

# Design of the Path Following Robot

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**Abstract—** This article shows design and accomplishment of the Path Follower Robot and its competence to sort out the appropriate line among black line. Since black colour has its own apparent property, robot can therefore easily differentiate among only black colour and the robot is directed in a way it follows the preferred path based on the algorithm steps coded to it and reaches the destination.

*In the world of smart technology advances to turn down human physical work, the Wi-Fi camera enables us to get live telecasting images or videos. Based on the algorithm given and through the instruction given from the sensors the robot can move through different path. The processed information from the moving robot without direct intervention by the user is automatically gathered to cloud server. The implemented system can be executed in any commercial, industrial, medical and also in educational labs. Practically a Path following robot can easily follow the path as per direction guided by the user.*

**Indexed Terms--** Ultrasonic Sensor, IR Proximity Sensor, Arduino Uno R3, L293D Motor, Wi-Fi camera, GPS tracker, cloud computing server, 4AA Battery.

## I. INTRODUCTION

The Path tracing Robot is an programmed robot that can automatically identifies a path .according to the path drawn, it goes after the path with the help of an IR sensor affixed to the robot. The path drawn should be a Blackline over a white surface thus avoiding any encounter error. Path follower robot also consists of a Proximity sensor that detects any barrier ahead of the moving robot thus resisting any irrelevant crash. Other

than the Path following capabilities this robot also has the competence map the navigate junction to store the data in the cloud and move in the particular region without any error and decides on which junction to turn and which junction ignore this would require robot to have desired angle to turn and junction counting capacities. Through feedback mechanism the robot has the ability to man oeuvre to particular direction and stay on the course by constantly checking the false shift through the control system used must understand the path thus creating a simple closed loop system. Path follower robot is developed and coded in such a way that it performs assigned work thoroughly without any fault and identifies given path The Arduino will the receive the transmitted signal , senses and identifies the particular lane and move in desired direction. To control the speed and direction of the path follower robot a device called micro controller is fixed to process the received input signal. According to the received signal it controls the direction and speed of the path follower robot. This way the path follower robot works without any fault.

An ultrasonic sensor is used with an ability to identify an object and calculate the length between the obstacle and robot. Through the sound frequency passed through it as it affixed to the forefront of the path following robot. It measures the length between the obstacle and the path following robot and the obstacle. Ultrasonic sensor transmits the sound wave of particular frequency and identifies the received bounced signal from the obstacle.

This can be applied for military purposes, delivery services, transportation systems, blind assisting applications.

## II. MOTIVATION

In the world of smart technology advances to turn down human physical work, it is essential to innovate black colour path follower robot, In airport we use robot to bear off accoutrements and grips from one point of disembarkation to the other. We can use as self-acting in dwelling, and in buffet robots acts like suppliers at Robot Restaurant in Taj, Mumbai. It was inaugurated in December 2019. Pros of such robots is that they can function efficiently for 6-7 long hours of time with a single charge battery. Thus, it is profitable for the business itself. Therefore, for a substantial nation like India, essential to the Path follower robots in restaurants, industries military. Thus, these types of robots come into market when big and massive equipment are to be transferred from one place to another within industries.in future. This method can be executed in running buses or other mass transit systems.

## III. RELATED WORK

Robotics is the one domain where many systems have persisted to advance and is been utilized in different operational environment. Therefore, it means it is stayed on popular in the field of analysis and production.

Pak Daman M. et.al has developed a path following robot to improve the accuracy of path following by affixing the IR proximity sensors [1].

Priyank Patil has designed an automatic voltage regulator path following robot for reading the voltage either 0 or 1 when passing through the path through IR sensors based on the reflection or absorption of light[2].

Cloak I. et.al has developed a path follower robot with an addition of music so as to be entertained in the malls and hotels with a capability of carrying the weight of 380 kg [12].

Nor Manisha Abdul Ghani et.al, has innovated a two-wheel parity with the solution of using infrared sensors to balance inclination and also controlling robot through remote [11].

Goma T. et.al has developed a robot with the control of 45-50 individual control switch to control the movement of robot and the movement can be

controlled in any direction and can be tested in different condition [13].

Roman Osorio C. et.al innovated an intellectual path follower robot with magnetic sensors for directing the movement if performance is modified [14].

M. Zari Azharuddin et.al developed a path follower robot with mapping facility with the affirming of v2x sensor as a compass is being digital [15].

Bajestani et.al designed a technical controlled path following robot with addition of new techs in the detection and avoidance of barrier and colour for the smooth movement. [16].

Kazie Mahmud Hasan et.al developed an automatic identification of the path colour and then avoiding the barrier passing through it . the microcontroller is replaced by logic gates for the accuracy of finding different colour [17].

## IV. PRINCIPLE

Path Follower has two Ultrasonic sensors and an IR sensor fixed in it. The principle of working a robot depends on the phenomenon of light. As we know that light would be absorbed by black and light will be reflected back in white colour. and through IR transmitter and receiver also called as photo diodes. When the photo diodes transmit the light on the black surface and no rays are reflected back. When Arduino gets 0 input i.e., low as input and the IC7805 regulates the voltage supplied to it and the received voltage is sent to the Arduino microprocessor. The power supply to the DC motor is done through the battery attached to it. Then the microprocessor controls the DC motors through H-Bridge motor driver L298N which follows H- Bridge configuration in controlling the direction of rotation of a DC motor. The Pros of using H-Bridge are : We could get power separately applied to the motor which is notable in saying that 2 dc motor is not applicable for 5v power supply. Motor A and Motor B are connected to micro controller which indeed follows connection of Motor A attach to terminal 1 and 2 while Motor B attach to terminal 3 and 4. therefore If we want left motor to rotate in one direction, we apply a high pulse to input 1 and low pulse to input 2. To reverse the direction reversed pulse input 1 and input 2. The same applies to the right motor. Speed control is possible through L298N motor driver through pulse

width modulation signal, The speed varies according to the width of the pulses and through the voltage when the robot senses black line it moves straight until it receives the reflected light once the robot receives the signal then the voltage will be high and till the sensor receives the low voltage. It turns either to right or left where one of the sensors presents receives signal on the right angle to right. The Wi-Fi enabled camera is placed at the forefront of the robot to map the path and it gets stored in the cloud. So as to improve the accuracy and stability for curved path for the smooth movement of the robot. Then the robot comes across the black strip lying perpendicular to the path then the robot stops at that instant.

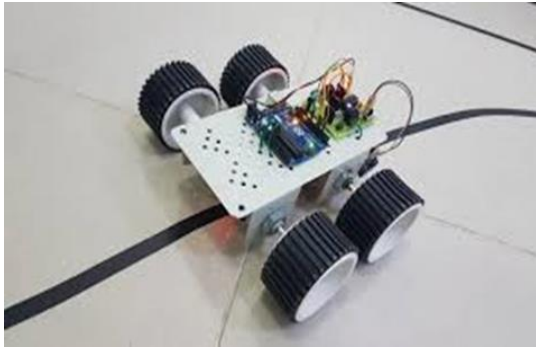


Figure 1: Path follower Robot

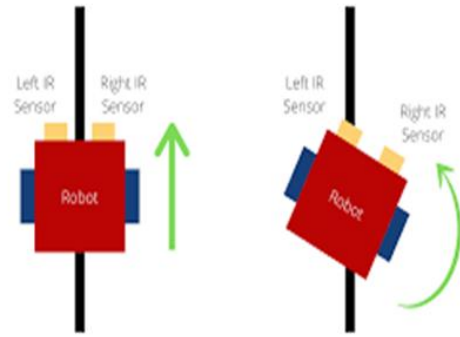
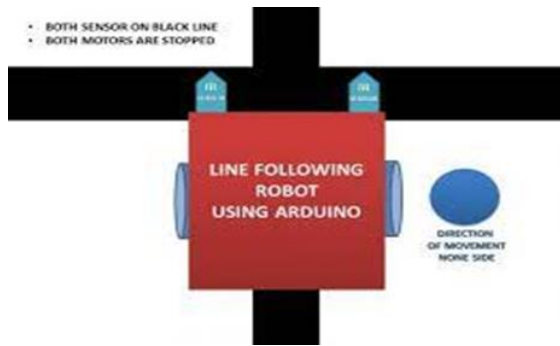
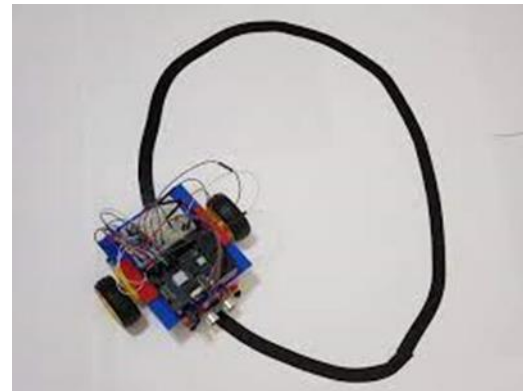


Figure 2: Circular path robot follower



**DIFFERENT TYPES OF PATHS FOR LINE FOLLOWER ROBOT**

The robot will follow a path as shown in the above figure and move in all different path of different angle

The robot will be running in all the different shapes of polygon shapes at a constant speed.

The path may be of any shape cycle it moves without any malfunction or error.

Figure 3: types of path

V. SENSORS

5.1 Arduino Uno



Figure A: ARDUINO UNO

ATmega328P instructor has a microcontroller board which as Arduino uno board. The components have 14 (I/O pins) which is (out of this 6PMW which works), It consist of 6 digital inputs, and a ceramic resonator made of 16MHZ, it consists of a USB drive, jack power, an ICSP header of ICSP and a button which can be used to reset. The board has all the parts needed to work on the Arduino uno board as shown in figure A. Arduino uno is connected to computer through USB cable and power it connects pass through AC to DC battery for working easily.

5.2L293D (Motor Driver)



Figure B: L293D (Motor Driver)

The Driver Motor IC has 16-Pin which is named has L932D. Motor driver is usually used to drive the motor. The L932E IC has two DC motors that has a power of working 2 DC driver motor at the same capacity of time. The driver motor of the two motors moves in the free paths as ordered. The principle working of the half H- bridge is followed in the IC L932E.To run the driver motor in both clockwise and anti-clockwise direction H bridge is set. To control the speed and direction of the driver motor, The input pins

are inserted to the microcontroller as shown in figure B.

5.3HC-SR04 (Ultrasonic Sensor)



Figure C:HC-SR04(ULTRASONIC SENSOR)

The HC-SR04 ultrasonic sensor consist of two parts namely transmitter and a receiver. The sensor knows us to identify the length from the object. The time taken to transmit the signal from the transmitter end to receiver end decide the distance between them. By using the contactless technology, the sensors receive the sound waves. With the help of this sensor the measurement required for the target can be calculated without accident and provides precise data. Between the range of 4cms to 600cms the sensor actually works. +5V DC supply is applied on the sensor. The dimension of the sensor is 44mm x 22 x 17mm, and <4mA power is used for the working of the sensor, The power operated is 17mA with a trigger pulse width of 12U as shown in figure c.

5.4 IR Sensor



Figure D: IR SENSOR

In order to sense the object from the environment an electrical device is used which emits light to sense the object. To detect the thermal radiation and motion of the object an IR sensor is used. The thermal radiation of some frequency is radiated by infrared spectrum. These are invisible radiation which can be only detected by sensors and not by humans. The IR LED emits the signal which is sensitive and is emitted by photodiode of certain wavelength. There will be a change in the output voltages and the resistances when the photodiode receives the IR light. There will be a change in the IR light received and the output voltages as shown in figure D.

### 5.5 Jumper Wires



Figure E: Jumper wires

Without soldering the parts for the electricity power has been terminal to different adjoining parts used for working the jumping wires and can be soldered easily. Soldering is not required and the wire is connected to the pins at each end and the points connected to be allowed. In order to change the connection between the circuit and the bread board , prototyping tools the wires are needed to change the circuit as shown in figure E.

### 5.6 IC 7805



Figure F: IC 7805

IC 7805 is a straight voltage regulator the main usage of this is to regulate variation of voltage supplied for it . And it includes three terminals including 5V of the fixed output voltage. Pin1 (Input): This is an input pin, where a positive unregulated voltage can be given like an input towards this pin., pin 2(Ground); This is the GND pin where this pin is similar to input and output . Pin3 (Output): This is output pin where the voltage can be taken from this pin is 5V as shown in figure F.

### 5.7 Chassis

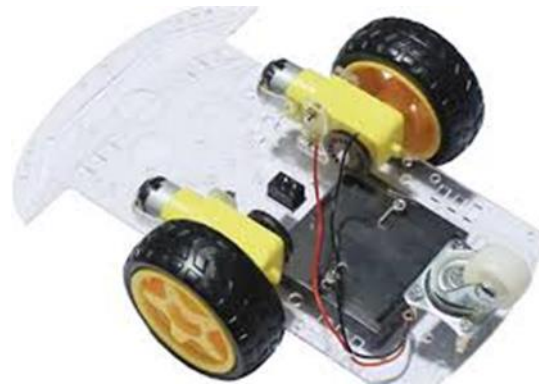


FIGURE G: Chassis

Chassis is the structural used for supporting the components placed above it for the connection and movement of robot. The good example for chassis is vehicle frame, it is attached to the below of the motor vehicle, on which body is attached or mounted; the running gear like transmission and wheels, and metals also will be used for the construction of chassis, this all includes then rolling chassis will be described eventually as shown in figure G .

### 5.8 Castor Wheel



Figure H: Castor wheel

A wheel and a mount are assembled for a caster. racks, dollies and maneuverer carts will make it easy for the caster supports. Casters will be in different diameters, widths, load rating and materials. This caster is assigned at the bottom of the chassis which helps the object to move easily as shown in figure H. Caster are available in different sizes and are made of rubber, aluminium, plastic, stainless steels.

### 5.9 Batteries



Figure I: BATTERY

Batteries are used for the supply of power for driving the motor. They store a electric power through redox reaction through a collection of more cells, the flow of ions in batteries is from chemical reaction. usually batteries made up of 3 components anode (-) and cathode (+) and some electrolyte substance which will chemically reacts with cathode and anode. Redox reactions process usually occurs when ions are combined between chemicals as shown in figure I.

### 5.9 WI-FI CAMERA



Figure J: WI-FI Camera

Wi-fi Cameras have been extensive in the market for their availability in the various application. It has a resolution of 1080 pixels. They can be affixed easily to any parts because of their flexibility in adaptation and their accuracy and calibre in capturing the image they have varied focal length and precision in m to comfort detecting the area which is not possible to move and they have direct access to other application and can be watched through mobiles or laptops, through the cellular network as shown in figure J.

### SOLAR PANEL

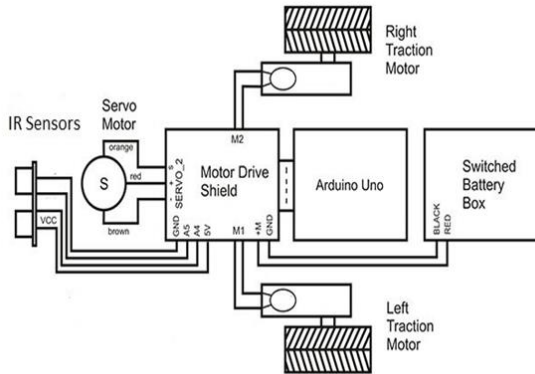


Figure K: Solar panel

Solar panel has been designed in the collection of the solar energy like photons. photons are nothing but solar particles that are collected on the surface they can

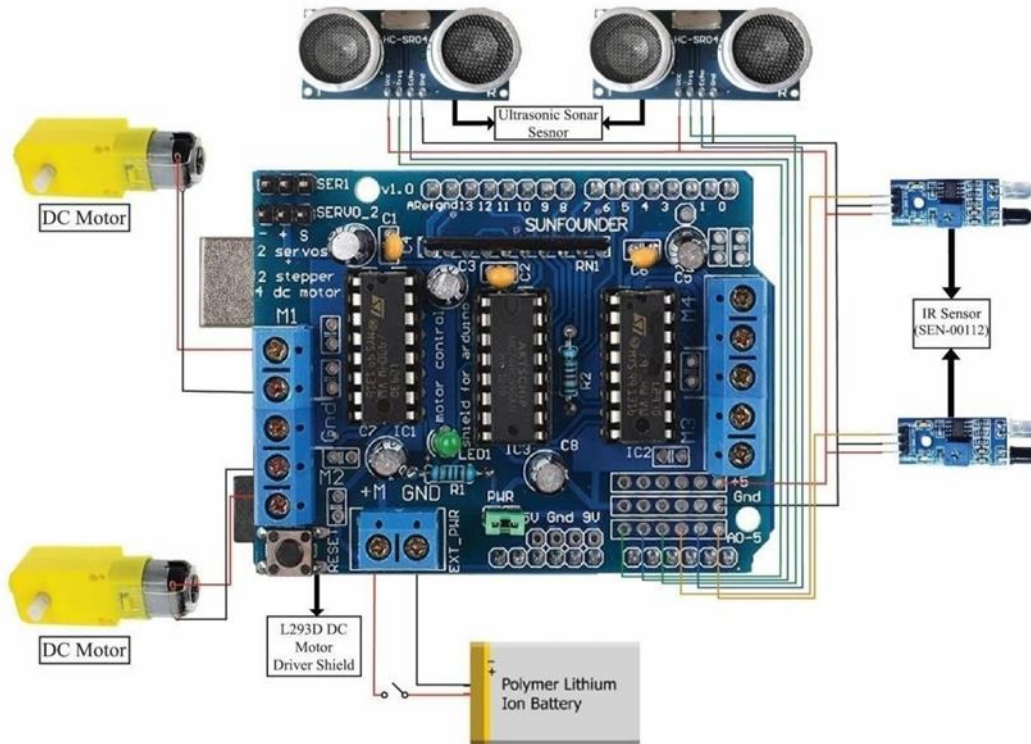
be used in the performing work through conversion of solar energy into many forms of energy. It is available abundant in nature they are usually smaller in size and expensive. the power supplied is usually low. they are made of semiconducting material like silicon as shown in figure KS.

6. BLOCK DIAGRAM



The above block diagram assists us to know the exact placing of components and its connection for a smooth flowing process of the path following robot. The IR sensor are placed in below the chassis for the identification of the particular intensity of light get reflected and the sensor are connected to the IC7805 voltage regulator to regulate the light voltage and to regulate volage and the received voltage signal is then passed to Arduino microprocessor for man oeuvre the dc motor to manage to control the wheel pace and the command through the L293D motor driver it receives then signal memory from microprocessor to change its path. The dc motor is connected to the battery for driving it according to signal received and the ultrasonic sensor sends frequent waves to check obstacle and if it is detected it is passed to microprocessor and the path that is travelled is then stored in the cloud storage through mapping it by placing camera for future reference to move.

- Architecture of the system



VI. SYSTEM ARCHITECTURE

Connection Between Motor Driver and Arduino

Motor Driver	Arduino
N 1	10
IN 2	9
IN 3	6
IN 4	5
VCC/ 12V	Vin / 5v
GND 5V	GND 5V

Connection through Arduino and IR sensor

IR Sensor	Arduino
Sensor 1:	
VCC	VCC
GND	GND
OUT	A0
Sensor 2:	
VCC	VCC
GND	GND A1
OUT	

Connection between Ultrasonic Sensor and Arduino

Ultrasonic Sensor	Arduino
GND	GND A3
ECHO	A5
TRIG	VCC
VCC	

VII. COST ESTIMATION

SL.NO	PRODUCT	COST (RS)
1.	ROBOT CHASSIS	2000
2.	CASTOR WHEEL	2500
3.	SHAFT	800
4.	CLAP	500
5.	BATTERY	2000
6.	CAMERA	2500
7.	CHARGER CONTROLLER	700
8.	ARDUINO UNO	1500
9.	CABLE	100
10.	BLUETOOTH	800
11.	WIRE	1000

12.	MISCELLANEOUS	1500
13.	GPS	1500
14.	IR SENSPOR	3000
15.	CABLE	200
16.	DOUBLE IR SENSOR	4000

Total estimated cost Rs 24600

SOURCE CODE

The complete code of the of the proposed system is presented below,

```
int Left=2;
int Liftin=3;
int Right_p=4;
int Right_n=5;

void setup()
{
```



```

pinMode(Left_p,OUTPUT);
pinMode(Left_n,OUTPUT);
pinMode(Right_p,OUTPUT);
pinMode(Right_n,OUTPUT);

pinMode(A0, INPUT);
pinMode(A1, INPUT);
pinMode(A2, INPUT);
pinMode(A3, INPUT);
pinMode(A4, INPUT);

}

void loop()

{
int ex_right=analogRead(A0);
int right=analogRead(A1);
int centre=analogRead(A2);
int left=analogRead(A3);
int ex_left=analogRead(A4);

if(ex_left<700 && ex_right<700)
{
digitalWrite(Left_p,HIGH);
digitalWrite(Left_n,LOW);
digitalWrite(Right_p,HIGH);
digitalWrite(Right_n,LOW);

}

if(ex_left>700 && ex_right<700)
{
digitalWrite(Left_p,HIGH);
digitalWrite(Left_n,LOW);
digitalWrite(Right_p,LOW);
digitalWrite(Right_n,LOW);

}

if(ex_left<700 && ex_right>700)
{
digitalWrite(Left_p,LOW);
digitalWrite(Left_n,LOW);
digitalWrite(Right_p,HIGH);
digitalWrite(Right_n,LOW);

}

}

```

## CONCLUSION

Overall, The path following robot designed and executed in this manner has shown a great working capability than the previous other models and the addition of the cloud storage and wifi enabled camera helps us to map the data and help to store that particular data . The advanced version of this path follower robot will be used in automatic robots , traditional conveyor belts, shopping malls and be used in transportation This should be operated easily without any use other devices such as smartphones, remote control, WiFi etc.

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