SECURITY BASED LINE FOLLOWING ROBOT

A MINI PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

Line follower robots are not new in the field of robotics, but with some add on features, they can become a lot more useful and efficiency of the setup can be multiplied many times over. Line Follower Robot is a mobile machine capable of detecting and tracing the available white path drawn on a blackened surface. By sensing with infrared sensors, the robot should be able to determine its position in a reasonable amount of time. If security features are added with robot it will be extremely beneficial to society. The design act as smart security-based cabin assistant. This system will be implemented to transferring documents in between the cabins. The documents are carried from one cabin to another cabin automatically with the help of security-based line follower robot. These types of technology reduce the human effort and time in working area without any interruption.

TABLE OF CONTENTS

CHAPTER NO	TITLE	PAGE NO
	ACKNOWLEDGEMENT	iii
	ABSTRACT	iv
	LIST OF TABLES	vii
	LIST OF FIGURES	viii
	LIST OF ABBREVIATIONS	ix
1.	**INTRODUCTION**	1
	1.1 OBJECTIVES	1
	1.2 OVERVIEW	1
	1.3 ORGANISATION OF REPORT	3
2.	**LITERATURE REVIEW**	4
	2.1 LITERATURE SURVEY	4
3.	**SYSTEM IMPLEMENTATION**	6
	3.1 PROBLEM IDENTIFICATION	6
	3.2 PROPOSED SYSTEM	7
	3.2.1 Workflow of Line Following Robot	8
	3.2.2 Design of robot and working	9
	3.3 COMPONENTS REQUIRED	10
	3.3.1 Arduino	10
	3.3.2 Motor Driver	11
	3.3.3 DC Motor	12
	3.3.4 Ultrasonic	13
	3.3.5 IR Sensor	14
	3.3.6 Specification of components	15
	3.4 SOFTWARE REQUIRED	16
	3.4.1 Software tool description	16

4.	**RESULTS AND DISCUSSION**	18
	4.1 SIMULATION RESULT	18
	4.2 HARDWARE RESULT	19
	4.3 PERFORMANCE	21
	4.4 APPLICATION AND USES	21
	4.5 ADVANTAGES	22
	4.6 DISADVANTAGES	22
5.	**CONCLUSION AND FUTURE SCOPE**	23
	5.1 CONCLUSION	23
	5.1 FUTURE SCOPE	23
	APPENDIX 1	24
	REFERENCES	27

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
3.1	Specifications of components used in Cabin Assistant	15

LIST OF FIGURES

FIGURE NO.	FIGURE NAME	PAGE NO.
3.1	Block Diagram of the Cabin assistant	8
3.2	Work flow of Line Following Robot	9
3.3	Sketch of Cabin assistant	10
3.4	Arduino	11
3.5	Motor Driver	12
3.6	DC Motor	13
3.7	Ultra-Sonic Sensor	14
3.8	IR Sensor	15
3.9	Flow chart of Line Following Robot	17
4.1	Simulation of Cabin assistant	18
4.2	Before installing the circuit board	19
4.3	After installing the circuit board	20
4.4	Working model of robot	20

LIST OF ABBREVIATIONS

A	Ampere
AC	Alternating Current
AVR	Automatic Voltage Regulator
DC	Direct Current
IR	Infrared Sensor
LED	Light Emitting Diode
mA	Milli Ampere
MHz	Mega Hertz
PIC	Peripheral Interface Controller
RPM	Rotation Per Minute
V	Volt

CHAPTER 1
INTRODUCTION

1.1 OBJECTIVES

The main objective of security-based line follower robot include.

- To transfer a document from one cabin to another cabin in working area.
- To reduce human effort and time.
- To maintain security-based automation system.

1.2 OVERVIEW

Line follower robots are self-contained, which means they automatically follow a pre-defined line. It usually follows a black or white on a white surface. A line follower performs the following basic functions: The IR sensor array mounted on the front-down side of the robot reads the pre-defined line and sends the readings to the Arduino. The data is evaluated and the necessary operations are performed by the Arduino's built-in AT Mega microcontroller. The steering system on this robot is straightforward. Three wheels are used: two attached to the motors on the robot's back section and one independent wheel on the front-middle section.

A line follower robot is a mobile machine that can detect and follow a drawn line on the floor. In general, the path is predefined and can be either visible, such as a black line on a white surface with a high contrast colour, or invisible, such as a magnetic field. Certainly, this type of robot should detect the line using its infrared ray (IR) sensors installed beneath the robot. The data is then transmitted to the processor via specific transition buses. As a result, the

processor will determine the appropriate commends and then send them to the driver, and the path will be followed by the line follower robot.

The working notion of a line follower is linked to light. The behaviour of light at black and white surfaces is used here. When light strikes a white surface, it is almost totally reflected, while light strikes a black surface is completely absorbed. A line follower robot is built using this light behaviour.

Line follower robots have a wide range of applications in industry. It can be used to transport heavy and dangerous items. Transporting radioactive materials within a factory poses a significant risk to human life. In that part, a line follower robot can assist. It may also monitor patients at a hospital and alert doctors in crucial situations. In the restaurant industry, it can assist in a variety of areas, including food service and order taking.

These robots can be used in industries to replace traditional conveyer belts as automated equipment carriers. Automobile applications: These robots can also be used as self-driving cars on roads equipped with embedded magnets.

Since the Line follower robot is an intriguing project that can be built with various types:

- Microcontroller 8051 Line Follower Robot
- Line Follower Robot based on the Raspberry Pi
- Texas MSP430 Launchpad
- Simple Line Follower based on the PIC Microcontroller
- ATmega16 AVR Microcontroller Line Follower

The Line Follower Robot can track a line using an infrared sensor. This sensor includes an infrared transmitter and receiver. The IR transmitter (IR LED) sends out the light, and the receiver (Photodiode) waits for it to return.

An IR light will only return if it is reflected by a surface. Whereas all surfaces do not reflect IR light, only white surfaces can completely reflect them and black surfaces can completely observe them.

1.3 ORGANISATION OF REPORT

Chapter 1 provides a general overview of the project and the importance of autonomous robots in the world.

Chapter 2 summarizes the literature review related to Line following robot.

Chapter 3 gives proposed system, design description and implementation of hardware and software

Chapter 4 deliberates the result of the proposed system and show the advantages and disadvantages.

Chapter 5 discusses the conclusion and future scope.

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE SURVEY

[1] **Su K Y, Gul J Z, and Choi K H** reported "A biomimetic jumping locomotion of functionally graded frog soft robot" in 2017. The design and modelling of a flex-rigid soft robot for locomotion. The finding reveal that the robot can locomotes with specific velocity, and the model predict its movement.

[2] **Prabha P S and Shivaanivarsha N** designed "A design of firefighting and supervising self-sufficient robots" in 2017. The objective was to create Fire quenching robot is hardware standard known to naturally extinguish the fire at the time of accidents. Autonomous fire robots are process on its own without human interposition.

[3] **Goncalves J, Pinto V H, and Costa P** presented a paper, "A Line Follower Educational Mobile Robot Performance Robustness Increase Using a Competition as Benchmark" in 2019. The proposed approach was tested using the Robotic Day line Follower Competition as a benchmark. The robot is controlled at the low level by an Arduino, while the high level is handled by an RPI running an object pascal application.

[4] **Shomito Kumar Ghosh, Toheen Bhuiyan, Raihan Chowdhury, Iamail Jabiullah** "A Line Follower Robot with Obstacle Detection by Ultrasonic" in 2019. In this paper the basic requirement for a line follower robot with ultrasonic sensor are visualized.

[5] **Abdul Latif, Hendro Agus Widodo, Robbi Rahim, Kunal Kunal** reported "Implementation of Line Follower Robot based Microcontroller ATMega32A" in 2020. Here the study employs an experimental approach, with a research process based on sequences such as needs analysis, mechanical chart

design, electronic part design and control program design, manufacturing, and testing.

[6] **Satyam Tayal, Harsh Pallav Givind Rao, Suryansh Bhardwaj, Harsh Aggarwal** proposed "Line Follower Robot: Design and Hardware Application" in 2020. In this paper advanced programming, manipulators, and sensors, among other things, are used to control these actions.

CHAPTER 3
SYSTEM IMPLEMENTATION

A line follower robot is one that is programmed to follow a user-specified ‘line' or path. This line or path could be as simple as a white line on the floor or as complex as imbedded lines, magnetic markers, and laser guide markers. Different sensing systems can be used to detect these distinct markers or 'lines.' These systems can range from simple low-cost light-detecting circuits to complex vision systems. Which method to use would be determined by the accuracy and flexibility required for sensing. Line following robots have been used in semi-autonomous to fully autonomous factories throughout the industrial world. In this context, these robots act as material carriers, transporting products from one manufacturing location to another without the use of rail, conveyor, or other means. In this setting, these robots act as materials carriers, transporting products from one manufacturing location to another without the use of rail, conveyor, or gantry systems. In addition to line following abilities, these robots should be able to negotiate junctions and decide which junctions to turn and which junctions to ignore. This would require the robot to be able to turn 90 degrees and count junctions. Sensor location also plays a role in improving the robot's performance for the previously mentioned tasks, adding to the problem's complexity.

3.1 PROBLEM IDENTIFICATION

Now a days there are lot of works in home and office, so that our concentrate will be on our work in that time if any particular think is needed, an distraction will happen to collect that think. This type of interruption will distract our work and the time will be wasted. In working areas, they use to

maintain n-number of documents, it may be missed unknowingly with another person. So, to avoid these situations, gave an idea to design a security-based line following robot, to deliver a particular document to the particular person at right time without any delay.

3.2 PROPOSED SYSTEM

Robots can consist of fixed robots and mobile robots. Mobile Robots are robots with a mobile base which makes the robot move freely in the environment. One of the advanced mobile robots is the Line Follower Robot. It is basically a robot which follows a particular path or trajectory and decides its own course of action which interacts with obstacle. The path can be a black line on the white floor (visible) or a magnetic field (invisible). Its applications start from basic domestic uses to industrial uses, etc. The present condition in industry is they are carrying the parcels or materials one place to another place using the crane system. Sometimes lifting of big weights at that time may cause the breakage of lifting materials and will be cause damage to the parcels also. The line following robots is commonly used for carry children through shopping malls, homes, entertainment places, industries. The use of line following robotic vehicle is transport the materials from one place to another place in the industries. This robot movement completely depends on the track. The robot can do anything you set them to do. Like in factories all they have to do with making their products is make the robot.

For that problem an solution is called security-based line following robot. In this there will be specific travelling path for the robot by using the root map it will reach the place and after collecting the required things. It reaches the original location by using the same path. It is security-based robot to the product which is carried by the line following robot.

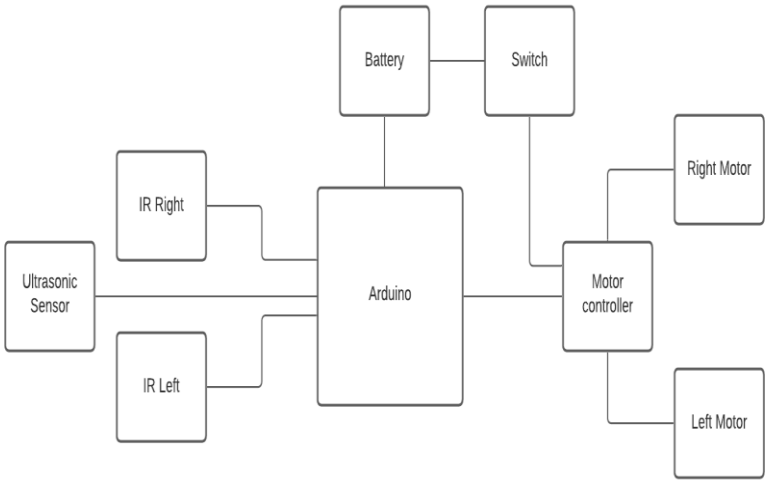

Fig 3.1 Block Diagram of the Cabin assistant

Because this is the most basic of beginner robotics projects. As shown in the Fig 3.1 the robot that can follow a line drawn on the ground without straying too far from it. Sensors are fitted beneath the robot's front half of the body, and two DC motors propel the robot forward. Inside, a circuit receives information from sensors and regulates the rotational speed of the wheels. The motor is controlled so that when a sensor detects a black line, it slows down or even stops. Turning is thus possible because to the difference in rotation speed.

3.2.1 Workflow of Line Following Robot

Step 1: In the initial stage materials has been purchased (Arduino Uno, IR sensor, Ultrasonic, DC Motor, Motor Driver) as shown in the Fig 3.2.

Step 2: Fabrication of chassis using the cardboard as a base and fixed the front tire with ball bearing. Backside of the chassis is fixed with motor, at the edge there is a two IR sensor.

Step 3: After completion of the chassis installation of circuit boards is made. Software and hardware implementation is completed.

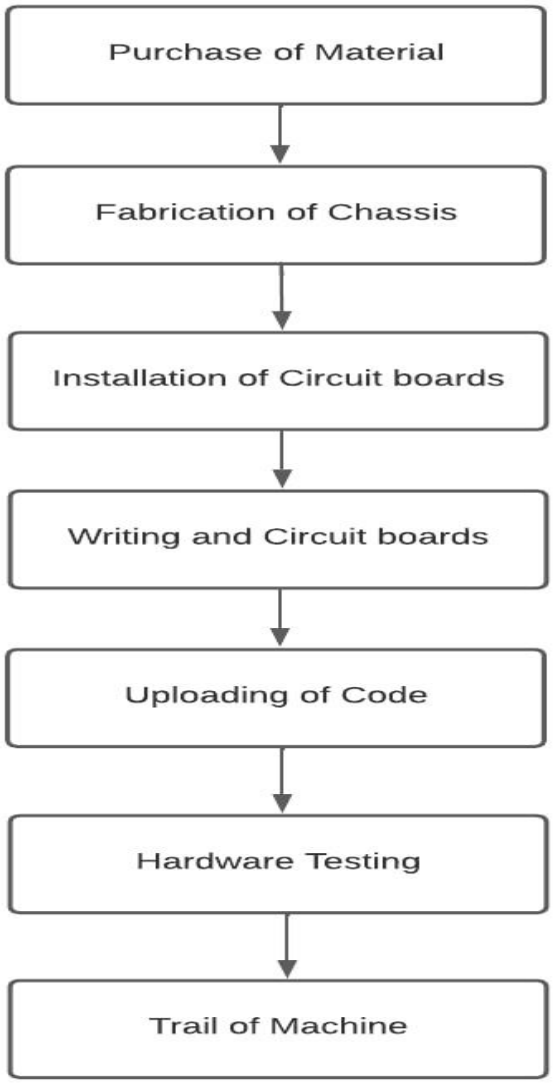

Fig 3.2 Work flow of Line Following Robot

3.2.2 Design of robot and working

In the below mentioned Fig 3.3 shown that the dc motor is placed back side of the robot and two IR sensor in front side of the robot IR sensor will sense the line and give information to the Arduino which is placed center. After that Arduino will give information to the motor driver which is placed near to the Arduino. Motor driver will control the dc motor which is placed in the backside

of the robot. There is a two front wheel which is rotated using ball bearing so that it can go with the flow of dc motor.

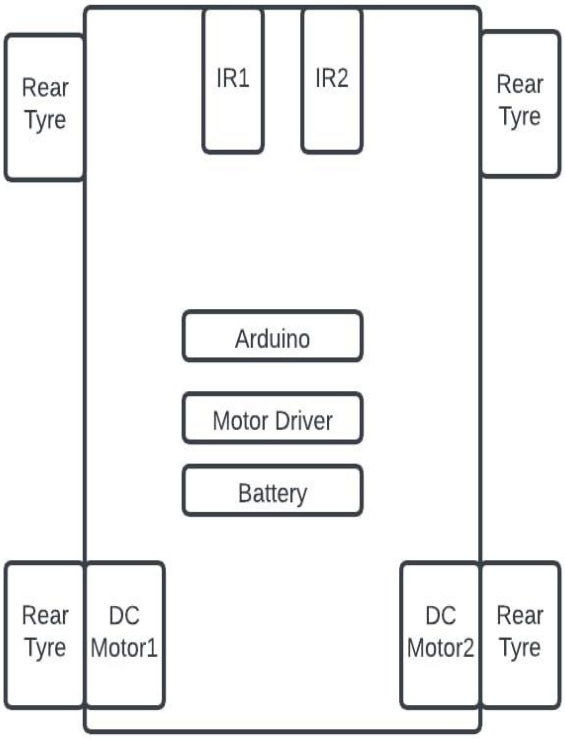

Fig 3.3 Sketch of Cabin assistant

3.3 COMPONENTS REQUIRED

The hardware required is divided in the following category:

3.3.1 Arduino

The Arduino Uno is an open-source micro-controller board designed by Arduino and based on the Microchip ATmega328P micro-controller. The board has digital and analogue input/output (I/O) pins that can be used to connect to different expansion boards (shields) and other circuits. The board features 14 digital I/O pins, 6 analogue I/O pins, and is programmable through a type B USB cable using the Arduino IDE (Integrated Development Environment). It

can be powered by a USB cable or an external 9-volt battery, with voltages ranging from 7 to 20 volts. The Arduino Nano and Leonardo are comparable. The Italian word "uno" means "one" and was chosen to represent the first release of Arduino Software. The Uno board is the first in a series of USB-based Arduino boards it, along with version 1.0 of the Arduino IDE, served as the standard version of Arduino, which has since been superseded by succeeding releases. The ATmega328 on the board is preprogrammed with a boot loader, allowing it to be programmed without the requirement of an external hardware programmer as shown in the Fig 3.4.

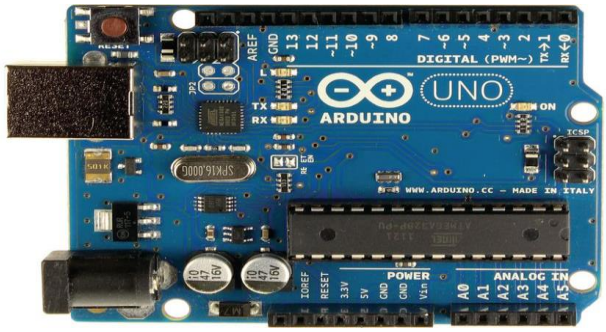

Fig 3.4 Arduino

3.3.2 Motor Driver

In an integrated circuit, as shown in the Fig 3.5 the L298N Motor Driver module contains an L298 Motor Driver IC, a 78M05 Voltage Regulator, resistors, capacitors, a Power LED, and a 5V jumper.78M05 Voltage regulator will be enabled only when the jumper is placed. The internal circuitry will be powered by the voltage regulator when the power source is less than or equal to 12V, and the 5V pin can be utilized as an output pin to power the microcontroller. When the power supply is greater than 12V, the jumper should be removed and a separate 5V should be provided through the 5V connector to power the internal circuitry.

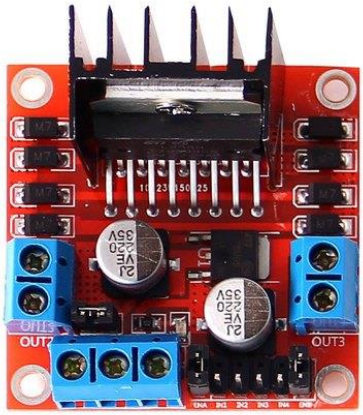

Fig 3.5 Motor Driver

3.3.3 DC Motor

Any rotary electrical motor that converts direct current (DC) electrical energy into mechanical energy is known as a DC motor. The most common types rely on magnetic fields to produce forces. Almost all DC motors contain an internal system, either electro mechanical or electronic, that changes the direction of current in portion of the motor on a regular basis. Because they could be powered by existing direct-current lighting power distribution networks, DC motors were the first extensively utilized motors. The speed of a DC motor can be varied across a large range by varying the supply voltage or adjusting the current intensity in the field windings. Tools, toys, and appliances all employ small DC motors.

The universal motor is a lightweight brushed motor that can run on direct current and is used in portable power tools and appliances as shown in the Fig 3.6. Larger DC motors are being employed in electric vehicle propulsion, elevator and hoist drives, and steel rolling mill drives. In many applications, power electronics has made it possible to replace DC motors with AC motors.

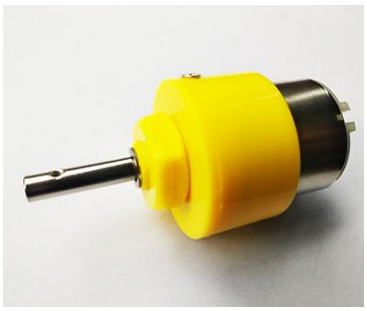

Fig 3.6 DC Motor

3.3.4 Ultrasonic

An ultrasonic sensor as shown in the Fig 3.7 is a device that uses ultrasonic sound waves to determine the distance to an item. A transducer is used in an ultrasonic sensor to emit and receive ultrasonic pulses that relay information about the proximity of an item. High-frequency sound waves bounce off walls and create distinct echo patterns. Ultrasonic sensors work by emitting a sound wave that is above the human hearing range. The sensor's transducer functions as a microphone, receiving and transmitting ultrasonic sound. To deliver a pulse and receive the echo, our ultrasonic sensors, like many others, use a single transducer. The sensor measures the time between sending and receiving the ultra-millisecond to determine the distance to a target. This module's operation is straightforward. It emits a 40kHz ultrasonic pulse that travels through the air and bounces back to the sensor if it encounters an obstruction or object. The distance can be estimated by multiplying the travel time by the sound speed. Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed. The technology is limited by the shapes of surfaces and the density or consistency of the material. For example, foam on the surface of a fluid in a tank could distort a reading.

Fig 3.7 Ultra-Sonic Senser

3.3.5 IR SENSOR

An infrared (IR) sensor as shown in the Fig 3.8. is an electrical device that detects and measures infrared radiation in its immediate surroundings. In 1800, an astronomer named William Herchel made an unintentional discovery of infrared light. He noticed that the temperature just beyond the red light (separated by a prism) was the highest while measuring the temperature of each colour of light. Because its wavelength is longer than visible light, IR is invisible to the naked eye (though it is still on the same electromagnetic spectrum). Infrared radiation is produced by everything that emits heat (temperatures over roughly five degrees Kelvin). Infrared sensors can be active or passive. Infrared sensors that are active both emit and detect infrared radiation. Active IR sensors are made up of two parts: an LED and a receiver. When an object approaches the sensor, the LED's infrared light reflects off of it and is recognised by the receiver. Active infrared sensors are often utilised in obstacle detection systems as proximity sensors (such as in robots). Infrared radiation is an electromagnetic wave with wavelength of 700nm to 1 mm. It is emitted by objects with temperature above 0 kelvin. Furthermore, intensity and wavelength of infrared radiation depends on the temperature of the object.

Fig 3.8 IR Sensor

3.3.6 Specification of components

Table 3.1. Specifications of components used in Cabin Assistant

S. No	Particulars	Quantity	Specification
1	Arduino Uno	1	• Processor: 16 MHz ATmega328 • Operating Voltage: 5V • Input Voltage: 7-12 V
2	Motor Driver	1	• Driver Model: L298N 2A • Logic Voltage: 5V • Driver Voltage: 5-35V • Current Sense for each motor.
3	IR Sensor	2	• 5V DC Operating voltage • I/O pins are 5V and 3.3V compliant • Range: Up to 20cm • 20mA supply current
4	DC Motor	2	• Operating voltage: 4.5V-18V • No-Load Speed (12V): 200 RPM

			• Gear ratio 30:1
5	Ultrasonic	1	• Power Supply: 3.3V – 5V • Working Frequency: 40Hz. • Ranging Distance: 3cm – 350cm/3.4m.
6	Battery	1	• 9V (Rechargeable battery)

3.4 SOFTWARE REQUIRED

For the simulation of the circuit, Proteus software is used. For coding and uploading the sketch, the Arduino 1.8.19 is used.

3.4.1 Software tool description

Proteus Design Set is a proprietary code tool suite for electronic design automation. Electronic design experts and technicians mostly use the program to develop schematics and electronic prints for printed circuit board manufacture. The Proteus Design Suite's schematic capture feature is utilized for both design simulation and the design phase of a PCB layout project. Schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design phase of a PCB layout project. It is therefore a core component and is included with all product configurations.

The processing flow of software simulation

Step 1: If both the sensors are identifying the line the motor will function in reverse direction as shown in the Fig 3.9.

Step 2: If left sensor identifies the line, left motor will work.

Step 3: If right sensor identifies the line, right motor will work.

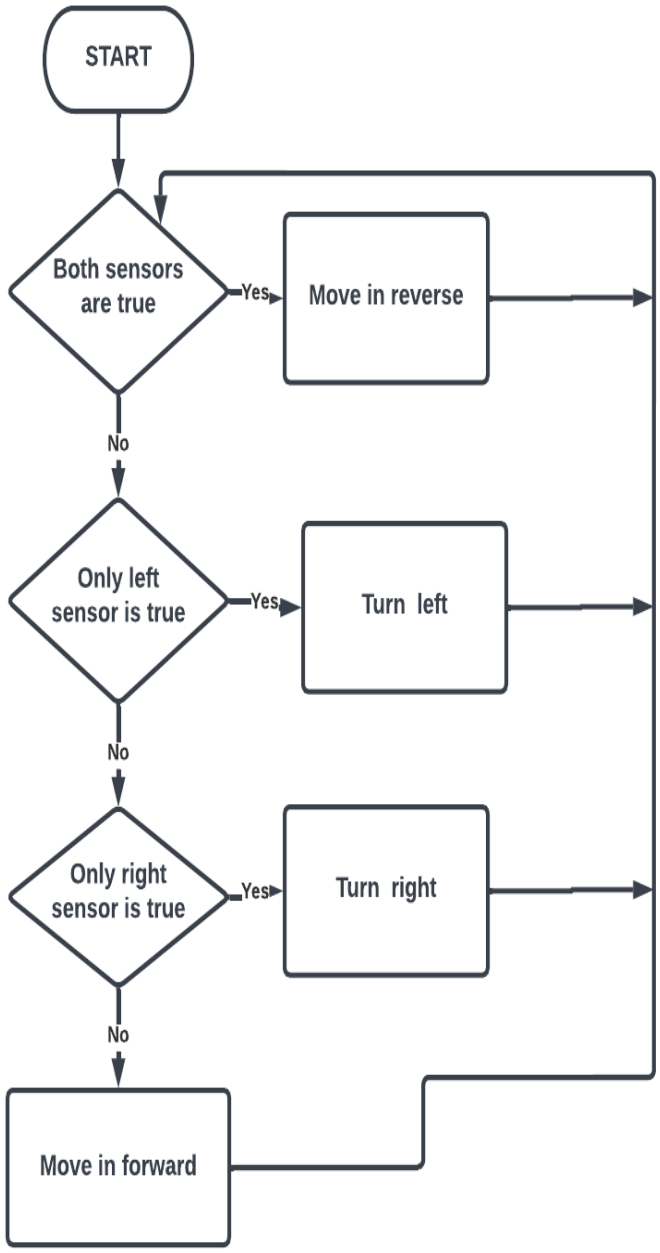

Fig 3.9 Flow chart of Line Following Robot

CHAPTER 4

RESULT AND DISCUSSION

4.1 SIMULATION RESULT

The project has been simulated using Proteus software. As a result, it is an essential component that comes standard with all product configurations. Proteus contains Arduino library so that Arduino can be used in uploading the Arduino code and made the connection with dc motor and infrared sensor. If both the sensors identify the black line it will move forward. If the right sensor identifies the line, it will turn right (left motor will turn off) and if the left sensor will identify line, it will turn left (right motor will turn off) as shown in the Fig 4.1.

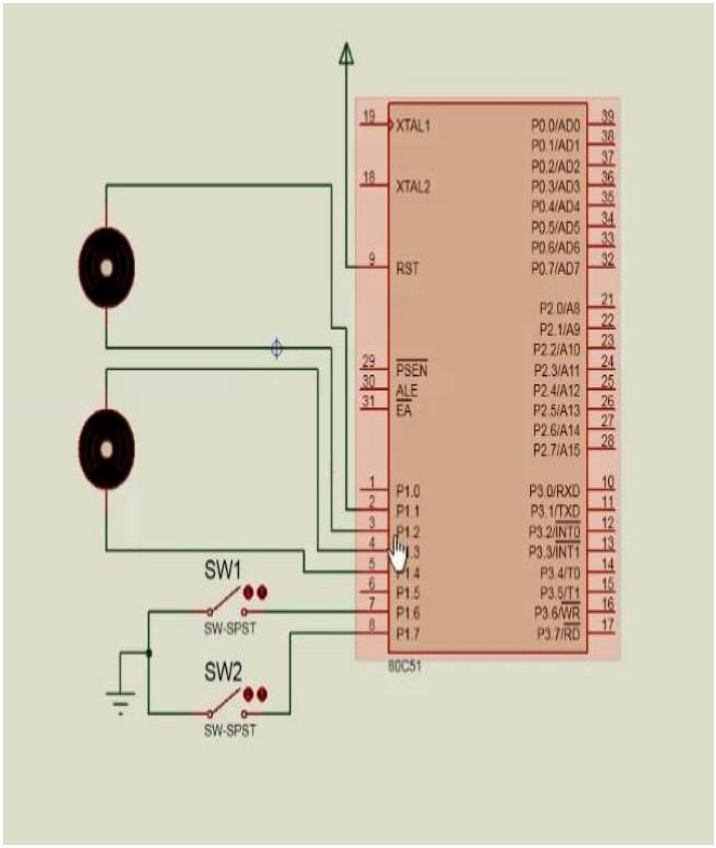

Fig 4.1. Simulation of Cabin Assistant

4.2 HARDWARE RESULT

Step 1: In this Fig 4.2 shows the chases of the robot. In chases, cardboard is used as a base in that dc motor with tire as a back tire and tire with ball bearing as a front tire. The components are connected with cardboard using U clamp, bolt and nuts.

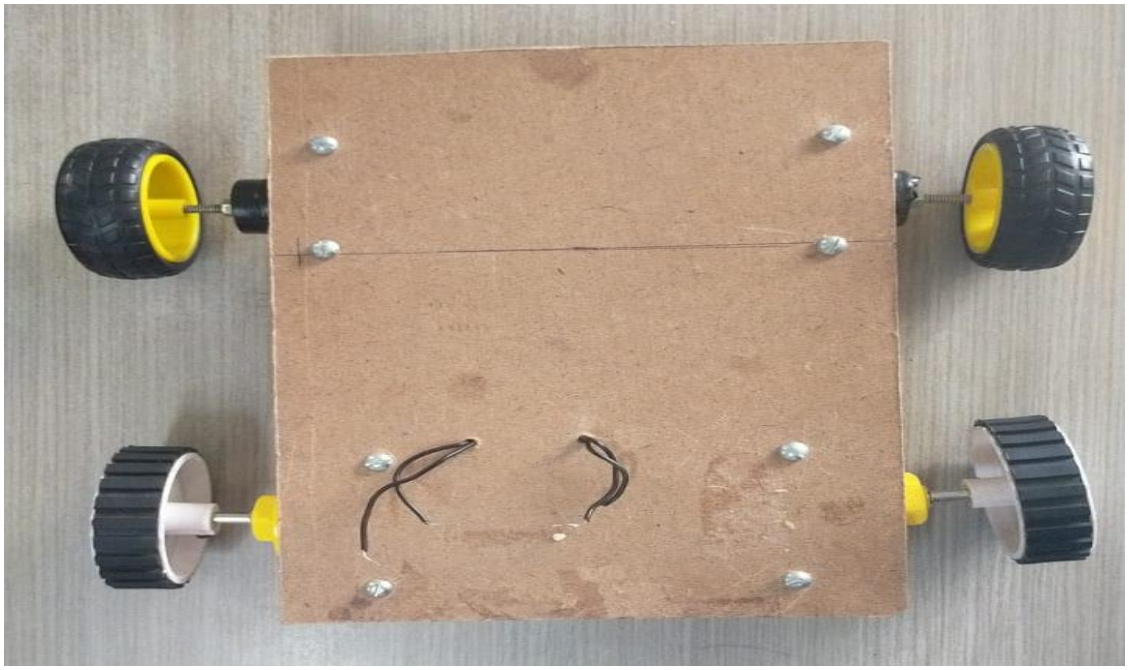

Fig 4.2 Before installing the circuit board

Step 2: In this Fig 4.3 shows the chases with circuit board (Arduino Uno and Motor Driver). In chases, circuit board is installed after uploading the code. Completed all the wiring with the board and motor.

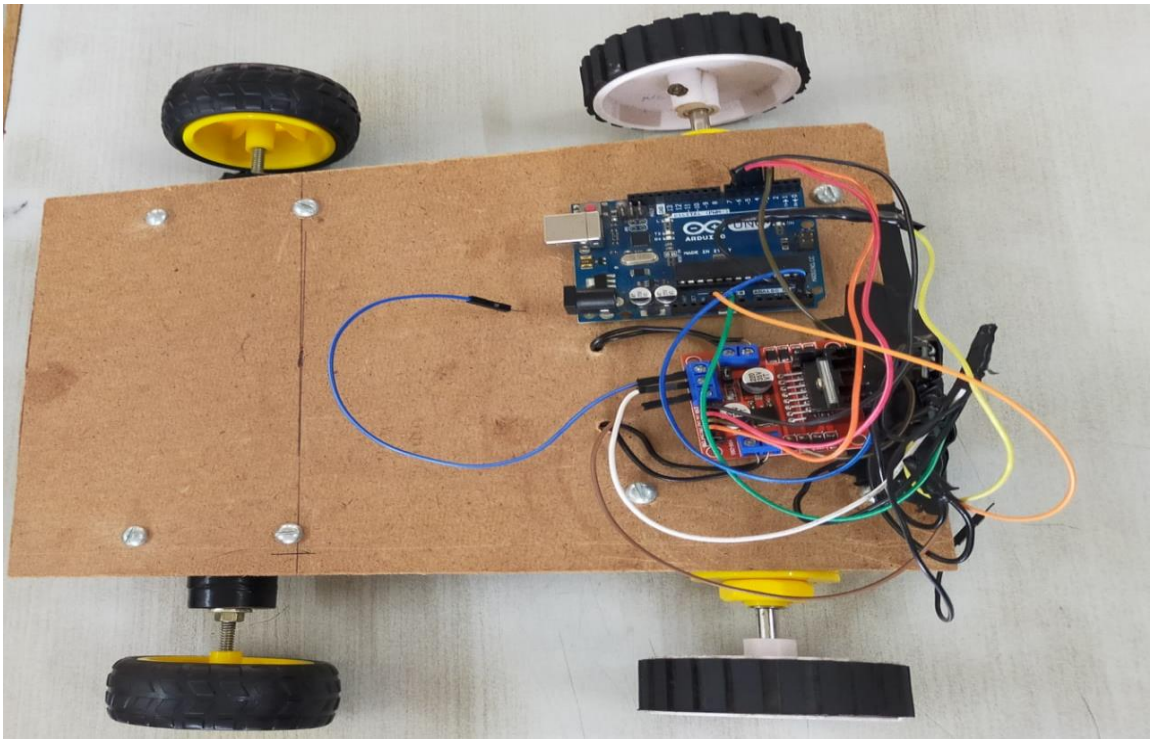

Fig 4.3. After installing the circuit board

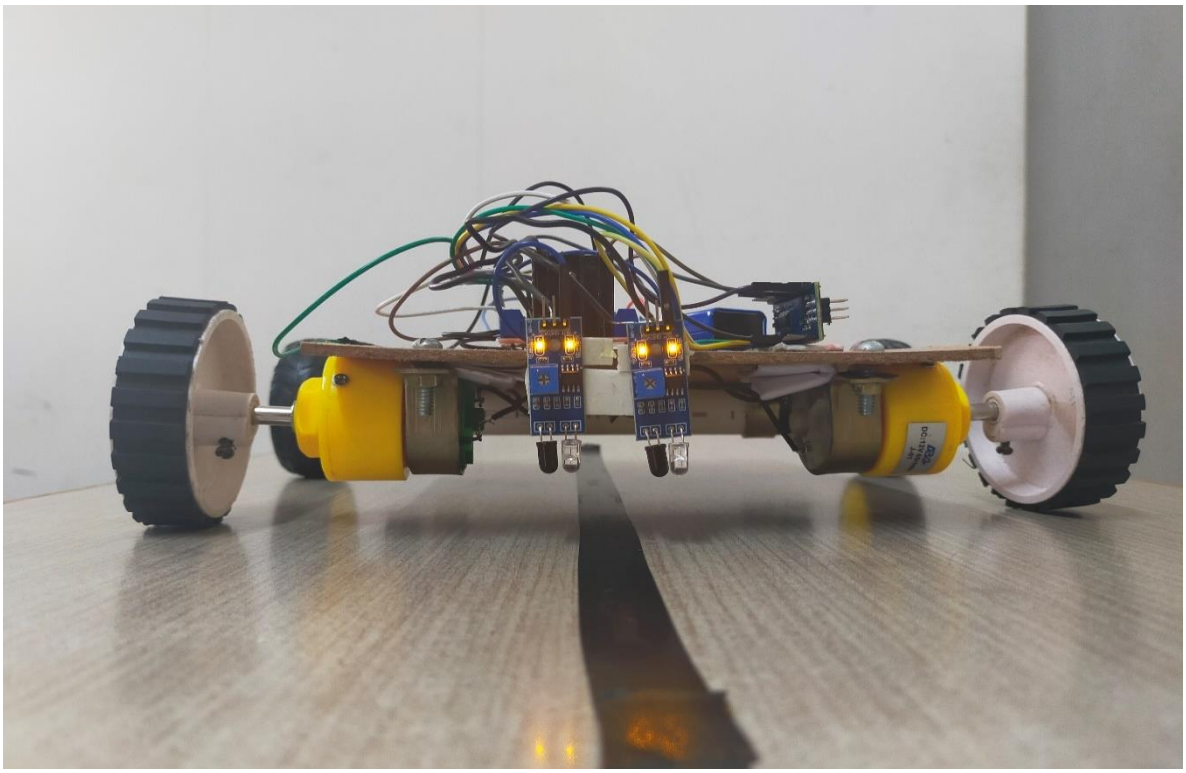

Fig 4.4 Working Model of Robot

Step 3: In this Fig 4.4 shows the working model of our robot; the robot was placed on the path and IR sensor is sensing the line and it's started to work.

4.3 PERFORMANCE

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-filed. In this the robot had done for transferring document from one place to another place with good speed and with security. There is a gear dc motor so that it will stop suddenly. By using this it will follow only the given path and turn according to the given path with the same speed. It will reduce the human work so that it will make us to concentrate in the work. Now a days it is used in hospital for transferring food to the patients in the hospital in a specified path which is done before. It is also used in domestic purpose for transferring food, documents and others. If there are any obstacles in the path it will stop at that point and indicate to the owner. After removing the obstacles, it will move smoothly in the path.

4.4 APPLICATION AND USES

- Industrial Applications: These robots can be utilized to replace traditional conveyor belts in industries as automated equipment carriers.
- Automobile applications: These robots can also be employed as self-driving cars that travel on roads equipped with magnets.
- Domestic applications: These can be utilized in the home for things like floor cleaning and transferring objects, among other things.
- Direction applications: These can be utilized to provide path guidance in public venues such as shopping malls and museums.

- A line follower Robots are commonly used to automate processes in industries, military purposes, and consumer applications.
- They are quite useful since they can operate independently, i.e., as automatic guided vehicles.

4.5 ADVANTAGES

- These types of robot movement are usually automatic.
- They can also be used for long distance.
- They can be used in industries as automated equipment carriers.
- They can be used to transferring document from one place to another place in a specified path.
- It will reduce the human work and time.

4.6 DISADVANTAGES

- It always needs a path to run either white or else since the IR rays should reflect from the particular path (color mostly used white on black).
- It cannot carry more than three kilograms.
- It can travel between only two points.
- If there is any object in its path then it will not continue it will stop in that position until it is removed.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONLUSION

The main motive of the project is to reduce the human's work and time. The robot has been designed which moves from one cabin to the other cabin to transfer files. It can be used as cabin assistant robot and will be helpful for physically challenged people. It is discovered that the robot designed moves at normal speed with correct accuracy and no delay.

5.2 FUTURE SCOPE

The robot has been designed to move from a single cabin to the other cabin at present. In future it can be implemented for multiple cabins using a line following robot with new technology called Artificial Intelligence algorithm. These types of robots are automatic and can also be used for long distance. AI based algorithm will be more efficient, with more accuracy and highly secured system.

APPENDICES

SOURCE CODE

```
#define R1 4
#define R2 5
#define L1 2
#define L2 3
#define R A4
#define L A5
void Stop(){
  digitalWrite(R1,LOW);
  digitalWrite(R2,LOW);
  digitalWrite(L1,LOW);
  digitalWrite(L2,LOW);
  }
  void Forward(){
  digitalWrite(R1,LOW);
  digitalWrite(R2,HIGH);
  digitalWrite(L1,LOW);
  digitalWrite(L2,HIGH);
  }
  void Left(){
  digitalWrite(R1,LOW);
  digitalWrite(R2,HIGH);
  digitalWrite(L1,LOW);
  digitalWrite(L2,LOW);
```

```
  }
  void Right(){
  digitalWrite(R1,LOW);
  digitalWrite(R2,LOW);
  digitalWrite(L1,LOW);
  digitalWrite(L2,HIGH);
  }
void setup(){
  Serial.begin(9600);
  pinMode(R1, OUTPUT);
  pinMode(R2, OUTPUT);
  pinMode(L1, OUTPUT);
  pinMode(L2, OUTPUT);
}


void loop() {
  int n=0;
  if(n==1x){
 if(digitalRead(R)==HIGH&&digitalRead(L)==LOW) {
  Right();
 }
 else if(digitalRead(L)==HIGH&&digitalRead(R)==LOW){
 Left();
 }
 else if(digitalRead(L)==HIGH&&digitalRead(R)==HIGH){
```

```
Forward();
}
else if(digitalRead(L)==LOW&&digitalRead(R)==LOW){
 Stop();
}
 }else{
    if(digitalRead(R)==HIGH&&digitalRead(L)==LOW) {
  Left();
}
else if(digitalRead(L)==HIGH&&digitalRead(R)==LOW){

Right();
}
else if(digitalRead(L)==HIGH&&digitalRead(R)==HIGH){
 Stop();

}
else if(digitalRead(L)==LOW&&digitalRead(R)==LOW){

  Forward();
}
 }
}
```

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