A Project Report
On

Automated Transport System Using Autonomous BOT.

Submitted for partial fulfilment of the requirements for the subject Project Based Learning (TE, 6th Semester) of

BACHELOR OF ENGINEERING

BY

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CERTIFICATE

This is to certify that the project work entitled **"Line Followe With Obstacles Avoiding Using Arduino"** is a bonafide work carried out by Dhruv Kumbhar (TE A&R 34), Vedant Kumbharkar (TE A&R 35), Saniya Mundhe (TE A&R 43) in partial fulfilment of the requirements for the subject Project Based Learning (SE, 4th Semester) of degree of Bachelor of Engineering in Second Year Engineering from **DR. D. Y. Patil Institute of Technology, Pimpri during the academic year 2022-2023.**

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Date:

Place: DR .D.Y. Patil institute of technology Pimpri ,Pune

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ABSTRACT

This project focuses on developing a Automated Transport System Using Autonomous Bot. The robot employs an array of sensors including an Ultrasonic sensor for obstacle detection and an IR sensor for line tracking. A 12V battery powers the system, managed by a battery holder for convenience. The robot's movement is controlled by a DC motor connected through the L298 motor driver, ensuring precise and efficient navigation. The integration of these components enables the robot to follow a specified path while autonomously avoiding obstacles encountered along the way. This project showcases the application of Arduino-based robotics in real-world scenarios, combining sensor data processing, motor control, and autonomous navigation techniques.

CHAPTER ONE
INTRODUCTION

1. Introduction:

In the realm of robotics and automation, the development of intelligent systems capable of navigating complex environments has garnered significant interest. One such application is the creation of a line-following robot with obstacle avoidance capabilities, a project that combines elements of sensor integration, motor control, and autonomous decision-making. This project aims to design and implement a Line Follower with Obstacle Avoidance Using Arduino and L298 Motor, leveraging the versatility and accessibility of Arduino microcontrollers and the robust motor control offered by the L298 motor driver. Key components including DC motors, Ultrasonic sensors for obstacle detection, IR sensors for line tracking, and a 12V battery system form the backbone of this robotic system. By integrating these components and employing intelligent algorithms, the robot will be able to follow a predefined path while dynamically adjusting its trajectory to avoid obstacles encountered in its environment. This project not only serves as a practical demonstration of robotics principles but also showcases the potential of Arduino-based systems in creating adaptable and responsive autonomous machines.

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.

1.4 Automated Transport System Using Autonomous Bot

The Automated Transport System 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.

1.4.1 Features of Automated Transport System Using Autonomous BOT.

1. **Autonomous Navigation:** The system is capable of autonomously navigating predefined routes without human intervention, utilizing advanced sensors and algorithms for obstacle detection and path planning**.**
2. **Real-Time Monitoring:** It offers real-time monitoring and tracking of the bot's location, speed, and status, providing operators with live updates and insights into the system's performance**.**
3. **Traffic Management:** The system includes traffic management features such as traffic signal detection and coordination, optimizing route efficiency and minimizing congestion.

4. **Safety Protocols**: It incorporates safety protocols such as collision avoidance mechanisms, emergency stop capabilities, and fail-safe systems to ensure safe operation in dynamic environments.
5. **Efficient Task Allocation:** The system optimizes task allocation and scheduling for multiple bots, maximizing resource utilization and minimizing idle time.
6. **Integration with IoT:** It integrates with Internet of Things (IoT) devices and platforms for data exchange, remote monitoring, and control, enabling seamless integration into smart city infrastructure.
7. **Scalability:** The system is scalable to accommodate varying transport demands, allowing for the deployment of additional bots as needed to meet evolving requirements.
8. **Energy Efficiency**: It prioritizes energy efficiency through intelligent route planning, idle-time minimization, and energy-aware algorithms, maximizing operational sustainability.
9. **Adaptive Learning**: The system leverages machine learning and adaptive algorithms to continuously improve performance, learn from past experiences, and adapt to changing operational conditions

1.5 Methodology

- Studying the existing model
- Literature survey
- Preparing the Model design in Arduino.
- Applying boundary conditions by calculating the loads acting.
- Printing 3D model for further operation.
- Reprinting the failed component.
- Conclusion.

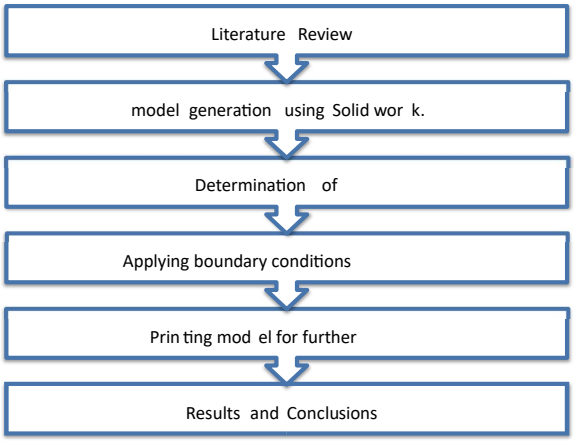

Table 1.1: Flow chart of methodology

1.6 Types of Automated Transport System Using Autonomous BOT.

1. **Mobile Robot:** The autonomous bot used in the transport system falls under the category of mobile robots, designed to move and operate in dynamic environments without external guidance.
2. **Autonomous Robot:** As an autonomous bot, it belongs to the category of robots capable of performing tasks and making decisions independently, relying on onboard sensors and algorithms for navigation and operation.
3. **Collaborative Robot (Cobot):** If the system involves multiple autonomous bots working together in a coordinated manner to transport goods or perform tasks, it can be classified as a collaborative robot system.
4. **Service Robot:** Depending on the specific tasks performed by the autonomous bot, such as delivering items within a facility or transporting goods between locations, it may be classified as a service robot focused on logistical tasks.
5. **Intelligent Robot:** The system's integration of advanced sensors, real-time monitoring, and decision-making capabilities qualifies it as an intelligent robot, capable of adapting to changing conditions and optimizing its performance.
6. **Networked Robot:** If the autonomous bots communicate with each other and with a central control system through a network, facilitating coordinated movements and task allocation, they can be categorized as networked robots.
7. **Transportation Robot:** Given its primary function in transporting items or materials within a defined area, the autonomous bot can also be classified as a transportation robot, specializing in logistical operations.
8. **Smart Robot:** Incorporating features such as real-time monitoring, traffic management, and energy-efficient algorithms, the system aligns with the characteristics of smart robots focused on automation, efficiency, and adaptability.

Chapter TWO

LITERATURE REVIEW

Following is a list of researchers who has worked in this area of sprocket chain and optimization. The combination with the following literature research on the latest use of alternate materials is expected to make the investigation as complete as possible. For this research, many international and national papers were helpful. Worldwide researchers have applied the efforts of design sprocket chain as,

1. **Author:** Kumar Rishabh

   Paper Title: Design of Autonomous Line Follower Robot with Obstacle Avoidance

   Publication Year: 2021

   Work Description:

   The paper presents the design and implementation of a Line Follower Robot capable of selecting the desired line among black and white lines, which can be combined with different colors.

   The robot possesses the ability to differentiate among different colors due to each color's distinct properties, enabling it to detect obstacles and choose alternative paths to reach its target.

   It is programmed with instructions to sense a line and move towards the target, maneuvering through congested curves by continuously gathering data from sensors.The robot features collision avoidance capabilities through obstacle sensors, ensuring it reaches its target without collisions.

   The proposed system is versatile and can be implemented in commercial, industrial, medical, and educational lab settings.

2. **Author:** Ayob Amrani

   Paper Title: Design and Implementation of Line Follower and Obstacle Detection Robot

   Publication Year: 2020

   Work Description:

The 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.

The number and layout of sensors, along with the chosen method, significantly influence the robot's response to the line, ensuring desired accuracy and speed.

The robot is equipped with an anti-collision system using an ultrasonic distance sensor to detect and avoid obstacles, particularly at line crossovers where multiple robots navigate a complex line together.

3. **Authors**: Punetha, Deepak, Neeraj Kumar, and Vartika Mehta

   Publication Year: 2018

   Paper Title: Development and Applications of Line Following Robot-Based Health Care Management System

   Work Description:

   The paper outlines methodologies for assessing, planning, administering, and enhancing health care management systems using a line following robot.

   The robot is designed to follow a line to deliver medication to patients as needed, utilizing a light-based resistor sensor (LDR) and an IR sensor switch near the patient for navigation and interaction.

   The robot's functionality relies on recognizing and following a pre-determined line, typically a black line in a white region of a different hue, using observable signals and a four-sensory system for precise movements.

   DC gear motors control the robot's wheel movement, with control algorithms developed and tested using the Arduino Uno interface to adjust motor speeds and navigate along the line accurately.

   The purpose of the project is to develop algorithms for controlling the robot's movement parameters, ensuring it can effectively trace and follow the specified line to perform assigned tasks in various conditions within a health care setting.

4. **Authors**: Savita Mamadapur, Deekshit Reddy L R, Abhishek K V, Jagadeesh G P, Karthik H.

   Publication Year: 2022

   Paper Title: Line Following Robot with Object Avoidance using Arduino

   Work Description:

   The paper describes a line following robot with object avoidance capabilities using Arduino technology.

   The robot is designed to follow a black and white line or a white line in dark conditions, utilizing an Arduino Uno microcontroller for processing input signals and controlling motor speeds for navigation.

The system includes sensors for line detection and a process of questioning and decision-making to adjust robot movements based on input changes, ensuring precise speed and direction control along the specified path.

The robot's functionality is self-contained, focusing on tracing and following the given line while maintaining track and completing assigned tasks efficiently.

5. **Author:** Samira Badrloo

   Publication Year: 2021

   Paper Title: Image-Based Obstacle Detection Methods for the Safe Navigation of Unmanned Vehicles

   Work Description:

   The paper reviews image-based obstacle detection techniques used by unmanned vehicles such as Unmanned Surface Vehicles (USVs), Unmanned Aerial Vehicles (UAVs), and Micro Aerial Vehicles (MAVs).

   Over 110 papers from 23 high-impact computer science journals published over the past 20 years were reviewed, focusing on monocular and stereo-based methods.

   Monocular methods use a single camera and are categorized into appearance-based, motion-based, depth-based, and expansion-based techniques, suitable for small robots like MAVs and compact UAVs due to their simple and fast computations.

   Stereo-based methods use pairs of synchronized cameras to create real-time 3D maps for obstacle localization, categorized into Inverse Perspective Mapping (IPM)-based and disparity histogram-based methods. However, these methods face challenges such as computational complexity, illumination sensitivity, and camera calibration requirements.

   Recent advancements in deep learning networks have been explored for fast and reliable obstacle detection solutions, although challenges remain in complex and unknown environments with various object types and shapes.

   The paper highlights the need for future studies to focus on detecting narrow and small moving obstacles and improving fast obstacle detection capabilities in image-based obstacle detection systems for unmanned vehicles.

6. **Author:** S. Mandole

   Publication Year: 2022

   Paper Title: A Path Follower Robot using Battery

   Work Description:

   The paper focuses on the development of a Path Follower Robot, an autonomous robot designed to follow a black line on a contrasting surface autonomously.

   The robot utilizes arrays of optical sensors to detect and follow the line, ensuring precise and flexible movement along the desired path.

   The basic principle of the Path Follower Robot is to detect and follow the line using feedback from sensors, with the direction of motion determined by the outputs of two sensors.

   An IR sensor detects when the robot deviates from its path, enabling it to make corrections and stay on course while navigating towards its destination.

   The project aims to create a reliable line follower robot capable of autonomously following a specified path and reaching its destination by continuously adjusting its movements based on sensor feedback.

7. **Authors:** Abdul Latif, Hendro Agus Widodo, Robbi Rahim, Kunal Kunal

   Publication Year: Not specified

   Paper Title: Implementation of Line Follower Robot based Microcontroller ATMega32A

   Work Description:

   The study employs an experimental method involving needs analysis, mechanical chart design, electronic part design, control program design, manufacturing, and testing to implement a line follower robot based on the ATmega32A microcontroller.

   The line follower robot is tested and found to successfully follow a black line on a white floor, displaying its status on an LCD. However, it exhibits sensitivity issues with line sensors at certain speeds, with optimal performance observed between 90-150 rpm and difficulties above 150 rpm.

8. **Authors:** Saharsh Oswal and SaravanaKumar

   Publication Year: 2021

   Paper Title: Line Following Robots on Factory Floors: Significance and Simulation Study using CoppeliaSim

   Work Description:

   The paper presents the design, assembly, and dynamic simulation of a line following robot equipped with a proximity sensor for collision avoidance and vision sensors for line tracking.

   The robot model is created using Autodesk Inventor 2018, and the assembly and simulation are conducted using CoppeliaSim software.

   The simulation study aims to demonstrate the significance of implementing such robots on factory floors, capable of covering a 10-meter path in approximately 8 seconds.

   CoppeliaSim software enables checking the dynamic properties of the robot and assigning different actuation codes to each component, facilitating a comprehensive simulation of the robot's behavior and performance on the factory floor.

CHAPTER THREE
DESIGN AND DEVELOPMENT

3.1 Introduction

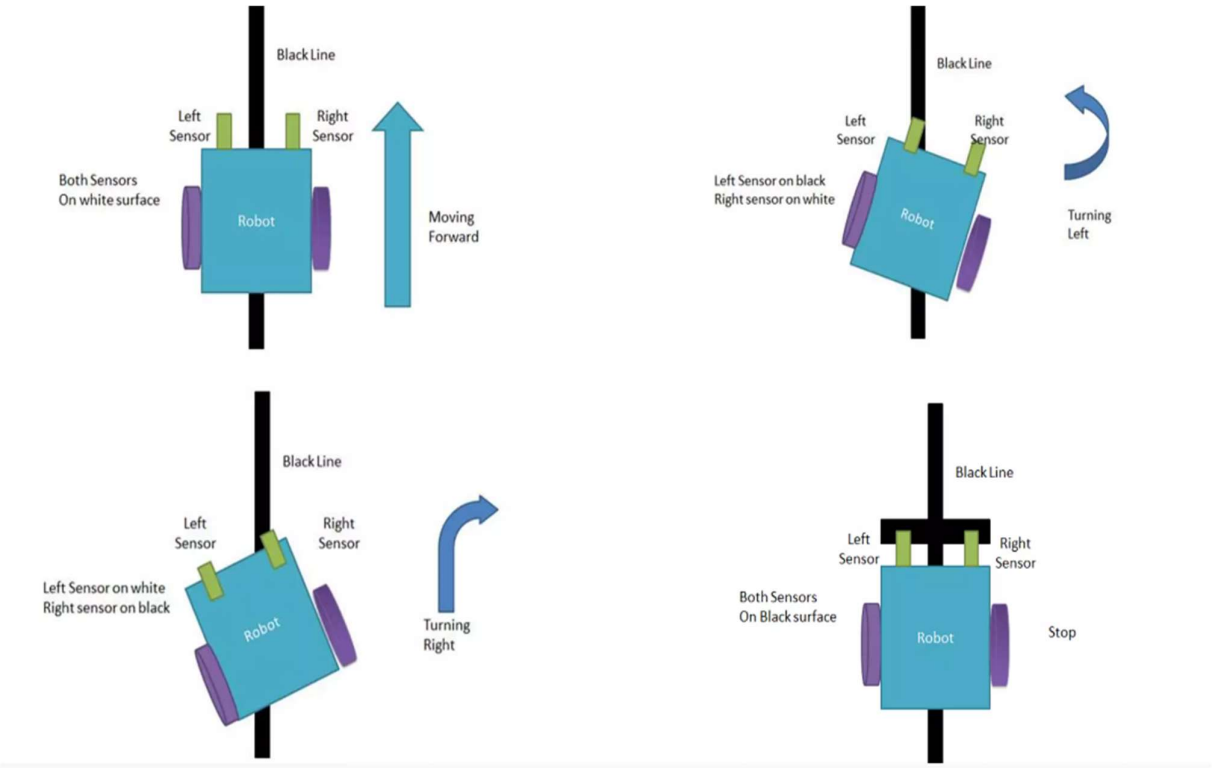

Fig.3.1: Principle of Line Follower BOT

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.

3.2 Concepts of model

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.

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.

3.3. Applications

1. **Warehousing and Logistics:** The system streamlines warehouse operations by autonomously transporting goods between storage locations, picking stations, and shipping areas, reducing manual labor and optimizing inventory management.
2. **Manufacturing Facilities**: It facilitates material handling and assembly line operations within manufacturing plants, ensuring timely delivery of components and minimizing production downtime.
3. **Hospital and Healthcare:** In healthcare settings, the system can be used for automated medication delivery, linen transport, and waste management, enhancing efficiency and reducing human error.

4. **Retail and Distribution Centers:** It supports efficient order fulfillment and inventory replenishment in retail stores and distribution centers, improving customer service and inventory accuracy.
5. **Airport and Transportation Hubs**: The system aids in baggage handling and airport logistics, optimizing luggage transfer processes and enhancing passenger experience.
6. **Smart Cities:** In smart city environments, the system serves as a sustainable and efficient mode of public transport, offering on-demand shuttle services, last-mile connectivity, and mobility solutions for residents and visitors.

CHAPTER FOUR
METHODS TO DESIGN AND MANUFACTURING MODEL

4.1 Introduction

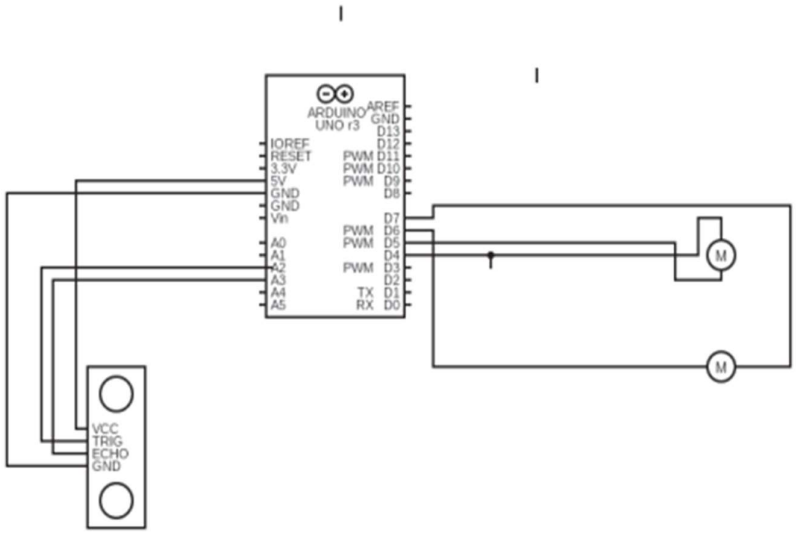

Fig 4 .1: Circuit Diagram of Obstacle Avoidance Robot.

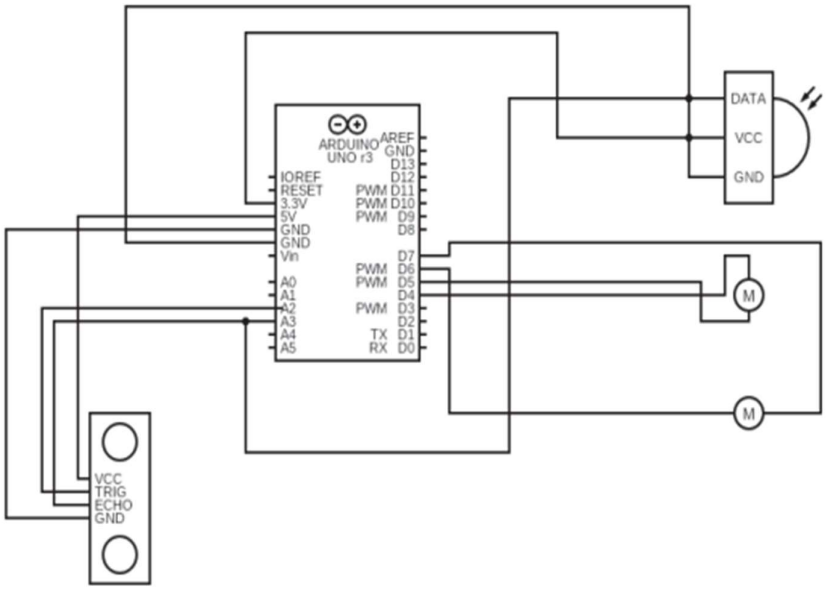

Fig 4.2: Circuit Diagram of Line following robot.

4.4Circuit Consideration.

When designing an electronic circuit, there are several key considerations that engineers take into account. Here are some important design considerations for circuit design:

1. Functionality: The circuit must perform the desired function or operation accurately and reliably. Engineers need to carefully define the circuit's requirements and specifications to ensure that it meets the intended purpose.
2. Power Supply: The power requirements of the circuit components must be considered, including voltage levels, current ratings, and power consumption. The power supply design should provide stable and appropriate power to all components.
3. Component Selection: Choosing the right components for the circuit is crucial. Factors such as component specifications, reliability, availability, and cost are considered. Components should be selected to match the desired performance and meet the electrical requirements of the circuit.
4. Signal Integrity: Maintaining signal integrity is important to ensure proper functioning of the circuit. This involves minimizing noise, interference, and distortion in signal transmission. Techniques such as proper grounding, signal shielding, and noise filtering are employed to preserve signal integrity.
5. Thermal Management: Circuits generate heat during operation, especially power-hungry components. Adequate thermal management is necessary to prevent overheating and ensure the longevity and reliability of the circuit. Heat sinks, thermal pads, and cooling fans are commonly used to dissipate heat.
6. Safety: Safety considerations are critical, particularly for circuits that interact with humans or high-power systems. Proper isolation, protective features, and compliance with safety standards should be incorporated to ensure user safety and prevent electrical hazards.
7. Cost and Manufacturability: The cost of components, complexity of the circuit, and ease of manufacturing should be taken into account. Engineers strive to balance performance and functionality with cost-effective designs that can be efficiently manufactured.
8. Testing and Troubleshooting: Designing circuits with testability in mind simplifies the troubleshooting and debugging process. Incorporating test points, built-in diagnostics, and using modular designs can help identify and rectify issues effectively.

These considerations may vary depending on the specific application and requirements of the circuit. Engineers often iteratively refine the design, considering trade-offs and making adjustments to optimize performance, reliability, and manufacturability.

In electronic design, it is important to develop proper schematics of the **circuit design** for the success of the electronic product. An engineer must draw a neat and clean layout for the required circuit for the specific purpose by using the conventional method or going for Electronic Design Automation tools. Since drawing the schematic with the help of hands can lead to errors, so it is generally preferred to use certain EDA tools for better performance and efficiency of the circuits. Listed below are important tips to

consider when designing the circuit layout. When designing a circuit for a bot with an Arduino and motor drive, there are several important considerations and rules to keep in mind. Here are some key guidelines:

1) Functionality
2) Power supply
3) Components Selection
4) Signal integrity
5) Testing and Troubleshooting.

These considerations may vary depending on the specific application and requirements of the circuit. Engineers often iteratively refine the design, considering trade-offs and making adjustments to optimize performance, reliability, and manufacturability.

CHAPTER FIVE
PROJECT MODEL

5.1 Introduction

The fundamental point of any robot is to diminish human exertion. As indicated by the reason, various sorts of robot are intended for down-to-earth applications.In any workplace, proper observation is required all the time for better outcomes.This robot can be utilized in businesses for conveying merchandise starting with one spot and then onto the next. The principle justification for why this robot can be utilized for the transportation of products is its fit and failure to remember capacity, and that implies that once the robot is put on the ideal way the working of the robot is programmed, there is no requirement for controlling the robot physically. This makes the line-following robot more proficient and valuable when compared to other regular robots. A conventional impediment keeping away from robots cannot help in the transportation of products since there is no specific way for the robots. It will move haphazardly by keeping away from the impediment and will not arrive at the necessary choice. The development of obstructions staying away from the robot cannot be controlled. Taking into account this element line following robot has more helpful applications. This works on the working of the line following robot, because in any workplace impediments are normal, so if the line supporter cannot distinguish any obstructions on its way, it will leads to huge impact.Adding the highlights of the impediments to staying away from the robot to a conventional line following the robot prevents any damage to the robot.

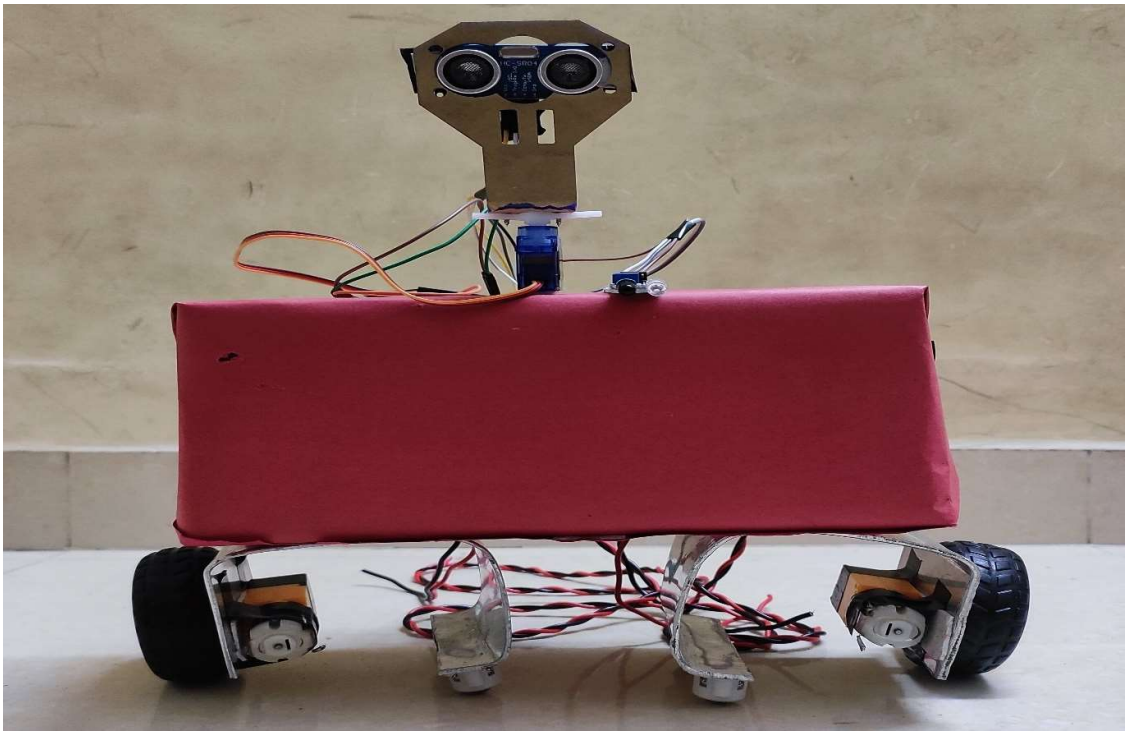

Fig.5.1:Project Model

5.2 Components used:-

Component/ model	Remark
Solderless Breadboard	Standard size, allows easy prototyping and circuit building without soldering
4 Wheel Robot car kit	Chassis with 4-wheel drive, suitable for various terrain and maneuverability.
Arduino UNO	Microcontroller board with ATmega328P, versatile for programming and controlling electronic projects
IR sensor x 2	Detects infrared light for line following or obstacle avoidance
Mini servo Motor Holder	Fits standard mini servo motors, provides stable mounting for motor applications.
Ultrasonic Sensor Holder	Ensures precise positioning and stability for distance measurement
Ultrasonic Sensor HC	Accurate and reliable for distance sensing in robotics projects.
4pcs smart Robot Car Tyers Wheels	Rubber tires with good traction and durability for robot mobility
Male to Female Jumper Wires	Assorted lengths, facilitates easy connections between components on the breadboard and other devices.
Hard jumper Wire	Durable, provides stable electrical connections.
On/Off Switch	SPST switch, convenient for controlling power to the circuit.
18650 Battery Holder – 2 cell	Holds the batteries that power the robot, providing the necessary voltage and current for operation.
L2988 Motor Driver	Controls the speed and direction of the DC motors that drive the robot's wheels, essential for precise movement .

CHAPTER SIX

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION:

Robots are pivotal in both global economies and daily life, with a focus on their competitiveness and patent design across industries based on application types. The demand for robotic technology is expanding, notably in manufacturing, medical, service, defense, and consumer sectors, exemplified by industrial robots like the linear robot, showcasing potential for industrial use through material optimization and motor movement enhancements. The setup cost depends significantly on machinery, land, construction, and maintenance, with potential for cost-effective solutions through robotic replacements for skilled labor, offering improved task precision and reduced per-unit costs.

6.2 FUTURE SCOPE:

Line follower robots with obstacle detection present opportunities for enhanced functionality, including advancements in obstacle detection accuracy through technologies like LIDAR or computer vision. Future work can explore autonomous navigation algorithms, multi-agent coordination for complex tasks, integration with other technologies such as drones or 3D printers, and specialized designs for specific applications like search and rescue or hazardous environment inspection. Further improvements can be made by increasing the number of IR sensors or using sensor arrays for better obstacle detection and control, enhancing the robot's intelligence and maneuverability.

REFERENCES

1. Razvan Solea, Adrian Filipescu and Grigore Stamatescu" Sliding-mode real-time mobile platform control in the presence of uncertainties ",Decision and Control(2019) 32 16-18.
2. T. Palleja,M. Tresanchez,M. Teixido,J. Palacin" Modeling floor-cleaning coverage performances of some domestic mobile robots in a reduced scenario", Robotics and Autonomous Systems(2020) 58 37- 45.
3. M.R.B. Bahara, A.R. Ghiasib, H.B. Bahara, "Grid roadmap based ANN corridor search for collision free, path planning ",Scientia Iranica (2012) 19 1850-1855.
4. Ayoub Bahmanikashkoolia , Majid Zareb, Bahman Safarpourc, Mostafa Safarpourd" Application of Particle Swarm Optimization Algorithm for Computing Critical Depth of Horseshoe Cross Section Tunnel "APCBEE Procedia(2018)9 207–211.
5. Spyros G. Tzafestas"9 – Mobile Robot Control V: Vision-Based Methods",Introduction to Mobile Robot Control(2014) 319–384.
6. Spyros G. Tzafestas"11 – Mobile Robot Path, Motion, and Task Planning", Introduction to Mobile Robot Control (2014) 429–478.
7. Masoud Nosrati , Ronak Karimi , Hojat Allah Hasanvand "Investigation of the * (Star) Search Algorithms: Characteristics, Methods and Approaches" Applied Programming(2012) 2 251-256.
8. Dr. R.Anbuselvi "PATH FINDING SOLUTIONS FOR GRID BASED GRAPH" Advanced Computing(2013).
9. M. Sri Venkata Sai Surya, K. Bhogeshwar Reddy, K. Pavan Kalyan and S. Senthil Murugan, "Smart and Intelligent Line Follower Robot with Obstacle Detection", International Journal of Research and Scientific Innovation, vol. V, pp. 1-6, 2018.
10. Aamir Attar, Aadil Ansari, Abhishek Desai, Shahid Khan, Dipashri Sonawale, "Line Follower and Obstacle Avoidance bot using Arduino", International Journal of Advanced Computational Engineering and Networking, vol. 5, pp. 18-21, 2017.
11. Kumaresan P,Priya.G,Kavitha B R, Ramya G and M.Lawanyashri, "A Line

Following Robot for Hospital Management", International Journal of Pure and Applied Mathematics, vol. 116, 2017