LINE FOLLOWER ROBOT WITH OBSTACLE AVOIDANCE

A Project Report Phase – II

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering Degree in Electronics and Communication Engineering

By

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **VAMSI KRISHNA SANDU - (39130496)** and **VANAPALLI NAGA RAJU NIKESH - (39130498)** who carried out the project entitled **"LINE FOLLOWER ROBOT WITH OBSTACLE DETECTION"** under my supervision from November 2022 to April 2023.

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DECLARATION

We, **VAMSI KRISHNA SANDU - (39130496) and NIKESH - (39130498)** hereby declare that the Project Report entitled **LINE FOLLOWER ROBOT WITH OBSTACLE DETECTION** is done under the guidance of **Dr. S. EMALDA ROSLIN, M.E., Ph.D.,** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in **Electronics and Communication Engineering.**

DATE: **24.4.23**

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I consider my self-most fortunate and immensely privileged to have worked under the guidance of **Dr. S. EMALDA ROSLIN, M.E., Ph.D.,** Department of Electronics and Communication Engineering to complete this project successfully.

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ABSTRACT

Line follower is a smart autonomous robot that detects or follows a visible line embedded in the ground. The trail is predetermined and can be selected with a high contrast color or with a black line visible on the trail surface. Infrared sensors are used to detect these lines. Typically speaking, the area unit of the infrared sensors is used to locate the path that the robot has to follow. The robot movement is automatic and can be used for applications of long distances. It is the fundamental line follower robot's function. The device proposed for commercial, medical, rescue and military operations are extremely useful. In particular, these past constraints are no longer necessary with recent technological advances in computing. The production of tracking systems can now be made more capable of reliably estimating the target location behind the obstacle. The benefit of these technologies consists in the possibility of using an ultrasonic method for measurement without direct contact with a target. Different models and systems for indoor and outdoor object detection have been described in the literature. Using optical, heat base, infrared and ultrasonic approaches, object localization techniques were introduced. Indoor positioning systems monitor and locate objects and enclose environments inside buildings. Wireless methods, optical tracking, and ultrasonic techniques are used for object position detection systems. The goal of this study is to develop a monitoring system that follows certain paths and can detect objects and edges using ultrasonic frequencies. If some object is put, a regular line follower will try to move and smash the obstacle. This prototype of line follower robot tries to push the limit little to overcome this issue. It has been built in a way that any obstacle in front of it can be identified. It will stop and will not pass until the barrier remains. Also, it is able to identify every front edge and comply similarly. In industries, such as material handling, this type of robot performs many tasks. These robots are also used as machine-controlled carrier instruments in old conveyor belts switching industries.

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CHAPTER 1

INTRODUCTION

1.1 LINE FOLLOWING ROBOT

The Line Following Robot is an autonomous robot that detects a path and according to the path drawn, it follows the path with the help of an IR sensor attached to the robot. Autonomous robot are robots that can perform with a high degree of autonomy, which is particularly desirable in fields such as space exploration, cleaning floors, mowing lawn, and waste water treatment. Some modern factory robots are “autonomous” within the strict confines of their direct environment. It may not be that every degree of freedom exists in their surrounding environment, but the factory robot’s workplace is challenging and can often contain chaotic, unpredictable variables. The exact orientation and position of the next object of work and even the type of object and the required task must be determined. This can vary unpredictably. One important area of robotics research is to enable robot to cope with its environment whether this be on land, underwater, in the air, underground, or in space.

The path can be either a Blackline drawn over a white surface or a white line drawn over a black surface thus avoiding any detection error. Line follower robot also consists of an obstacle sensor that detects any obstacle in front of the Robot thus avoiding any unnecessary accidents. Line follower robot is designed and programmed in such a way that it does its job perfectly without any error and detects it’s given path. It operates in such a way that it detects and reads the path and transmits the signal to Arduino UNO. The microcontroller decides to make any changes (if needed) in the directions or speeds of the robot according to the inputs received. Thus, it sends the control signal to the speed and directions of the line follower robot. This way the line follower robot operates without any error. To make a line follower robot with object detection ability it is attached with an ultrasonic sensor, which is a device that can measures the distance between an object and robot by using sound waves. It calculates the distance between the line following robot

and the object obstructing it by sending a sound wave of a specific frequency and detecting the bounced sound wave at receiver It is important to understand that some objects might not be detect by ultrasonic sensor. This can be applied for military purposes, delivery services, transportation systems, blind assisting applications.

Classical line following robot is slow response to the error occur will easily leave its track that drawn on the floor. This problem will cause the motion of the robot to be unsmooth. Although the line following robot can follow the black lines, its motion still needs to be improved. The design and development of an autonomous line tracking robot is a very complicated task. There are many aspects that should be considered such as mechanical system, electrical circuit and microprocessor programming. All these aspects need to be fully integrated between each other. So that, the autonomous robot can be perfectly functional to achieve the tasks provided.In order to make sure this autonomous robot system fully integrate, the challenges are to decide and choose the best device should be implemented in this autonomous robot system. Furthermore, there are many types of rnicrocontroller, sensor device and driven motor in the market. Each of them has difference specifications, capability and functions. The biggest obstacle is to program the microcontroller based on the information gathered from the robot's line sensors. Basically each sensor provides the information to controller based on the signal that they got and the controller will decide what to do base on the programming loaded. For line sensor case, its information based on the rate of reflected light that have been detected by detector. In different environment or brightness of area, the rate of light detected by detector is fully different. So, the strong programming languages knowledge are needed to synchronize environment changes with the execute program in the microcontroller.

The project is designed to develop a robotic vehicle that follows a specific pathA pair of photo sensors comprising IR transmitter and photo diode is interfaced to the controller to detect the specified path for its movement.Line follower robot is a useful robot that is used in ware houses, industries, and stores etc, where it follows a dedicated path. This proposed system of a line following robot fulfils the desired functionality and demonstrates the working of it. It uses a pair of photo sensors,

comprising of one IR transmitter and a photo diode in each. It guides the robot to follow a specified path by giving appropriate signal to the microcontroller. Two DC motors are used interfaced to the microcontroller through a motor driver IC. Input signals given to the microcontroller from the sensors and then the controller takes the appropriate action according to the program written in it and drives motors as desired.Further the project can be enhanced by adding more advanced sensors to it. This will add more features to the existing project. For example, we can use ultrasonic sensors for detect any obstacle in front of the robot and to take appropriate action.

1.2 MOTIVATION

In time of automation advances to reduce human efforts, it is necessary to develop colour line following robot, this robot can be used in airports to carry equipment and baggage from one place to another place, and it can be used for home automation, in restaurant it is used as robotic waiter like in Robot Restaurant in Porur, Chennai. It was opened in November 2017. Advantage of such robots is that they can operate efficiently for 6-7 long hours with a single charge. Thus, it is profitable for the business itself. Therefore, for a large country like India, it is necessary to use the line following robots in restaurants, industries etc. Such Robots come into play when large and heavy machineries are to be transferred from one place to another within industries. This technology can be implemented in running buses or other mass transit systems.

A Robot is a machine which is completely automatic, i.e. it starts on its own, decides its own way of work and stops on its own. Robotics has greatly advanced in the developed countries. High performance, high accuracy, lower labor cost and the ability to work in hazardous places have put robotics in an advantageous position over many other such technologies but as for developing countries like Bangladesh it is still quite out of reach. But it is one of the most fascinating and interesting aspects to the new generations and a lot of development in robotics has been done in last couple of years. Robots have several useful applications in our daily. It is actually a replica of human

being, which has been designed to ease human burden. It can be controlled pneumatically or using hydraulic ways or using the simple electronic control ways.

1.3 OBJECTIVES

The main aim of this project is to design and develop an autonomous line tracking robot. This is achieved through these objectives.

- The robot must be capable of following a line.
- It should be capable of taking various degrees of turns.
- The robot must be insensitive to environmental factors such as lighting and noise.
- It must allow calibration of the line's darkness threshold.
- Scalability must be a primary concern in the design.
- The objective of the project is paper the multiple source Multiple Destination Robot (MDR-l) having the ability to choose a desired line among multiple lines autonomously. Every line has different colours as their identities. The robot can differentiate among various colours and choose a desired one to find its target. Unlike any other simple line follower robot, this robot can be considered as a true autonomous line follower robot having the ability to detect presence of obstacle on its path. A powerful close loop control system is used in the robot. The robot senses a line and endeavours itself accordingly towards the desired target by correcting the wrong moves using a simple feedback mechanism but yet very effective closed loop system. The robot is capable of following very congested curves as it receives the continuous data from the sensors

CHAPTER 2

LITERATURE SURVEY

2.1 LITERATURE REVIEW

Design of autonomous line follower robot with obstacle avoidance by Kumar Rishabh (2021). This paper shows design and implementation of the Line Follower Robot and its ability to select the desired line among black and white line. This can be combined with different colours. Since each colour has its own distinct property, robot can therefore easily differentiate among different colours and possess the ability to detect the presence of an obstacle and choose the other path to find its target. It is programmed in such a way that instructions are given to the robot which senses a line and attempts to move towards the target. The robot can easily move along very congested curves as it continuously data from the sensors. This robot avoids collision and it can detect collision with an obstacle sensor and hence reaching the target. The proposed system can be implemented in any commercial, industrial, medical and also in educational labs.

Design and implementation of line follower and obstacle detection robot by Ayob Amrani(2020). In this paper, we propose a method for a line follower robot based on the instantaneous computation of the radius of curvature of this line, using infrared line sensors. The number and layout of its sensors, as well as the method chosen, play an important role in the robot's response to the line, with the desired accuracy and speed. In addition, the robot must be equipped with an anti-collision system, using an ultrasonic distance sensor, to detect and avoid obstacles in several situations, especially at line crossovers, when other robots share a common complex line.

Punetha, Deepak, Neeraj Kumar, and Vartika Mehta (2018). "Development and applications of line following robot based health care management system. The methodologies for assessing, planning, administering, and enhancing the health care management system are outlined in this paper report. The line that follows the drug-

carrying robot is designed to provide the patient medication as needed. A linear robot is an electronic system that can recognize and follow a line painted on the ground. A line is typically defined by a pre-determined course that appears as a black line in a white region of adifferent hue. A robot is connected to a light-based resistor sensor, whose resistance varies depending on the amount of light. When LDR receives a big amount of light, it has a resistance to its lowest value, which is close to zero, and it has a resistance to its highest value, which is close to infinite, when there is no light falling on it. A robot is attached to an IR sensor switch located near the patient.

Line Following Robot with Object Avoidance using Arduino by Savita Mamadapur, Deekshit Reddy L R, Abhishek K V, Jagadeesh G P, Karthik H.(2022). One of the most significant functions of robots is tracing. Robot with a Linear Motion A self-contained robot that may be followed, or a black line painted at the top that blends two colors. It is configured to move in a straight line and automatically. The robot uses observable signals to recognize the line, which helps it stay afloat. Because of the four-sensory system, its movements are precise and varied. DC gear motors are used to control the movement of the robot's wheels. To develop and test algorithms for controlling motor speeds and moving the robot along the line, the Arduino Uno interface is employed. The purpose of this project is to use an algorithm to adjust the control parameters to control the robot's movement. It's a self-contained robot that points and traces a black and white line on the upper surface or a white line in the dark. The next robot must be able to view the given line again, maintain track of it, and do the tasks that have been assigned to it. The supplied path line should be followed by the design as well as a robot built in certain conditions when using the do function. It is made up of input, process, and output components in a better system. After reading the book and drawing a black / white or white / black path in an imagined world, send the input signal to an Arduino UNO microcontroller via a process that can be questioned and decisions taken. The microcontroller has determined the robot's directions and speed based on possible input detection modifications (if needed). Changes the outcome to any line follower speed direction that is possible. Following the robot's speed and naked directions, the programme delivers the initial or pre-configured control signals for the line.

Image-Based Obstacle Detection Methods for the Safe Navigation of Unmanned Vehicles by Samira Badrloo(2021). Mobile robots lack a driver or a pilot and, thus, should be able to detect obstacles autonomously. This paper reviews various image-based obstacle detection techniques employed by unmanned vehicles such as Unmanned Surface Vehicles (USVs), Unmanned Aerial Vehicles (UAVs), and Micro Aerial Vehicles (MAVs). More than 110 papers from 23 high-impact computer science journals, which were published over the past 20 years, were reviewed. The techniques were divided into monocular and stereo. The former uses a single camera, while the latter makes use of images taken by two synchronised cameras. Monocular obstacle detection methods are discussed in appearance-based, motion-based, depth-based, and expansion-based categories. Monocular obstacle detection approaches have simple, fast, and straightforward computations. Thus, they are more suited for robots like MAVs and compact UAVs, which usually are small and have limited processing power.

On the other hand, stereo-based methods use pair(s) of synchronised cameras to generate a real-time 3D map from the surrounding objects to locate the obstacles. Stereo-based approaches have been classified into Inverse Perspective Mapping (IPM)-based and disparity histogram-based methods. Whether aerial or terrestrial, disparity histogram-based methods suffer from common problems: computational complexity, sensitivity to illumination changes, and the need for accurate camera calibration, especially when implemented on small robots. In addition, until recently, both monocular and stereo methods relied on conventional image processing techniques and, thus, did not meet the requirements of real-time applications. Therefore, deep learning networks have been the centre of focus in recent years to develop fast and reliable obstacle detection solutions. However, we observed that despite significant progress, deep learning techniques also face difficulties in complex and unknown environments where objects of varying types and shapes are present. The review suggests that detecting narrow and small, moving obs tacles and fast obstacle detection are the most challenging problem to focus on in future studies.

A Path Follower Robot using Battery S.Mandole(2022). Path Following is one of the most important aspects of robotics. A Path Following Robot is an autonomous robot which is able to follow either a black line that is drawn on the surface consisting of a contrasting color. It is designed to move automatically and follow the line. The robot uses arrays of optical sensors to identify the line, thus assisting the robot to stay on the track. The array of four sensor makes its movement precise and flexible. The basic Principle of path Following Robot is it follows the path by detecting the line. The robot direction of motion depends on the two sensors outputs. Whenever robot moves away from its path it is detected by the IR sensor. The project aims to create a line follower robot able to follow a path and reach its destination. Sensing a line and manoeuvring the robot to stay on course while constantly correcting wrong moves using feedback from sensors forms a simple yet effective system.

Abdul Latif, Hendro Agus Widodo, Robbi Rahim, Kunal Kunal. Implementation of Line Follower Robot based Microcontroller ATMega32A. This study uses an experimental method, by conducting a research process based on sequences, namely: needs analysis, mechanical chart design, electronic part design and control program design, manufacturing, and testing. The line follower robot based on ATmega32A microcontroller has been tested and the results show that the line follower robot can walk following the black line on the white floor and can display the situation on the LCD. But this line follower robot still has shortcomings in the line sensor sensitivity process depending on a certain speed. At speeds of 90-150 rpm the line follower robot can follow the path, while more than 150 rpm the robot is not able to follow the path.

Line following robots on factory floors :Significance and Simulation study using CoppeliaSim(2021) by Saharsh Oswal and SaravanaKumar. This paper presents the design, assembly and dynamic simulation of a line following robot integrated with a proximity sensor for collision avoidance and vision sensors for line tracking. The model is designed using Autodesk Inventor 2018 and the assembly and simulation is carried out using CoppeliaSim software. This simulation study intends to provide significance of the implementation of such robots on a factory floor, which can cover a path of

distance 10 meters in approximately 8 seconds. The simulation for this robot is carried out using CoppeliaSim. The software allows us to check the dynamic properties of the robot and assign different actuation codes to every component.

2.2 Summary of the Literature

The paper describes the design and implementation of a line follower robot with advanced capabilities for detecting and differentiating between black and white lines of different colors. The robot is also able to detect obstacles in its path using ultrasonic sensors, and make decisions on how to navigate around them. The paper provides detailed information on the hardware and software components used in the robot, as well as the algorithm used for line following and obstacle detection.Ayob Amrani This paper proposes a method for a line follower robot based on the instantaneous computation of the radius of curvature of the line using infrared line sensors and anti-collision systems. The paper provides a detailed explanation of the algorithm used for computing the Kumar Rishabh radius of curvature of the line, and how it is used for line following. The anti-collision system is also described in detail, and the paper provides experimental results to validate the effectiveness of the proposed method.

Punetha, Deepak, Neeraj Kumar, and Vartika Mehta This paper outlines the development and application of a line following robot in a healthcare management system. The robot is designed to transport medical supplies and equipment in hospitals and clinics, and is capable of navigating through narrow corridors and tight spaces. The paper provides details on the hardware and software components used in the robot, as well as the algorithm used for line following and obstacle detection. Experimental results are also provided to demonstrate the effectiveness of the robot in a healthcare environment.Savita Mamadapur, Deekshit Reddy L R, Abhishek K V, Jagadeesh G P, Karthik H. - This paper presents a self-contained robot that can follow a black line on the surface using observable signals to maintain its movements precisely. The robot is designed to be small and lightweight, and is able to navigate through narrow spaces with ease. The paper provides details on the hardware and software components used in the robot, as well as the algorithm used for line following.

Experimental results are also provided to validate the effectiveness of the robot.Samira Badrloo - This paper reviews various image-based obstacle detection techniques used in unmanned vehicles. The reviewed techniques are divided into monocular and stereo methods based on whether a single or multiple synchronized cameras are used for obstacle detection. The paper provides detailed descriptions of each technique, including their advantages and limitations. The experimental results of each technique are also provided to validate their effectiveness in obstacle detection.

Overall, these research papers provide valuable insights into the design and implementation of line follower robots with advanced capabilities for obstacle detection and avoidance. The proposed algorithms and techniques can be used to develop more sophisticated robots with improved capabilities, and can also be applied to other areas such as autonomous vehicles and drones.

CHAPTER 3

PROPOSED METHODOLOGY

3.1 Principle of Line follower robot

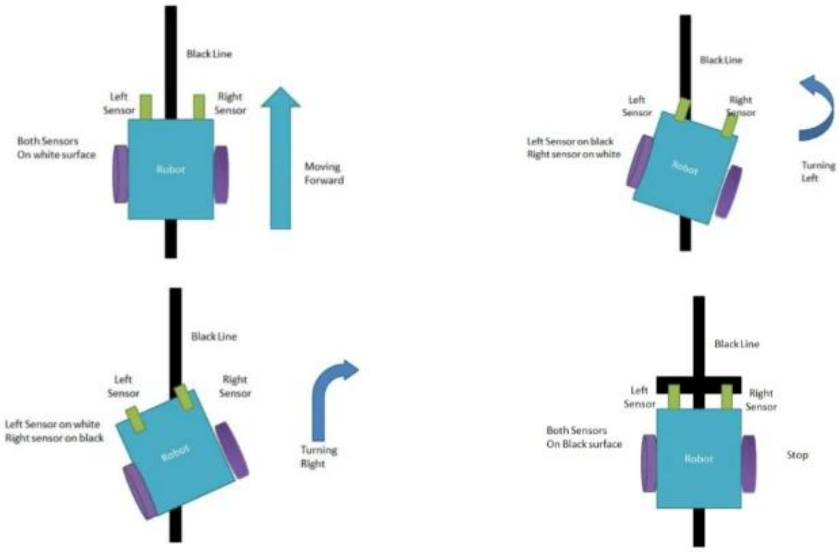

Fig:3.1 Principle of Line Follower

Line follower is an intelligent robot which detects a visual line embedded on the floor and follows it. The path is predefined and can be either visible like a black line on a white surface with a high contrasted color or the path can be a complex such as magnetic markers or laser guide markers. In order to detect these lines various sensors can be employed. Generally, infrared Sensors are used to detect the line which the robot has to follow. The robot movement is automatic and can be used for long distance application. Line follower can be modified by giving obstacle detection capability to it. If any object is placed on the path then a normal line follower will try to push the obstacle and hence it gets damaged. By using ultrasonic sensor, the line follower can detect an obstacle and can stop till the obstacle is removed. This type of robots can perform lot of tasks in industries, like material handling. These robots can be used as automated equipment carriers in industries replacing traditional conveyer belts. They also have domestic application and one of the interesting application of this line follower robot is in health care management. As this smart line follower robot

has obstacle detection capability it will not be damaged easily as it stops it motion till the obstacle is removed or till the path is changed. This ability of the robot increases it application especially in industries because obstacles are common in any workplace and if the robot is not able to detect the obstruction it will get damaged so this gives an added advantage wherever this intelligent line follower is used.

By using ultrasonic sensor, the line follower can detect an obstacle and can stop till the obstacle is removed. This type of robots can perform lot of tasks in industries, like material handling. These robots can be used as automated equipment carriers in industries replacing traditional conveyer belts. Line follower robot can be used in many industrial purposes. It can be used in carrying heavy and risky products. Radioactive products transportation inside a factory is very much risky for human life. A line follower robot can help in that section.The Line Follower Robot consists of two IR sensors and an Ultrasonic sensor attached to it. When the left sensor comes on the black line, then the robot turns the left side in the black line and if the right sensor senses a black line, then the robot turns the right side until both the left and right sensor senses white then only the robot moves forward . If robot comes across a path where there is another black strip lying perpendicular to the path then the robot stops at that instant .

If one of the infrared sensors (on the left) identifies a dark path while the other (on the right) detects a white path, the robot will also turn left. The robot turns left because the left engine remains upright while the right engine spins according to the clock.Generate the left engine rotate clockwise while the right engine rotates counterclockwise to make a steep right bend.To make a sharp left turn, rotate the right engine clockwise while rotating the left engine counterclockwise. When the ultrasonic sensor in front of the robot detects any interruption (at a predetermined distance), the motors stop rotating and the robot comes to a halt. As soon as the block is removed, the robot starts moving.

3.2 Block diagrom of Line following robot

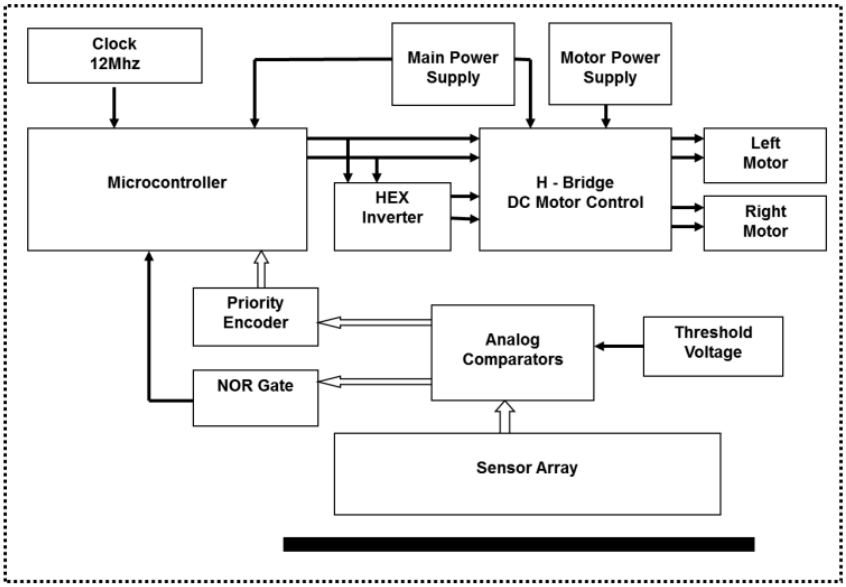

Fig:3.2 Block Diagram

According to the above above fig(3.2), we notice that a microcontroller (Atmega328p) is used to communicate with the whole system for processing the robotics functions. First, we need to connect both Vcc and ground pins of the Arduino Nano with a 9V power supply. As we know this is the main source for operating the whole system.After connecting the above connection, let's connect the L293D motor driver shield onto the Arduino UNO. Four geared motors are connected to the outer terminal of the motor driver as shown in the circuit diagram. This is a powerful motor driver that can drive four 6V motors easily.

Sensors,These are the components that detect the line and obstacles. Commonly used sensors include infrared sensors, ultrasonic sensors, and camera-based vision sensors.Microcontroller, The microcontroller is the brain of the robot. It receives input from the sensors, processes it, and sends commands to the motors to control the movement of the robot.Motor driver,This component is responsible for controlling the speed and direction of the motors that drive the robot. The motor driver receives commands from the microcontroller and converts them into signals that can be used

to control the motors.Power supply, The power supply provides the necessary voltage and current to power the components of the robot, including the microcontroller, sensors, and motor driver.Wheels, The wheels are responsible for moving the robot. The wheels can be controlled independently to allow the robot to turn and maneuver around obstacles. Obstacle avoidance module,This module is responsible for detecting obstacles in the path of the robot and taking evasive action to avoid them. It can use sensors such as ultrasonic or infrared sensors to detect obstacles and then send signals to the microcontroller to take evasive action.

The block diagram shows how these components are connected and how they work together to enable the robot to follow a line while avoiding obstacles. The sensors detect the line and obstacles, and the microcontroller processes this information and sends commands to the motor driver to control the movement of the robot. The power supply provides power to the components, while the wheels move the robot. The obstacle avoidance module detects obstacles and takes evasive action to avoid them, ensuring that the robot can navigate around obstacles while following the line.

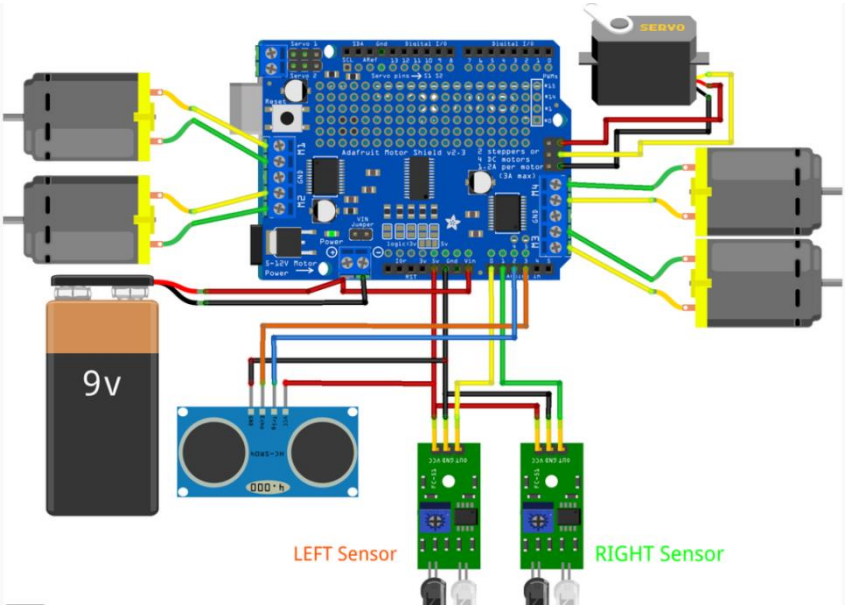

Fig:3.3 Circuit Diagram

3.3 Components Used

HC-SR04(Ultrasonic sensor)

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves.An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.To make a line follower robot with obstacle detection ability, it is attached with an ultrasonic sensor, which is a device that can measure the distance between an object and a robot sensor by using ultrasonic waves.

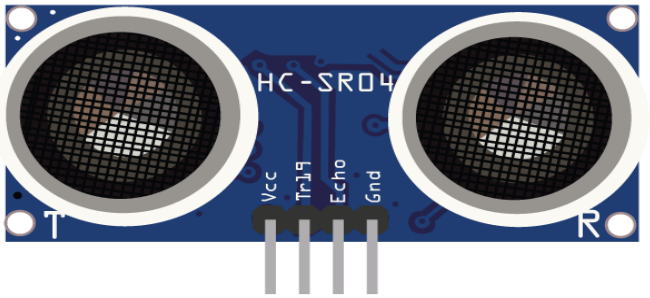

Fig:3.4 Ultrasonic Sensor

An ultrasonic distance sensor consists of two ultrasonic transducers; one acts as a transmitter with 40Khz frequency, and the other one acts as a receiver and listens to the reflected received pulses. The sensor produces an output pulse that is proportional to the distance of the object in front of the sensor. By reading the pulse width with a microcontroller, one can determine the distance of the object the sensor has an operating voltage of 5 volts and can provide excellent non-contact range detection between 2cm to 400cm.

To start the distance measurement process we need to set the trigger pin high for 10uS. In response, the sensor transmits an ultrasonic burst of eight pulses at 40KHz. The eighth pulse is so designed that the receiver can distinguish between the transmitted pulse from ambient ultrasound. When the 8-pulse transmission process is

finished, the echo pin goes high indicating the return signal. If those transmitted signals do not return after 38ms that means there is no obstruction present in front of the sensor. To start the distance measurement process we need to set the trigger pin high for 10uS. In response, the sensor transmits an ultrasonic burst of eight pulses at 40KHz. The eighth pulse is so designed that the receiver can distinguish between the transmitted pulse from ambient ultrasound. When the 8-pulse transmission process is finished, the echo pin goes high indicating the return signal. If those transmitted signals do not return after 38ms that means there is no obstruction present in front of the sensor.

The received pulse width can be used to determine the distance from the reflected object, we can do this with the distance-speed-time equation. Let's assume we have an unknown distance X, for which we have received 700us pulse width on the echo pin. Now to calculate the distance we will use the following formula.Distance = Speed x Time.Now we know the speed of sound is 343.2 m/s. To calculate the distance we need to convert the speed of sound to cm/us which will be 0.03432 cm/uS, and we also know the time value received from the ultrasonic sensor which is 700uS.Distance = (0.03432 cm/us x 700uS) / 2 = 12.012 cmNow we know that the object is 12.012 cm away from the sensor.

IR-Sensor

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, which can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received

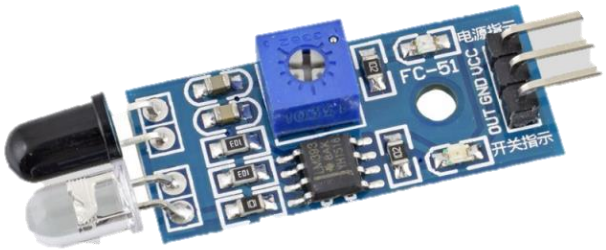

Fig:3.5 IR Sensor

The working principle of an infrared sensor is similar to the object detection sensor. This sensor includes an IR LED & an IR Photodiode, so by combining these two can be formed as a photo-coupler otherwise optocoupler. The physics laws used in this sensor are planks radiation, Stephan Boltzmann & weins displacement.IR LED is one kind of transmitter that emits IR radiations. This LED looks similar to a standard LED and the radiation which is generated by this is not visible to the human eye.

Infrared receivers mainly detect the radiation using an infrared transmitter. These infrared receivers are available in photodiodes form. IR Photodiodes are dissimilar as compared with usual photodiodes because they detect simply IR radiation. Different kinds of infrared receivers mainly exist depending on the voltage, wavelength, package, etc.Once it is used as the combination of an IR transmitter & receiver, then the receiver's wavelength must equal the transmitter. Here, the transmitter is IR LED whereas the receiver is IR photodiode. The infrared photodiode is responsive to the infrared light that is generated through an infrared LED. The resistance of photo-diode & the change in output voltage is in proportion to the infrared light obtained. This is the IR sensor's fundamental working principle.

Arduino Uno

The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also

the first USB board released by Arduino. It is considered as the powerful board used in various projects. Arduino.cc developed the Arduino UNO board.

Arduino UNO is based on an ATmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits.

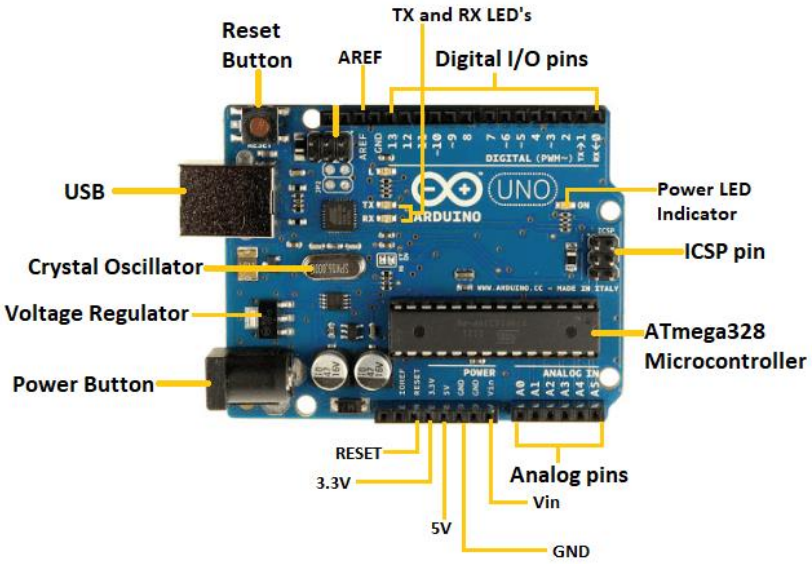

Fig:3.6 Arduino UNO

The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms.

The IDE is common to all available boards of Arduino.

Let's discuss each component in detail.

- ATmega328 Microcontroller- It is a single chip Microcontroller of the ATmel family. The processor code inside it is of 8-bit. It combines Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.
- ICSP pin - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board.

- Power LED Indicator- The ON status of LED shows the power is activated. When the power is OFF, the LED will not light up.
- Digital I/O pins- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- TX and RX LED's- The successful flow of data is represented by the lighting of these LED's.
- AREF- The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- Reset button- It is used to add a Reset button to the connection.
- USB- It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.
- Crystal Oscillator- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- Voltage Regulator- The voltage regulator converts the input voltage to 5V.
- GND- Ground pins. The ground pin acts as a pin with zero voltage.
- Vin- It is the input voltage.
- Analog Pins- The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output)pins.

The technical specifications of the Arduino UNO are listed below:

- There are 20 Input/Output pins present on the Arduino UNO board. These 20 pis include 6 PWM pins, 6 analog pins, and 8 digital I/O pins.
- The PWM pins are Pulse Width Modulation capable pins.
- The crystal oscillator present in Arduino UNO comes with a frequency of 16MHz.
- It also has a Arduino integrated WiFi module. Such Arduino UNO board is based on the Integrated WiFi ESP8266 Module and ATmega328P microcontroller.
- The input voltage of the UNO board varies from 7V to 20V.
- Arduino UNO automatically draws power from the external power supply. It can also draw power from the USB.

L293D Motor Driver

A motor driver is an integrated circuit chip which is usually used to control motors in autonomous robots. Motor driver act as an interface between Arduino and the motors . The most commonly used motor driver IC's are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. We will be referring the motor driver IC as L293D only. L293D has 16 pins.The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor.

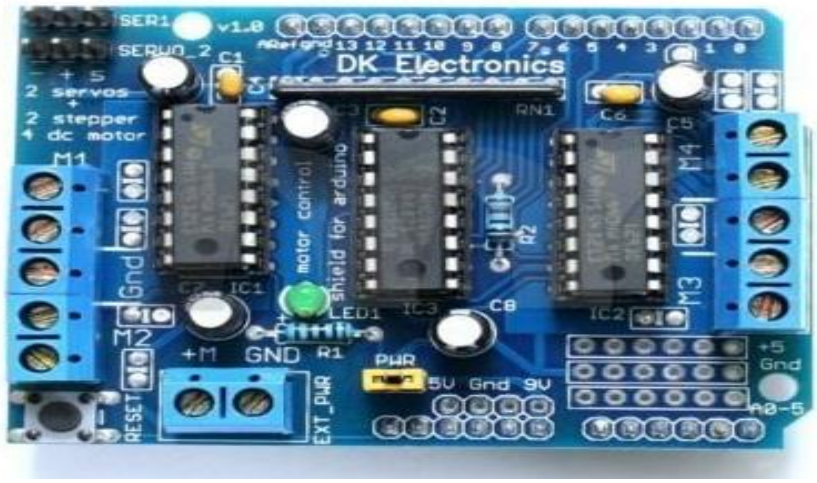

Fig:3.7 L293D Motor Driver

The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, DC and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.Now that we have completely understood how the L293D motor driver IC works we can connect all the required wires to the L293d Arduino, and we can write some code to rotate the motor and control the speed of the motor.

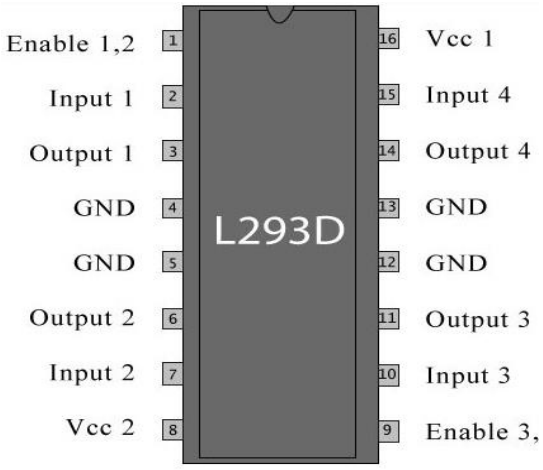

Fig:3.8 L293D Motor Driver Pin Diagram

Pin No. - Pin Characteristics

- 1 - Enable 1-2, when this is HIGH the left part of the IC will work and when it is low the left part won't work.
- 2 - INPUT 1, when this pin is HIGH the current will flow though output 1
- 3 - OUTPUT 1, this pin should be connected to one of the terminal of motor
- 4,5 - GND, ground pins
- 6 - OUTPUT 2, this pin should be connected to one of the terminal of motor
- 7 - INPUT 2, when this pin is HIGH the current will flow though output 2
- 8 - VCC2, this is the voltage which will be supplied to the motor.
- 16 - VCC1, this is the power source to the IC. So, this pin should be supplied with 5 V
- 15 - INPUT 4, when this pin is HIGH the current will flow though output 4
- 14 - OUTPUT 4, this pin should be connected to one of the terminal of motor
- 13,12 - GND, ground pins
- 11 - OUTPUT 3, this pin should be connected to one of the terminal of motor
- 10 - INPUT 3, when this pin is HIGH the current will flow though output 3
- 9 - Enable 3-4, when this is HIGH the right part of the IC will work and when it is low the right part won't work.

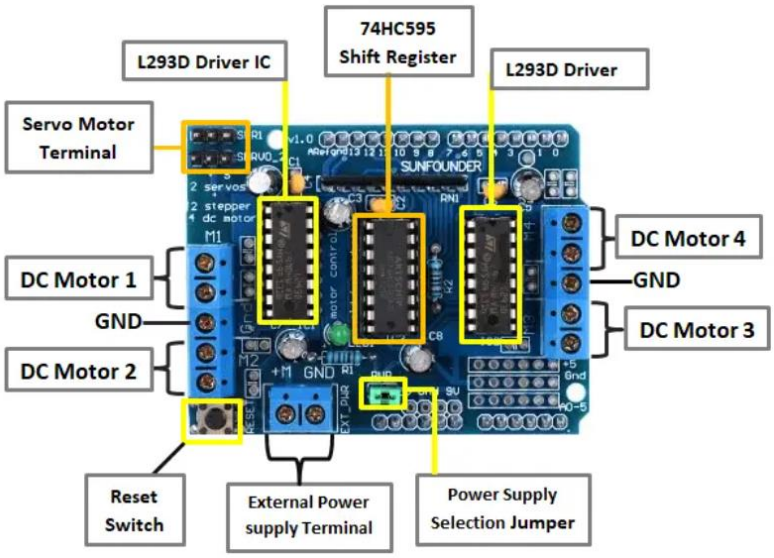

Fig:3.9 L293D Motor Driver pins function

This shield is based on the L293D IC and can drive 4 bi-directional DC motors , 2 stepper motors and 2 servo motors. It is mainly compatible with the Arduino UNO and MEGA boards.Take note that each channel of this module has the maximum current of 1.2A and doesn't work if the voltage is more than 25v or less than 4.5v. The L293D is a dual-channel H-Bridge motor driver capable of driving a pair of DC motors or single stepper motor. This shield offers total four H-Bridges and each H-bridge can deliver up to 0.6A to the motor.

The shield also comes with a 74HC595 shift register that extends 4 digital pins of the Arduino to the 8 direction control pins of two L293D chips.Power Supply considerations for the L293D motor driver.If you are using a single power supply for both Arduino and motors , simply plug it into the DC jack of the Arduino board or use the EXT_PWR block on the shield .Make sure the power jumper on the motor shield is in place. This method is best if the motor supply voltage is less than 12V.You can also use two separate power supplies for Arduino and motors for example you can power the Arduino through the USB and the motor powered off of a DC power supply or use two separate DC power supplies for the Arduino and motors. In this case make sure the jumper is removed from the motor shield.

Bo Motor

BO Motor is known as Battery Operated motor. These motors are commonly used in hobby-grade projects where the user requires a small DC motor as a simple actuator. The DC motor is considered the simplest motor with continuous angular rotation, which has various applications ranging from households to industries. Examples include an electric window in cars, machine tools, printers, electric vehicles etc.

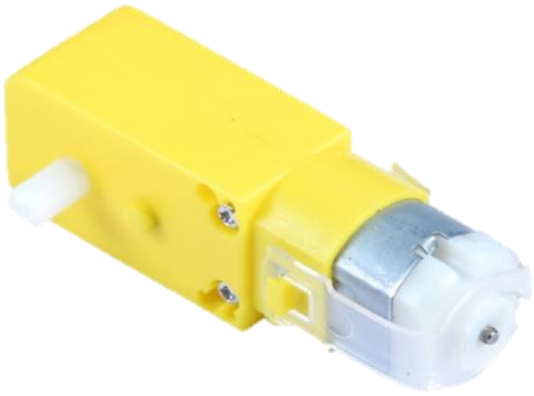

Fig:3.10 BO motor

The rotation of DC Motor can be controlled, which makes it ideal for Motor use in different categories. The operation of most of the DC motors depends on the magnetic field forces.BO series linear motor provides good torque and rpm at lower operating voltages. The BO motors are available in single Shaft, Dual Shaft, and DC Plastic Gear BO. These motors consume low current. In this project, we have used four single shaft BO motors.

This single shaft plastic geared motor gives good torque and rpm at lower operating voltages, which is the biggest advantage of these motors. Small shaft with matching wheels give optimized design for your application or robot. Mounting holes on the body & light weight makes it suitable for in-circuit placement. This motor is a perfect choice for light weight robots.

Specifications:

Voltage	2V to 12V
RPM	150 rpm
Gear	Plastic
Motor Type	Straight
Torque	4 kg-cm
Connector Type	2 pin Relimate Connector

Lithium-Ion Battery

A lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as a key component of its electrochemistry. During a discharge cycle, lithium atoms in the anode are ionized and separated from their electrons. The lithium ions move from the anode and pass through the electrolyte until they reach the cathode, where they recombine with their electrons and electrically neutralize. The lithium ions are small enough to be able to move through a micro-permeable separator between the anode and cathode.

In part because of lithium's small size (third only to hydrogen and helium), Li-ion batteries are capable of having a very high voltage and charge storage per unit mass and unit volume. Compared to the other high-quality rechargeable battery technologies (nickel-cadmium or nickel-metal-hydride), Li-ion batteries have a number of advantages. They have one of the highest energy densities of any battery technology today (100-265 Wh/kg or 250-670 Wh/L). In addition, Li-ion battery cells can deliver up to 3.6 Volts, 3 times higher than technologies such as Ni-Cd or Ni-MH. This means that they can deliver large amounts of current for high-power applications, which has Li-ion batteries are also comparatively low maintenance, and do not require scheduled cycling to maintain their battery life. Li-ion batteries have no memory effect, a detrimental process where repeated partial discharge/charge cycles can cause a battery to 'remember' a lower capacity.

Fig:3.11 Li-Ion battery

Generally, the negative electrode of a conventional lithium-ion cell is graphite made from carbon. The positive electrode is typically a metal oxide. The electrolyte is a lithium salt in an organic solvent. The anode (negative electrode) and cathode (positive electrode) are prevented from shorting by a separator.[10] The anode and cathode are separated from external electronics with a piece of metal called a current collector. The electrochemical roles of the electrodes reverse between anode and cathode, depending on the direction of current flow through the cell.

The most common commercially used anode is graphite, which in its fully lithiated state of LiC6 correlates to a maximal capacity of 1339 C/g (372 mAh/g). The cathode is generally one of three materials: a layered oxide (such as lithium cobalt oxide), a polyanion (such as lithium iron phosphate) or a spinel (such as lithium manganese oxide). More experimental materials include graphene-containing electrodes, although these remain far from commercially viable due to their high cost.

Lithium reacts vigorously with water to form lithium hydroxide (LiOH) and hydrogen gas. Thus, a non-aqueous electrolyte is typically used, and a sealed container rigidly excludes moisture from the battery pack. The non-aqueous electrolyte is typically a mixture of organic carbonates such as ethylene carbonate and propylene carbonate containing complexes of lithium ions.Ethylene carbonate is essential for making solid

electrolyte interphase on the carbon anode, but since it is solid at room temperature, a propylene carbonate solvent is added.

The electrolyte salt is almost always lithium hexafluorophosphate (LiPF6), which combines good ionic conductivity with chemical and electrochemical stability. Hexafluorophosphate is essential for passivating the aluminum current collector used for the cathode. A titanium tab is ultrasonically welded to the aluminum current collector. Other salts like lithium perchlorate (LiClO4), lithium tetrafluoroborate (LiBF4), and lithium bis(trifluoromethanesulfonyl)imide (LiC2F6NO4S2) are frequently used in research in tab-less coin cells, but are not usable in larger format cells, often because they are not compatible with the aluminum current collector. Copper (with a spot-welded nickel tab) is used as the anode current collector.

Current collector design and surface treatments may take various forms: foil, mesh, foam (dealloyed), etched (wholly or selectively), and coated (with various materials) to improve electrical characteristics.Depending on materials choices, the voltage, energy density, life, and safety of a lithium-ion cell can change dramatically. Current effort has been exploring the use of novel architectures using nanotechnology to improve performance. Areas of interest include nano-scale electrode materials and alternative electrode structures.The increasing demand for batteries has led vendors and academics to focus on improving the energy density, operating temperature, safety, durability, charging time, output power, elimination of cobalt requirements,[48][49] and cost of lithium-ion battery technology.

Servo Motor

A servo motor **is** a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a **servo** mechanism. If motor is powered by a DC power supply then it is called DC servo motor,

and if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only about the DC servo motor working**.**

Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, etc.

Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motors shaft, the greater the distance the lesser the weight carrying capacity. The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

It is a closed-loop system where it uses a positive feedback system to control motion and the final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.Here reference input signal is compared to the reference output signal and the third signal is produced by the feedback system. And this third signal acts as an input signal to the control the device. This signal is present as long as the feedback signal is generated or there is a difference between the reference input signal and reference output signal. So the main task of servomechanism is to maintain the output of a system at the desired value at presence of noises.

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly, and a controlling circuit. First of all, we use gear assembly to reduce RPM and to increase

torque of the motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now the difference between these two signals, one comes from the potentiometer and another comes from other sources, will be processed in a feedback mechanism and output will be provided in terms of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with the potentiometer and as the motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

All motors have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU.Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degree from either direction form its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°.

Servo motor works on PWM (Pulse width modulation) principle, means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears. High speed force of DC motor is converted into torque by Gears. We know that WORK= FORCE X DISTANCE, in DC motor Force is less and distance (speed) is high and in Servo, force is High and distance is less. The potentiometer is

connected to the output shaft of the Servo, to calculate the angle and stop the DC motor on the required angle.

Servo motor can be rotated from 0 to 180 degrees, but it can go up to 210 degrees, depending on the manufacturing. This degree of rotation can be controlled by applying the Electrical Pulse of proper width, to its Control pin. Servo checks the pulse in every 20 milliseconds. The pulse of 1 ms (1 millisecond) width can rotate the servo to 0 degrees, 1.5ms can rotate to 90 degrees (neutral position) and 2 ms pulse can rotate it to 180 degree. All servo motors work directly with your +5V supply rails but we have to be careful about the amount of current the motor would consume if you are planning to use more than two servo motors a proper servo shield should be designed.

Fig:3.12 Servo Motor

Switch

In electrical engineering, a switch is an electrical component that can "make" or "break" an electrical circuit, interrupting the current or diverting it from one conductor to another The mechanism of a switch removes or restores the conducting path in a circuit when it is operated. It may be operated manually, for example, a light switch or a keyboard button, may be operated by a moving object such as a door, or may be

operated by some sensing element for pressure, temperature or flow. A switch will have one or more sets of contacts, which may operate simultaneously, sequentially, or alternately. Switches in high-powered circuits must operate rapidly to prevent destructive arcing, and may include special features to assist in rapidly interrupting a heavy current. Multiple forms of actuators are used for operation by hand or to sense position, level, temperature or flow

Fig:3.13 Switch

Jumper Wires

Fig:3.14 Jumper wires

Most, if not all, electronics suppliers stock jumper wire in various lengths and assortments. These wires are commonly used with breadboards and other prototyping tools like Arduino.Jumper wires make changing circuits as simple as possible. A jumper wire may appear uncomplicated, and it doesn't get much more basic than other wires or cables. But there are tiny details you need to pay attention to.Generally, jumpers are tiny metal connectors used to close or open a circuit part. They have two or more connection points, which regulate an electrical circuit board.Their function is to configure the settings for computer peripherals, like the motherboard. Suppose your motherboard supported intrusion detection. A jumper can

be set to enable or disable it.Jumper Wires are electrical wires with connector pins at each end. They are used to connect two points in a circuit without solderingYou can use jumper wires to modify a circuit or diagnose problems in a circuit. Further, they are best used to bypass a part of the circuit that does not contain a resistor and is suspected to be bad.This includes a stretch of wire or a switch. Suppose all the fuses are good and the component is not receiving power; find the circuit switch. Then, bypass the switch with the jumper wire.

How much current (I) and voltage (V) can jumper wires handle? The I and V rating will depend on the copper or aluminium content present in the wire.For an Arduino application is no more than 2A and 250V. We also recommend using solid-core wire, ideally 22 American Wire Gauge (AWG).Although jumper wires come in a variety of colours, they do not actually mean anything. The wire colour is just an aid to help you keep track of what is connected to which.It will not affect the operation of the circuit. This means that a red jumper wire is technically the same as the black one.Even so, the colours can be used to your advantage to differentiate the types of connections. For instance, red as ground and black as power. Literally, what works for you!

Jumper wires come in three versions:

- Male-to-male jumper
- Male-to-female jumper
- Female-to-female jumper

And two types of head shapes: square head and round head.

The difference between each is in the endpoint of the wire. Male ends have a pin protruding and can plug into things, while female ends do not but are also used for plugging.Moreover, a male connector is referred to as a plug and has a solid pin for centre conduction. Meanwhile, a female connector is referred to as a jack and has a centre conductor with a hole in it to accept the male pin.Male-to-male jumper wires are the most common and what you will likely use most often. For instance, when connecting two ports on a breadboard, a male-to-male wire is what you will need.

Arduino IDE

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

The Arduino IDE will appear as:

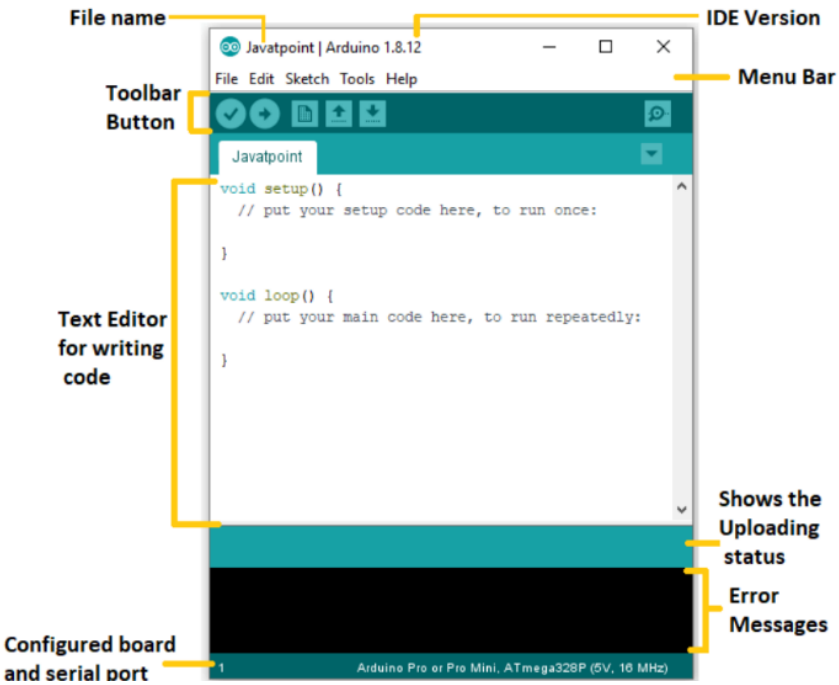

Fig:3.15 Arduino IDE

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Hardware Implementation

A microcontroller is the brain of the robot, which controls all its functions. It receives input signals from the sensors and generates output signals to the motor driver circuit. Some popular microcontrollers used for line follower robots are Arduino, Raspberry Pi, and PIC. A motor driver is an electronic circuit that controls the speed and direction of the motors. Line follower robots usually have two or more DC motors, and the motor driver circuit is responsible for controlling their movements. The most commonly used motor driver is the L293D, which is compatible with many microcontrollers. Line follower robots use various sensors to detect the line and obstacles. The most commonly used sensors are infrared (IR) sensors, which emit and receive IR radiation. The sensors are placed on the underside of the robot, and they detect the contrast between the line and the surface. To detect obstacles, ultrasonic sensors or IR distance sensors can be used.

A power source is required to power the microcontroller, motor driver, and sensors. The power source can be a battery or a power supply, depending on the requirements of the robot. The chassis is the physical structure of the robot, which holds all the components together. It can be made of plastic or metal, and its shape and size depend on the design requirements. The wheels are attached to the DC motors and enable the robot to move forward and backward. The size and type of wheels depend on the surface on which the robot will be operated. Other components such as LEDs, buzzers, and switches can also be included in the robot to enhance its functionality.

First, attach a motor driver shield to the arduino. Now connect the bo motors to the l293d motor driver shield.Motor 1 to motor driver M1,Motor 2 to motor driver M2,Motor 3 to motor driver M3,Motor 4 to motor driver M4,connect the IR sensor to motor driver.IR sensor OUT pin is connected to motor driver A0 pin.IR sensor GND pin is

connected to motor driver GND pin.IR sensor VCC pin is connected to motor driver 5v pin. Do the same for other IR sensor but make sure that OUT pin is connected to motor driver A1. Connect the servo motor to motor driver servo1 slot. Connect ultrasonic sensor to motor driver.Hc-sr04 TRIG pin to motor driver A2.Hc-sr04 ECHO pin to motor driver A3.Hc-sr04 5v pin to motor driver 5v.Hc-sr04 GND pin to motor driver GND.Now after Doing all the connections, it's time to upload the code.Connect the Arduino uno to pc via USB cable and open the Arduino IDE, select the Arduino board, and com port from the tool menu after that upload the given code.

4.2 Model of the Robot

If any object is placed on the path then a normal line follower will try to push the obstacle and hence it gets damaged. By using ultrasonic sensor, the line follower can detect an obstacle and can stop till the obstacle is removed. This type of robots can perform lot of tasks in industries, like material handling**.**Once the robot is convinced that a certain direction is clear of any obstacles, it will turn the robot in that particular direction and then move in a straight line along that direction till the next obstacle is found. If there is no way to go ahead the robot executes a full 180° turn.

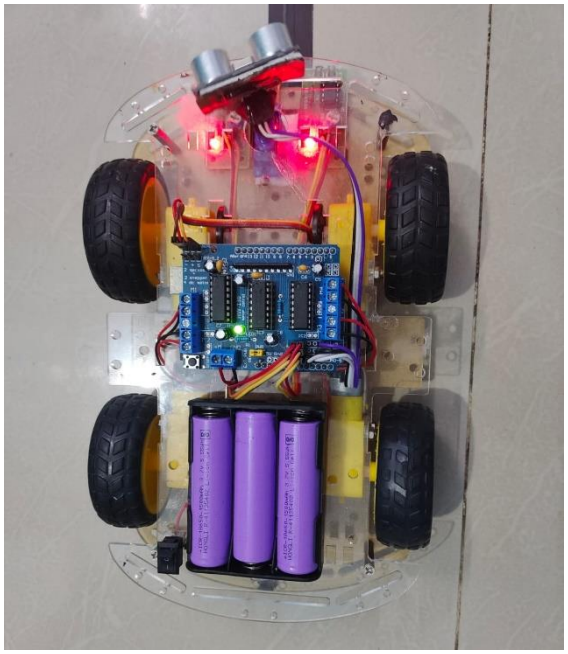

Fig:4.1Structure Of Line Follower Robot

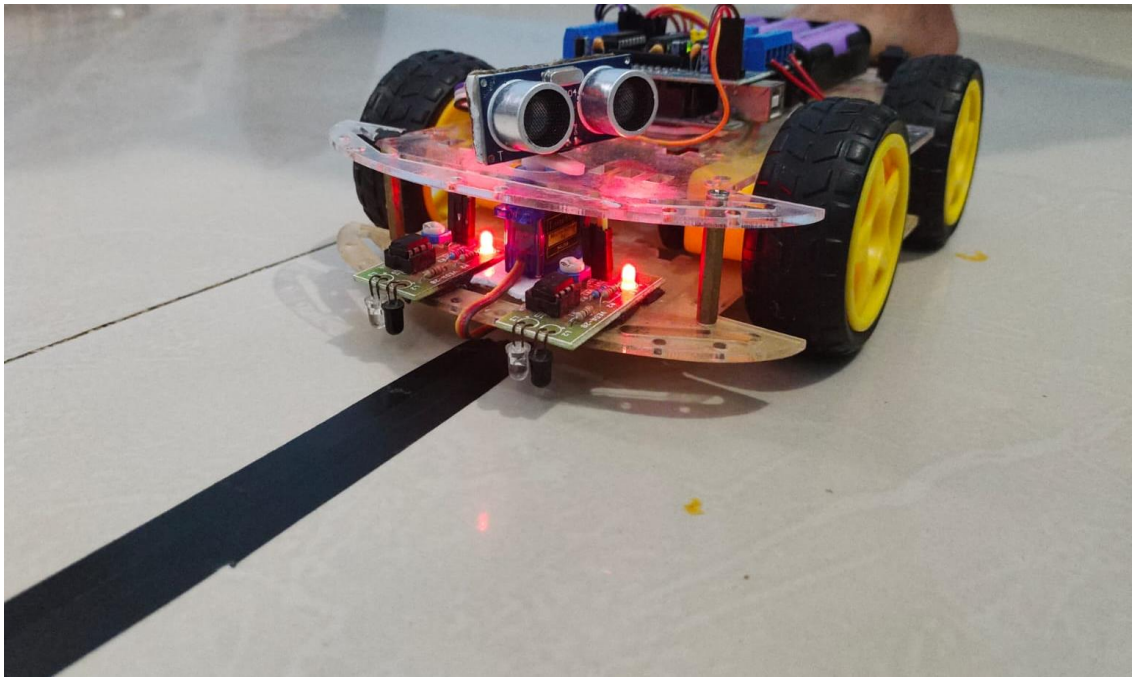

Fig:4.2 Working of Sensors

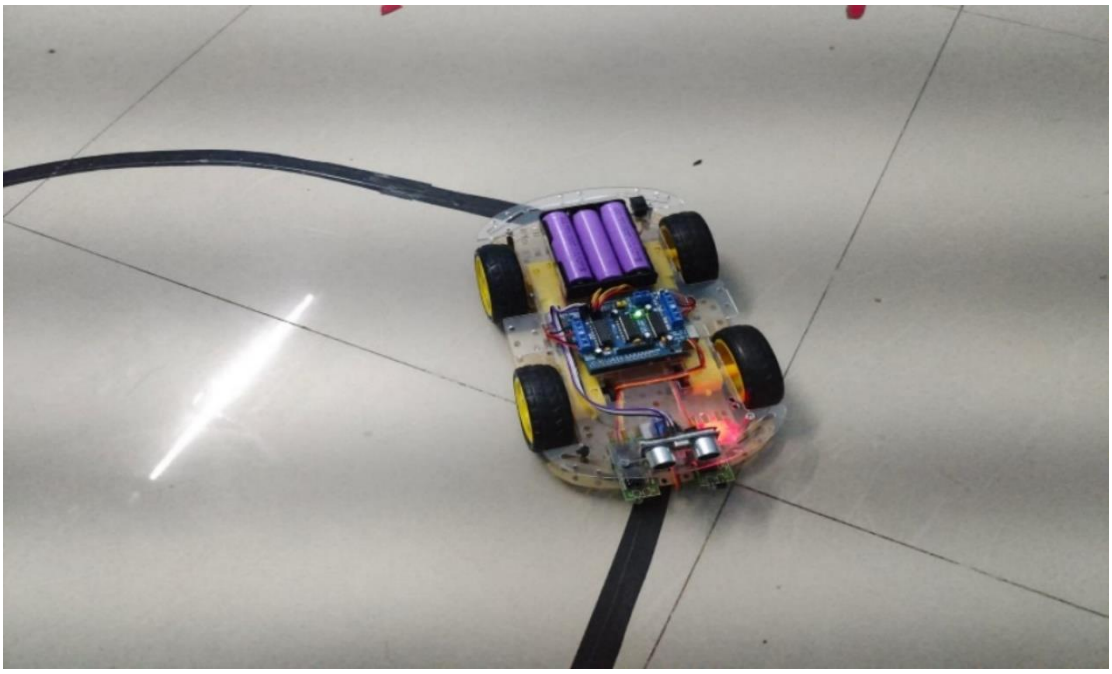

Fig:4.3 Robot Following The path

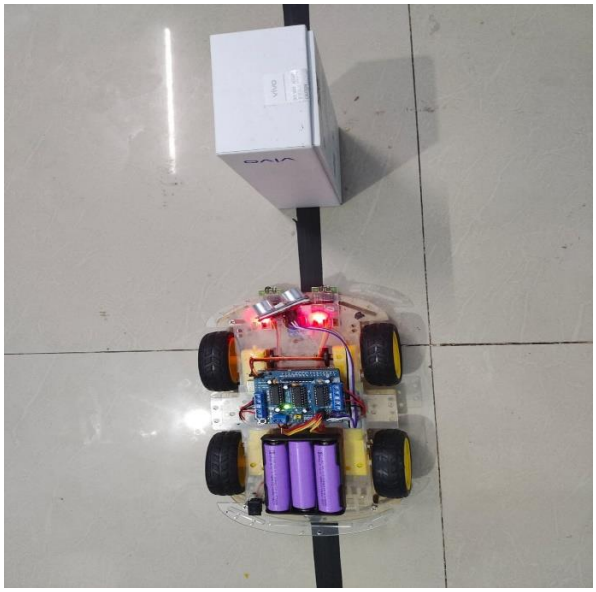

Fig:4.4 Robot Detecting the obstacle ***Fig:4.5 Robot Overcoming the Obstacle***

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. This robotic system can provide an alternative to the existing system by replacing skilled labor, which in turn can perform better tasks with accuracy and lower per capita cost. Line follower robots with obstacle detection have a wide range of potential future works. Here are some possible directions for future research and development Improved obstacle detection: Currently, most line follower robots use simple sensors to detect obstacles, such as infrared sensors or ultrasonic sensors. Future work could explore more advanced sensing technologies, such as LIDAR or computer vision, to improve obstacle detection accuracy and reliability.Autonomous navigation: Most line follower robots require a pre-determined path to follow.

CHAPTER 5

CONCLUSION AND FUTURE WORKS

Robots play a vital role in the global economy and in everyday life. Also of concern for robotic research is the competitiveness and design of patents in the world's industries according to their type of applications. The need for robotic technology is growing in a wide variety of human applications and applications, especially in the manufacturing, medical, service, defence and consumer industries. This linear robot is an example of an industrial robot. By studying this one can create a linear robot for use in industry. Performance can be improved by using good materials and hearing aids. improves motor movement. The cost of setting up a linear robot depends largely on the costly machinery, land, construction and watchmaking equipment to maintain and operate such equipment.

Another way to improve the current system is to replace trained workers with robotic robots. This robot will be able to manage a large number of assets in a manufacturing system in a shorter amount of time, with higher precision and cheaper cost per unit.The applications of the line follower are limited because it cannot be controlled. The only way to control the line follower is to change the path. Using WIFI module to control the line follower robot will not be helpful because more power will be consumed, so the battery will drain out quickly. Apart from these limitations smart and intelligent line follower robot can be used for long distance applications with a predefined path. This smart and intelligent robot has more benefits because it doesn’t consume much power.

This robotic system can provide an alternative to the existing system by replacing skilled labor, which in turn can perform better tasks with accuracy and lower per capita cost. Line follower robots with obstacle detection have a wide range of potential future works. Here are some possible directions for future research and development Improved obstacle detection: Currently, most line follower robots use simple sensors to detect obstacles, such as infrared sensors or ultrasonic sensors. Future work could explore more advanced sensing technologies, such as LIDAR or computer vision, to

improve obstacle detection accuracy and reliability.Autonomous navigation: Most line follower robots require a pre-determined path to follow.

Future work could focus on developing algorithms that enable robots to autonomously navigate to a given destination without a pre-determined path. This could involve using machine learning algorithms to teach the robot to recognize and avoid obstacles.Multi-agent coordination: Line follower robots could be deployed in groups to perform complex tasks. Future work could explore ways to coordinate the actions of multiple robots to achieve a common goal, such as collectively transporting an object from one location to another.Integration with other technologies: Line follower robots with obstacle detection could be integrated with other technologies to enable them to perform more complex tasks. For example, they could be integrated with drones to perform aerial surveys or with 3D printers to create complex structures.Real-world applications: There are many potential real-world applications for line follower robots with obstacle detection, such as search and rescue operations or inspection of hazardous environments. Future work could focus on developing robots that are optimized for specific applications, such as robots that are designed to navigate through tight spaces or robots that are designed to operate in extreme temperatures.

The line follower developed is also sensing any type of obstacle in its way and can also control speed with the help of speed regulator. Further improvement can be done in the robot by using more number of IR sensors or an array or IR sensors.This robot is able to produce the basic walking movements using two gear motors. They developed the robot with a very good intelligence which is easily capable to sense the obstacle and by processing the signal coming from the sensor it is perfectly avoiding the obstacle coming in the path.

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APPENDIX

A.SOURCE CODE:

```
#include <NewPing.h>

#include <Servo.h>

#include <AFMotor.h>

#define L_S A0 //ir sensor Left

#define R_S A1 //ir sensor Right

#define echo A3    //Echo pin

#define trigger A2 //Trigger

#define servo 10

AF_DCMotor motor1(1, MOTOR12_1KHZ);

AF_DCMotor motor2(2, MOTOR12_1KHZ);

AF_DCMotor motor3(3, MOTOR34_1KHZ);

AF_DCMotor motor4(4, MOTOR34_1KHZ);

int Set=18;

int distance_L=0, distance_F=0, distance_R=0;

void setup(){ // put your setup code here, to run once

Serial.begin(9600); // start serial communication at 9600bps

pinMode(R_S, INPUT); // declare if sensor as input

pinMode(L_S, INPUT); // declare ir sensor as input

pinMode(echo, INPUT );// declare ultrasonic sensor Echo pin as input

pinMode(trigger, OUTPUT); // declare ultrasonic sensor Trigger pin as Output
```

```
  motor1.setSpeed(100); motor2.setSpeed(100);motor3.setSpeed(100);
  motor4.setSpeed(100);
  pinMode(servo, OUTPUT);
 for (int angle = 70; angle <= 140; angle += 5)  {
   servoPulse(servo, angle);  }
 for (int angle = 140; angle >= 0; angle -= 5)  {
   servoPulse(servo, angle);  }
 for (int angle = 0; angle <= 70; angle += 5)  {
   servoPulse(servo, angle);  }
distance_F = Ultrasonic_read();
delay(500);}
void forword(){  //forword
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);}
void backword(){ //backword
  motor1.run(BACKWARD);
  motor2.run(BACKWARD);
  motor3.run(BACKWARD);
  motor4.run(BACKWARD);
}
void turnRight(){ //turnRight
```

```
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(BACKWARD);
  motor4.run(BACKWARD);
}
void turnLeft(){ //turnLeft
  motor1.run(BACKWARD);
  motor2.run(BACKWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);}
void Stop(){ //stop
  motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);}
void Check_side(){
    Stop();
    delay(100);
 for (int angle = 70; angle <= 140; angle += 5)  {
   servoPulse(servo, angle);  }
    delay(300);
    distance_R = Ultrasonic_read();
    Serial.print("D R=");Serial.println(distance_R);
```

```
    delay(100);
  for (int angle = 140; angle >= 0; angle -= 5)  {
   servoPulse(servo, angle);  }
    delay(500);
    distance_L = Ultrasonic_read();
    Serial.print("D L=");Serial.println(distance_L);
    delay(100);
 for (int angle = 0; angle <= 70; angle += 5)  {
   servoPulse(servo, angle);  }
    delay(300);
    compareDistance();
}
void loop(){
distance_F = Ultrasonic_read();
Serial.print("D F=");Serial.println(distance_F);
//if Right Sensor and Left Sensor are at White color then it will call forword function
 if((digitalRead(R_S) == 1)&&(digitalRead(L_S) == 1)){
  if(distance_F > Set){forword();}
                else{Check_side();}
 }
//if Right Sensor is Black and Left Sensor is White then it will call turn Right function
else if((digitalRead(R_S)==0)&&(digitalRead(L_S)== 1)){turnRight();}
//if Right Sensor is White and Left Sensor is Black then it will call turn Left function
```

```
else if((digitalRead(R_S) == 1)&&(digitalRead(L_S) == 0)){turnLeft();}
else if((digitalRead(R_S) == 0)&&(digitalRead(L_S) == 0)){Stop();}
}
void servoPulse (int pin, int angle){
int pwm = (angle*11) + 500;      // Convert angle to microseconds
 digitalWrite(pin, HIGH);
 delayMicroseconds(pwm);
 digitalWrite(pin, LOW);
 delay(50); // Refresh cycle of servo}
long Ultrasonic_read(){
  digitalWrite(trigger, LOW);
  delayMicroseconds(2);
  digitalWrite(trigger, HIGH);
  delayMicroseconds(10);
  long time = pulseIn (echo, HIGH);
  return time / 29 / 2;}
void compareDistance(){
  if(distance_R <= Set && distance_L <= Set && distance_F <= Set)
  {
    Stop();
    loop();
  }
    if(distance_R > distance_L){
```

```
turnLeft();
delay(500);
forword();
delay(600);
turnRight();
delay(500);
forword();
delay(600);
turnRight();
delay(500);
}
else if(distance_R < distance_L) {
 turnRight();
delay(500);
forword();
delay(600);
turnLeft();
delay(500);
forword();
delay(600);
turnLeft();
delay(500);
```

B. SCREENSHOTS:

_FINALcode2.ino

```
#include <NewPing.h>
#include <Servo.h>
#include <AFMotor.h>


#define L_S A0 //ir sensor Left
#define R_S A1 //ir sensor Right

#define echo A3    //Echo pin
#define trigger A2 //Trigger

#define servo 10

AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ);

int Set=18;
int distance_L=0, distance_F=0, distance_R=0;

void setup(){ // put your setup code here, to run once

Serial.begin(9600); // start serial communication at 9600bps

pinMode(R_S, INPUT); // declare if sensor as input
pinMode(L_S, INPUT); // declare ir sensor as input

pinMode(echo, INPUT );// declare ultrasonic sensor Echo pin as input
pinMode(trigger, OUTPUT); // declare ultrasonic sensor Trigger pin as Output
```

_FINALcode2.ino

```
 motor1.setSpeed(100);
 motor2.setSpeed(100);
 motor3.setSpeed(100);
 motor4.setSpeed(100);

 pinMode(servo, OUTPUT);

for (int angle = 70; angle <= 140; angle += 5)  {
  servoPulse(servo, angle);  }
for (int angle = 140; angle >= 0; angle -= 5)  {
  servoPulse(servo, angle);  }

for (int angle = 0; angle <= 70; angle += 5)  {
  servoPulse(servo, angle);  }



distance_F = Ultrasonic_read();

delay(500);
}

void forword(){  //forword
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
}

void backword(){ //backword
  motor1.run(BACKWARD);
```

_FINALcode2.ino

```
61  void backword(){ //backword
62    motor1.run(BACKWARD);
63    motor2.run(BACKWARD);
64    motor3.run(BACKWARD);
65    motor4.run(BACKWARD);
66  }
67
68  void turnRight(){ //turnRight
69    motor1.run(FORWARD);
70    motor2.run(FORWARD);
71    motor3.run(BACKWARD);
72    motor4.run(BACKWARD);
73  }
74
75  void turnLeft(){ //turnLeft
76    motor1.run(BACKWARD);
77    motor2.run(BACKWARD);
78    motor3.run(FORWARD);
79    motor4.run(FORWARD);
80  }
81
82  void Stop(){ //stop
83    motor1.run(RELEASE);
84    motor2.run(RELEASE);
85    motor3.run(RELEASE);
86    motor4.run(RELEASE);
87  }
88
89  void Check_side(){
90      Stop();
91      delay(100);
```

_FINALcode2.ino

```
88
89  void Check_side(){
90      Stop();
91      delay(100);
92   for (int angle = 70; angle <= 140; angle += 5)  {
93     servoPulse(servo, angle);  }
94      delay(300);
95      distance_R = Ultrasonic_read();
96      Serial.print("D R=");Serial.println(distance_R);
97      delay(100);
98    for (int angle = 140; angle >= 0; angle -= 5)  {
99     servoPulse(servo, angle);  }
100     delay(500);
101     distance_L = Ultrasonic_read();
102     Serial.print("D L=");Serial.println(distance_L);
103     delay(100);
104  for (int angle = 0; angle <= 70; angle += 5)  {
105    servoPulse(servo, angle);  }
106     delay(300);
107     compareDistance();
108 }
109
110 void loop(){
111 //============================================
112 //     Line Follower and Obstacle Avoiding
113 //============================================
114
115 distance_F = Ultrasonic_read();
116 Serial.print("D F=");Serial.println(distance_F);
117
118
```

_FINALcode2.ino

```
119   //if Right Sensor and Left Sensor are at White color then it will call forword function
120    if((digitalRead(R_S) == 1)&&(digitalRead(L_S) == 1)){
121     if(distance_F > Set){forword();}
122                         else{Check_side();}
123    }
124
125   //if Right Sensor is Black and Left Sensor is White then it will call turn Right function
126   else if((digitalRead(R_S) == 0)&&(digitalRead(L_S) == 1)){turnRight();}
127
128   //if Right Sensor is White and Left Sensor is Black then it will call turn Left function
129   else if((digitalRead(R_S) == 1)&&(digitalRead(L_S) == 0)){turnLeft();}
130
131   else if((digitalRead(R_S) == 0)&&(digitalRead(L_S) == 0)){Stop();}
132
133   }
134
135   void servoPulse (int pin, int angle){
136   int pwm = (angle*11) + 500;      // Convert angle to microseconds
137    digitalWrite(pin, HIGH);
138    delayMicroseconds(pwm);
139    digitalWrite(pin, LOW);
140    delay(50); // Refresh cycle of servo
141   }
142
143
144   //*********************Ultrasonic_read**************************
145   long Ultrasonic_read(){
146     digitalWrite(trigger, LOW);
147     delayMicroseconds(2);
148     digitalWrite(trigger, HIGH);
149     delayMicroseconds(10);
```

_FINALcode2.ino

```
153
154   void compareDistance(){
155     if(distance_R <= Set && distance_L <= Set && distance_F <= Set)
156     {
157       Stop();
158       loop();
159     }
160       if(distance_R > distance_L){
161     turnLeft();
162     delay(500);
163     forword();
164     delay(600);
165     turnRight();
166     delay(500);
167     forword();
168     delay(600);
169     turnRight();
170     delay(500);
171     }
172     else if(distance_R < distance_L)
173     {
174      turnRight();
175     delay(500);
176     forword();
177     delay(600);
178     turnLeft();
179     delay(500);
180     forword();
181     delay(600);
182     turnLeft();
183     delay(500);
```

C.RESEARCH PAPER

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Line Follower Robot With Obstacle Avoidance

1 message

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Line Follower Robot With Obstacle Avoidance

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ABSTRACT

Line follower is a clever independent robotic that detects or follows a seen line embedded within the ground. The trail is predetermined and may be decided on with a high comparison colour or with a black line seen on the path floor. Infrared sensors are used to stumble on these strains. commonly speaking, the location unit of the infrared sensors is used to find the direction that the robotic has to observe. The robotic movement is automatic and suitable for long-distance shipments. it's far the fundamental line follower robotic's characteristic. The tool proposed for business, clinical, rescue and military operations are extremely useful. particularly, those past constraints are not necessary with current technological advances in computing. The manufacturing of tracking systems can now be made more capable of reliably estimating the target vicinity in the back of the obstacle. The gain of those technology consists inside the opportunity of the use of an ultrasonic approach for measurement with out direct contact with a target. exceptional models and systems for indoor and outside item detection have been defined within the literature. using optical, heat base, infrared and ultrasonic strategies, object localization techniques were introduced. Indoor positioning structures monitor and discover objects and enclose environments inside homes. wireless methods, optical tracking, and ultrasonic strategies are used for item role detection structures. The goal of this study is to broaden a tracking gadget that follows certain paths and can locate objects and edges using ultrasonic frequencies. If a few object is put, Typically, a line follower will attempt to pass and break the impediment. This prototype of line follower robotic attempts to push the limit little to conquer this trouble. it's been built in a way that any obstacle in front of it may be recognized. it'll forestall and could now not pass until the barrier stays. also, it is able to pick out each front aspect and comply in addition. In industries, including cloth dealing with, this form of robot performs many obligations. those robots also are used as gadget-controlled carrier contraptions in vintage conveyor belts switching industries.

INTRODUCTION

The line Following robotic is an self sustaining robotic that detects a path and according to the course drawn, it follows the path with the assist of an IR sensor connected to the robotic. self sufficient robot are robots that could carry out with a excessive diploma of autonomy, that is in particular applicable in fields consisting of area exploring, floor cleaning, and mowing garden, and treatment of waste water. some contemporary industrial robots are "self reliant" in the tight restrictions in their immediate surroundings. It can no longer to be that each diploma of freedom is present of their immediate surroundings, but the manufacturing unit robotic's place of job is hard and can frequently incorporate changeable chaos and unpredictability. The precise direction and function of the following item work, including even the form the item and the necessary project tought to be decided. This is subject to sudden changes. One crucial place and robotics studies is to permit robotic to address its

surroundings whether or not whether on land or in the ocean, inside the atmosphere, below, or in area.

The path can be either a Blackline drawn over an area or line that is white drawn over a black floor hence fending off any detection errors. Line follower robot additionally is composed of an obstacle sensor that detects any obstacle in the front of the robot as a consequence avoiding any unnecessary accidents. Line follower robot is designed and programmed in one of these way that it does its activity perfectly without any errors and detects it's given route. It operates in the sort of way that it detects and reads the course and transmits the sign to Arduino UNO. The microcontroller decides to make any modifications (if wanted) in the guidelines or speeds of the robot in line with the inputs received. for this reason, it sends the manipulate sign to the rate and directions of the road follower robot. This manner the road follower robotic operates without any error. To make a line follower robot with object detection potential it is connected with an ultrasonic sensor, which is a device which could measures the distance between an item and robot by means of the usage of sound waves. It calculates the distance among the line following robotic and the item obstructing it by means of sending a valid wave of a particular frequency and detecting the bounced sound wave at receiver it is critical to keep in mind that a few objects might not be stumble on via ultrasonic sensor. This might be applied for navy purposes, transport Dienstleistungen und Transport structures, blind assisting packages.

Standard line following robotic is gradual reaction to the mistake occur and without difficulty abandon it song the drawing at the ground. This hassle will result in movement to be rough of the robot. even though the road following robotic can adhere to the dark strains, its movement nevertheless desires to be advanced. The layout and improvement of an self sustaining line monitoring robot is a completely complicated challenge. there are numerous components that need to be considered which include mechanical machine, electric Programming for circuits and microprocessors. These kind of features must be completely incorporated among one another. Hence, the independent robotic may be flawlessly practical to reap the obligations supplied.to be able to make certain this self reliant robotic device totally include, the demanding situations are to determine and pick the first-rate device need to be applied on this independent robotic machine. Moreover, There are several kinds of sensor, microcontroller, and pushed motor within a marketplace. Each one of them distinction specs, both capacity and capabilities. The largest impediment is to software based on a microcontroller at the records amassed from the line sensors on the robot. essentially all sensors gives the facts based controller totally at the sign they obtained, and the controller will make a decision based on the code loaded. In the instance of a line sensor, its information-based totally at the charge of light reflection which have been found with the aid of detector. In distinctive surroundings or area's brightness, the price of mild discovered by way of complete detection specific. So, the robust programming dialects information are necessary for synchronising surroundings modifications after execution application inside the microprocessor.

The undertaking is intended to grow a robot automobile that comes after particular pathA pair of photograph devices with an IR transmitter and photograph The controller is connected to the diode to hit upon the desired route for its motion.Line follower robotic is a beneficial robotic being utilized the ware homes, businesses, stores, etc, in which It adheres to a focused direction. This suggested robot that follows lines satisfies the desired functionality and shows how it operates. It makes use of a couple of picture sensors with a single infrared transmitter and a image diode in each. It publications the machine to comply with a distinctive direction through sending the microcontroller the proper signal. The microcontroller is interfaced with DC motors thru a motor driving force IC. enter alerts provided by the sensors to the microcontroller after which the supervisor removes the correct motion consistent with this system driven and written in it cars as favored.similarly the venture can be more desirable by means of adding greater superior sensors to it. this may upload greater functions to the present project. as an instance, we are able to make use of ultrasonic sensors discover any impediment in the in front of robotic and to take the necessary steps.

LITERATURE SURVEY

Design of self sufficient line follower robotic with impediment avoidance by **Kumar Rishabh** (2021). This paper indicates layout and implementation of the road Follower robotic and its ability to choose the favored line among black and white line. this may be combined with extraordinary colorings. considering that each color has its own wonderful belongings, robot can therefore without problems

differentiate among exceptional shades and own the capability to hit upon the presence of an impediment and choose the alternative direction to discover its target. it's miles programmed in this type of manner that commands are given to the robotic which senses a line and tries to move toward the target. The robot can without difficulty move alongside very congested curves as it continuously information from the sensors. This robotic avoids collision and it can locate collision with an impediment sensor and hence achieving the target. The proposed device can be carried out in any industrial, business, clinical and also in educational labs.

The development and use of line followers and impediment detection robotic through **Ayob Amrani**(2020). This study examines advise a technique for line-following robots primarily based at the quick calculation of this line's radius of curvature, the usage of sensors with infrared lines. The variety and its sensor arrangement, in addition to the strategy selected is crucial position in the robotic's in response to road, using the favored precision and velocity. similarly, the machine should possess an anti-collision system machine, the use of a distance sensor using ultrasound, to discover and keep away from barriers under various circumstances, mainly at line intersections, while different machines percentage a not unusual complicated line.

Punetha, Deepak, Neeraj Kumar, and Vartika Mehta (2018). The methodologies for assessing, planning, administering, and enhancing the health care control machine are mentioned on this paper report. the line that follows the drug-carrying robotic is designed to offer the patient remedy as wanted. A linear robotic is an electronic device which can recognize and observe a line painted at the ground. A line is generally described by means of a pre-determined direction that appears as a black line in a white place of a different hue. A robotic is connected to a mild-primarily based resistor sensor, whose resistance varies depending on the amount of light. LDR has a resistance to its lowest value, which is near to zero, and a resistance to its greatest value when it receives a significant amount of light. Scalability needs to be the main focus of the design. An IR sensor switch is connected to a robot that is placed close to the patient.

Line Following robotic with object Avoidance using Arduino by Savita Mamadapur, Deekshit Reddy L R, Abhishek okay V, Jagadeesh G P, Karthik H.(2022). one of the maximum full-size functions of robots is tracing. robot with a Linear movement A self-contained robotic that can be observed, or a black line painted on the pinnacle that blends two hues. it's far configured to transport in a directly line and automatically. The robotic makes use of observable alerts to apprehend the line, which allows it live afloat. because of the four-sensory gadget, its moves are precise and sundry. DC tools cars are used to control the movement of the robotic's wheels. To expand and take a look at algorithms for controlling motor speeds and transferring the robot alongside the line, the Arduino Uno interface is employed. The motive of this undertaking is to apply an set of rules to alter the manipulate parameters to manipulate the robotic's motion. it's a self-contained robot that factors and strains a black and white line on the top floor or a white line inside the dark. the following robotic must be capable of view the given line again, hold music of it, and do the responsibilities that have been assigned to it. The supplied course line must be observed by means of the layout in addition to a robot built in positive situations when using the do feature. it is made from input, procedure, and output additives in a better gadget. After reading the book and drawing a black / white or white / black route in an imagined global, send the input signal to an Arduino UNO microcontroller through a system that may be puzzled and choices taken. The microcontroller has determined the robot's instructions and speed based on feasible input detection modifications (if needed). adjustments the final results to any line follower velocity direction that is feasible. Following the robot's velocity and naked instructions, the programme gives you the initial or pre-configured manipulate signals for the line.

Image-based impediment Detection strategies as the secure Unmanned vehicle navigation automobiles via Samira Badrloo(2021). Mobile robots don't have a motive force either a pilot or, as a result, ought to be capable of locate boundaries autonomously. This paper critiques diverse image-primarily based impediment detection techniques hired via unmanned cars consisting of Unmanned surface motors (USVs), Unmanned Aerial motors (UAVs), and Micro Aerial automobiles (MAVs). greater than a hundred and ten documents from 23 high-effect computer technological know-how the journals that were posted in the recent two decades, were examined. The procedures had been stereo and monocular divisions. The previous makes use of a unmarried digicam, whilst the latter uses snap shots taken by synchronised cameras. The categories of based on appearance, movement, depth, and growth-monocular obstacle detection based methods are covered in detail. single-sighted obstacle detection methods have a basic, rapid, and easy computations. As a result, their is better suitable for small and limited-processing-power such as MAVs and small UAVs. Contrarily, stereo-based totally approaches create a genuine 3-D map produced from the surroundings using a pair (or pairs) of synchronised

cameras in order to identify the boundaries. Stereo-based procedures have been classified as disparity histogram-based and Inverse Attitude Mapping (IPM)-based processes. disparity histogram, terrestrial or aerial -primarily based strategies be afflicted by not unusual issues include computational complexity, sensitivity to changes in illumination, and the need for accurate camera calibration, particularly when done on small robots. Moreover, until recently, both stereo and monocular techniques trusted traditional image processing strategies and, for that reason, did no longer satisfy the standards of actual-time packages. consequently, deep gaining knowledge of the focus of has been on networks consciousness in current years to mature speedy and dependable impediment detection answers. but, we found that no matter substantial development, deep mastering strategies additionally face problems settings that are difficult to understand where items of various Variety and shapes gift. The analysis shows that recognising slim and little, shifting obs tacles and speedy Obstacle detection is the most important difficult trouble to consciousness going forward research.

A direction Follower robot using Battery S.Mandole(2022). route One of the is given below maximum crucial elements about robotics. A course Following a robot is self reliant robotic which is capable observe both a dark line is painted on the floor including an opposing shade. It is automatically constructed should proceed and adhere to the path. The robotic utilises optical sensor arrays to perceive the road, enabling the robot to remain at the tune. The four sensor array allows for accurate and adaptable movement. The fundamental principle of path Following robotic is it follows the direction via detecting the line. The robotic course of motion relies upon on the 2 sensors outputs. whenever robot moves far from its course it's miles detected by the IR sensor. The project aims to create a line follower robot capable of follow a route and reach its vacation spot. Detecting directing the robot to stay on course with the aid of a line continuously fixing a mistake movements with feedback from sensors is a straightforward yet efficient approach.

Robbi Rahim, Kunal Kunal, Hendro Agus Widodo, and Abdul Latif. This examine uses an experimental technique, through carrying out a studies system based totally sequences, specifically: wishes evaluation, design of mechanical charts, electronic component layout and manage software development, production, and testing. The ATmega32A microcontroller-based line-following robot has been examined and the findings indicate that the road Robot follower that can walk along a black line at white flooring and may show the circumstance at the liquid crystal display nonetheless, that line following robotic nonetheless has drawbacks inside dependent on a, the line sensor sensitivity procedure positive speed. In a range of ninety-one hundred fifty rpm the road follower robot can comply with the direction, whilst greater than 150 rpm the robot isn't always capable of comply with the direction.

Robots that follow lines in manufacturing unit floors:importance and Simulacrum take a look at the use of CoppeliaSim(2021) by Saharsh Oswal and SaravanaKumar. The design, construction, and dynamic simulation of a line-following robot are presented in this article incorporated includes proximity sensors to prevent collisions and vision sensors to detect lines monitoring. The version was created with the aid of Autodesk Inventor 2018, and CoppeliaSim was used for simulation and assembly. Using this model examine intents to offer importance a result of the use of such robots on a manufacturing unit ground, that could cowl a walkway that is 10 metres long about eight seconds. The simulation for this robotic is finished the usage of CoppeliaSim. The programme permits we will examine the dynamic homes and assign the robot one-of-a-kind actuation codes to every factor

EXISTING SYSTEM:

Internal transportation is a method for moving raw materials, manufactured goods, and completed items inside a manufacturing facility. The internal movement of can, nevertheless, account a significant chunk of an organization's energy usage, For example, in companies where a sizable Some production is automated.

- Robots that follow lines with computers in public transportation
- utilising a remote web server to operate a line follower robot
- Implementation of autonomous line follower robot

PROPOSED SYSTEM

The line follower robot has several different industrial uses. It can be used to move heavy and dangerous cargo. moving radioactive substances within a facility is extremely dangerous to human life. At that section, a line follower robot can be helpful.

ADVANTAGES:

- Robot movement is automatic
- Ease of construction
- Fit-and-forget approach
- Increases productivity & safety etc.

CIRCUIT DIAGRAM:

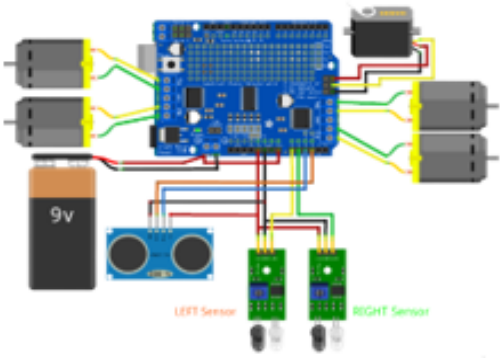

Fig:- 1

RESULTS AND DISCUSSIONS

The objective of this work is to extend a tracking device that travels along predetermined lines and uses ultrasonic frequencies to find objects and edges. If a few objects are placed, a line follower will typically try to pass and get around the obstruction. The line follower robotic prototype makes a valiant effort to overcome this challenge. Its design makes it possible to identify any obstacles in its path. It will stop and won't be able to pass until the barrier is maintained. Moreover, it has the ability to recognise each front aspect and follow suit. This type of robot handles several tasks in various industries, including the handling of textiles. Also, those robots are utilised as gadget-controlled carrier devices in retro conveyor belts.

It commands the machine to follow a specific route by providing the appropriate signal to the microcontroller. A motor driving force IC connects the microcontroller to DC motors. the supervisor removes the appropriate motion commensurate with this system-driven and written in it automobiles as preferred, following which the sensors' alerts are entered into the microcontroller. The project can also become more appealing by including more advanced sensors. This could add more features to the current project. For instance, we can employ ultrasonic sensors to find any obstructions in front of the robot and take the necessary action.

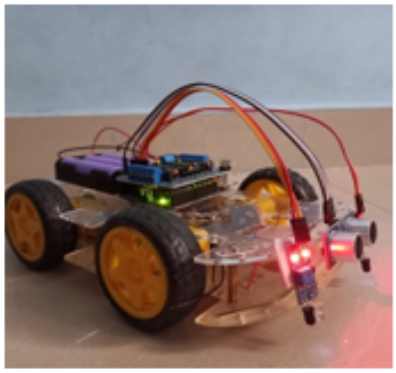

Fig:- 2

CONCLUSION

A sophisticated independent robotic device called a "line follower" finds or follows a line that can be seen buried in the earth. The path is predetermined and can be selected using a high contrast colour or a black line that can be seen on the path's surface. These strains are discovered using infrared sensors. Typically, the direction that the robotic has to watch is determined using the location unit of the infrared sensors. Automatic and suited for long-distance shipments, the robotic movement. It's by far the most important trait of a line-following robot. The suggested tool is very helpful for commercial, medical, rescue, and military missions. Particularly, the technological advancements in computing now mean that those earlier restrictions are no longer required.

It is now possible to increase the accuracy with which tracking system manufacturers can estimate the target area behind a barrier. The benefit of this technology is the ability to measure objects using an ultrasonic method without coming into contact with them directly. The literature has identified extraordinary models and methods for both indoor and outdoor item detection. Object localization systems utilising optical, heat-based, infrared, and ultrasonic technologies were introduced. Inside homes, settings are contained and monitored by indoor positioning structures. For item role detection structures, wireless techniques, optical tracking, and ultrasonic techniques are employed.

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