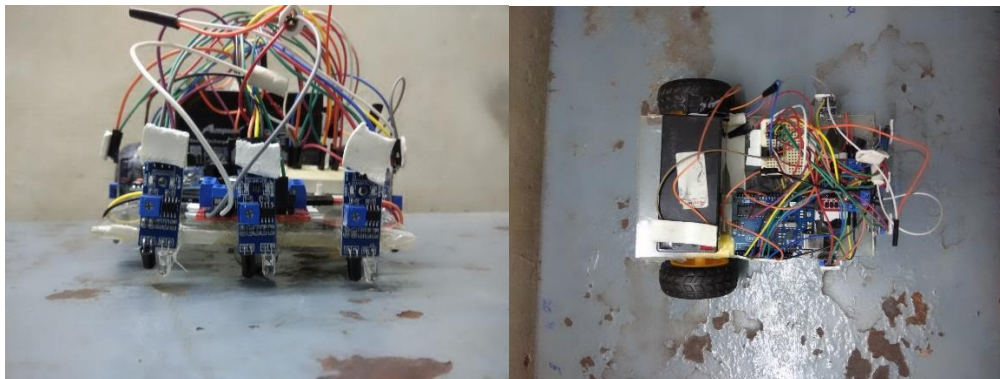
4. FABRICATION:

4.1. Working Principle:

- Line Follower Robot mainly works on the principle that as the IR sensors gives input signal to Arduino and According to code, it Arduino gives output signal to the motor driver so that motors will be controlled and makes the robot to follow the black line accurately.
- Working Link:
 1. https://drive.google.com/file/d/1zogLF77QuG_Lg0jv81o7HOkqhyAqOzt3/view
 2. https://drive.google.com/file/d/1wYKj8oBi-mNXahB8sB9J_8pIxxIJoYz-/view
 - link 1 is checking all conditions in the path
 - link 2 is running in a path by us

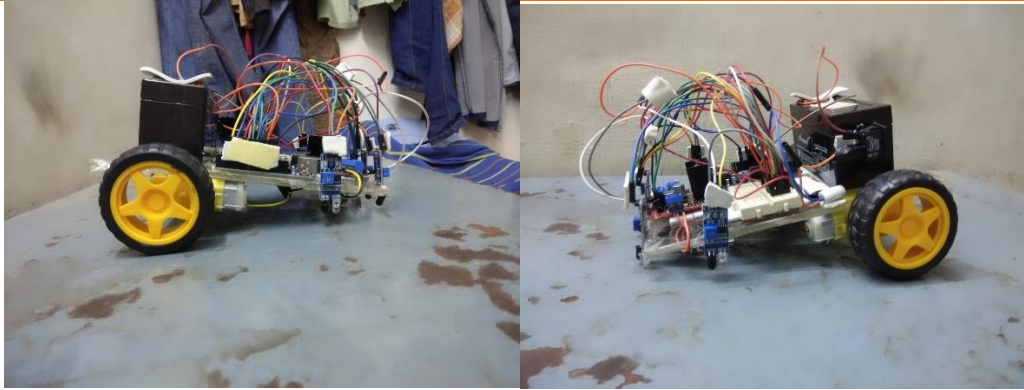
4.2. Assembly:

- **Step 1:**
Prepare a Chasis for the Line Follower Robot in such a way that it is very light weight plastic fiber in the dimensions of 20cm length, 11.5cm width and 0.5cm thickness
- **Step 2:**
Arrange all the components with glue gun according to the connections given in the code keep the sensors as 1 at middle position, 2 and 3 sensors are placed with a gap between 6cm, 4 and 5 sensors are placed at the either side.
- **Step 3:**
Give the sensors connection of VCC and GND to the breadboard and OUT to the Arduino Digital input
- **Step 4:**
Give 12V battery terminals to breadboard where the 7035 regulator is placed so that it will convert to 5V and gives to Arduino board supply and to IR sensors.



Front View

Top View



Right Side View

Left Side View



Overall View

4.3. Technical Issues:

- Possibility 1:
Potentiometry of the sensors: we can adjust the potentiometry signal when whole line follower robot is completed.
- Possibility 2:
Connections Error: Once we have to check all the connections neatly so that we may have clarity on line follower robot.
- Possibility 3:
Wheels directions: we can change the polarity at either at motor driver or at the motor
- Possibility 4:
Failures of the components: we should maintain all the components as spare parts especially 7035 Regulator

4.4. Code for Line Follower Robot:

//created by Anupoju Sai Vamsi, Goutham at jan 2nd, 2019

```
void setup()
{
  pinMode(3, INPUT); //left sensor 1
  pinMode(4, INPUT); //left sensor 2
  pinMode(5, INPUT); //middle sensor3
  pinMode(6, INPUT); //right sensor 4
  pinMode(7, INPUT); //right sensor5
  pinMode(8, OUTPUT); //LEFT MOTOR.
  pinMode(9, OUTPUT);
  pinMode(10, OUTPUT); //RIGHT MOTOR.
  pinMode(11, OUTPUT);
}
// put your setup code here, to run once
void loop()
{
  int a = digitalRead(3);
  int b = digitalRead(4);
```

```
int c = digitalRead(5);
int d = digitalRead(6);
int e = digitalRead(7);
if ((a == LOW && b == LOW && c == HIGH && d==LOW && e== LOW)|| (a == LOW && b == HIGH && c == HIGH &&
d==HIGH && e== LOW)|| (a == HIGH && b == HIGH && c == HIGH && d==HIGH && e== HIGH))//FORWARD
{
    digitalWrite(8, HIGH);
    digitalWrite(9, LOW);
    digitalWrite(10, HIGH);
    digitalWrite(11, LOW);
}
if ((a == LOW && b == HIGH && c == LOW && d==LOW && e==LOW)|| (a==HIGH && b== HIGH && c==LOW &&d==
LOW &&e==LOW)|| (a==HIGH && b== HIGH && c==HIGH &&d== LOW &&e==LOW)|| (a==HIGH && b== LOW &&
c==LOW &&d== LOW &&e==LOW)|| (a==LOW && b== HIGH && c==HIGH &&d== LOW &&e==LOW)|| (a==HIGH &&
b== HIGH && c==HIGH && d==HIGH && e==LOW)) //LEFT TURN
{
    digitalWrite(8, HIGH);
    digitalWrite(9, HIGH);
    digitalWrite(10, HIGH);
    digitalWrite(11, LOW);
}
if ((a == LOW && b == LOW && c == LOW && d==HIGH && e==LOW)|| (a==LOW && b== LOW && c==LOW &&d==
HIGH &&e==HIGH)|| (a==LOW && b== LOW && c==HIGH &&d== HIGH &&e==HIGH)|| (a==LOW && b== LOW &&
c==LOW &&d== LOW &&e==HIGH)|| (a==LOW && b== HIGH && c==HIGH &&d== HIGH &&e==HIGH)|| (a==LOW &&
b== LOW && c==HIGH &&d== HIGH &&e==LOW) ) //RIGHT TURN
{
    digitalWrite(8, HIGH);
    digitalWrite(9, LOW);
    digitalWrite(10, HIGH);
    digitalWrite(11, HIGH);
}
if (a == LOW && b == LOW && c == LOW && d==LOW && e== LOW) // BACK
{
    digitalWrite(8, LOW);
    digitalWrite(9, HIGH);
    digitalWrite(10, LOW);
    digitalWrite(11, HIGH);
}
}
```

5. SWOT ANALYSIS:

5.1. ADVANTAGES:

- It can be used for home for floor cleaning etc.
- In hotels they are being used for the transfer of things from one place to another following a straight path.

5.2. LIMITATIONS:

- Additional sensors should be placed.
- It should have a specified path either in black or white surface.
- Speed is low and instable on different line thickness and tough angles

5.3. APPLICATIONS:

- Shopping malls
- Homes
- Entertainment places
- industries

5.4. FEATURES:

- Robust design

- Performance in terms of speed is high

6. CONCLUSIONS:

After the project we arrived to the following conclusions:

- Line Follower Robot of low cost with simple design is fabricated.
- It's weight is around 300 grams as the body weight effects on speed, it is very light weighted. We used two motors, two wheels, Arduino, Motor driver with 7805 regulator for the power supply of 12V.
- It can be used in industrial applications.
- Code for this Robot with 5 sensors has been written with simple logics and in understandable language.
- Hence this Robot with 5 sensors has designed and worked properly to track the black line accurately

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