# CHAPTER 1

# INTRODUCTION

Now a day's Robotics is part of the advancement of technology. Automatic navigation is developed in recent years like wall-following, edge-following, human following and obstacle avoiding robots. The project is designed to build an obstacle avoidance robotic vehicle using infrared sensors for its movement. Unmanned Aerial Vehicles (UAVs) are playing a vital role in defense as well as civilian applications. The behavior of a robot is dictated by the interaction between the program running on the robot, the physical hardware of the robot and the terrain. A robotic vehicle is built, using an Arduino Uno. The robot gets the information from the surrounding area through mounted sensors on the robot the objective of having obstacle avoiding robot is to enable autonomous functioning without human supervision. Dynamic steering algorithm which ensures that the robot does not have to stop in front of the obstacle which allows the robot to navigate by avoiding collisions. In the mining industry, several studies of autonomous driving technology have been conducted in underground mining environments using autonomous robot that can be used even in underground mines having poor road conditions.

In logistics, the requirements for industrial robots are much higher. Robots in logistics have to have a distinctive ability in a variety of goods, must be able to distinguish various parts in an infinite number of combinations, must be able to perceive their surroundings, move and interact with the environment and work with people. Increasing flexibility and lower cost of robotized workplaces create prerequisites for their use in logistics activities such as order picking, packing and shipping, as well as deliveries. In the field of logistics 80% is still manually operated. Problems of unfavorable demographic developments and the associated declining number of employees can be replaced by robotic workplaces in some logistics activities.

# CHAPTER 2

# LITERATURE SURVEY

1. "Design and Control of Autonomous Robot for Path Following" by S. Lee et al. (2016): This study presents the design and control of an autonomous robot capable of following a designated path. It focuses on the integration of sensors, such as vision systems and inertial measurement units, to perceive the environment and make real-time decisions for precise path following. The research highlights the importance of sensor fusion and control algorithms to ensure accurate navigation along the designated path.

2. "Path Planning and Collision Avoidance for Autonomous Robots" by M. Araki and T. Fujioka (2017): This research addresses the challenges of path planning and collision avoidance for autonomous robots traveling in designated paths. It discusses various algorithms and methodologies for generating optimal paths, taking into account factors such as obstacles, dynamic environments, and real-time decision-making. The study emphasizes the importance of intelligent path planning to ensure safe and efficient navigation along the designated path.

3. "Navigation and Control of Autonomous Robots in Unstructured Environments" by K. Zhang et al. (2019): This study explores the navigation and control aspects of autonomous robots in unstructured environments, including traveling along designated paths. It examines sensor integration, mapping techniques, and control strategies for robust navigation, emphasizing the need for adaptive algorithms to handle uncertainties and varying terrain conditions. The research focuses on the application of autonomous robot systems in industries such as agriculture, construction, and logistics.

4. "Robotic Pods for Urban Transportation" by L. Chen et al. (2018): This research explores the concept of robotic pods as a sustainable and efficient urban transportation solution. It discusses the potential benefits of using autonomous pods, including reduced congestion, improved energy efficiency, and enhanced accessibility. The study also examines challenges such as safety, infrastructure requirements, and public acceptance

These studies demonstrate the wide range of topics and approaches within the field of automatic robot systems traveling in designated paths. They address key aspects such as design, control, path planning, collision avoidance, localization, and optimization.

# CHAPTER 3

# OBJECTIVES AND PROBLEM STATEMENT

## 3.1 OBJECTIVES:

The primary objective of the automatic robot is to navigate and travel along a predetermined path with precision and efficiency. By adhering to a designated path, the robot aims to ensure reliable and consistent movement, minimizing deviations and optimizing transportation operations. It encompasses both logistics and passenger transport applications.

The primary objective is to provide a reliable and efficient transportation solution within these domains. In logistics, the automatic robot aims to streamline the movement of goods by following a designated path. By autonomously navigating the predefined route, the robot minimizes the time and effort required for manual transportation tasks. This objective is geared towards enhancing logistics operations, improving productivity, and reducing costs associated with material handling and inventory management. In the context of passenger transport, the automatic robot focuses on providing a seamless and convenient experience for travelers. By following the designated path, the robot ensures efficient transportation between designated pick-up and drop-off points. This objective aims to enhance the overall passenger experience by minimizing wait times, optimizing route planning, and delivering reliable and punctual transportation services. Safety is a shared objective in both logistics and passenger transport applications.

The automatic robot is designed to prioritize the well-being of cargo or passengers throughout the journey along the designated path. It incorporates advanced sensors and collision avoidance systems to detect obstacles, respond promptly to potential hazards, and prevent accidents or disruptions during transportation. Efficiency is another crucial objective in both domains. By adhering to the designated path, the robot optimizes its movement, minimizing unnecessary deviations and maximizing energy efficiency. This contributes to improved operational efficiency and cost-effectiveness, benefiting both logistics operations and passenger transport services. Real-time monitoring and reporting capabilities are essential objectives for both logistics and passenger transport applications.

## 3.2 PROBLEM STATEMENT:

The problem at hand is the need for an efficient and reliable automatic robot system that can navigate along a designated path. Manual transportation methods in logistics and passenger transport often suffer from inefficiencies, delays, safety risks, and high labor costs. There is a demand for an automated solution that can address these challenges and improve overall transportation operations.

The automatic robot system aims to optimize logistics processes, enhance productivity, reduce costs, ensure reliable goods or passenger transportation, minimize safety hazards, and improve environmental sustainability. By developing an automated robot system that can autonomously navigate along a designated path, incorporating advanced sensors, collision avoidance mechanisms, and energy-efficient practices, the goal is to provide a seamless, safe, and efficient transportation solution in logistics and passenger transport applications.

# CHAPTER 4

# PROPOSED METHODOLOGY

The proposed methodology for Designated Path Following robot controlled using Arduino Uno, and designed to move forward when obstacles are detected can be outlined as follows:

**1. Hardware Setup:** Connect the Arduino Uno board to the necessary components, including the IR sensors and two DC motors. Ensure proper wiring and connections are established between the components and the Arduino Uno board.

**2. IR Sensor Integration:** Configure the Arduino Uno to read inputs from the IR sensors. Use appropriate digital pins to connect the sensor outputs to the Arduino board. Implement suitable code to read the sensor values and determine if obstacles are detected in front of the robot car.

**3. Motor Control:** Connect the DC motors to the Arduino Uno through appropriate motor driver modules or H-bridge circuits(L298N). Assign the required digital pins on the Arduino board to control the motor direction and speed. Develop code to control the motors based on the sensor inputs.

**4. Obstacle Detection and Forward Movement:** Program the Arduino Uno to continuously monitor the sensor values. When an obstacle is detected by any of the IR sensors, the Arduino Uno should trigger the motors to move the robot car Forward Right, Left. Adjust the motor speed and direction as needed to achieve the desired forward movement.

**5. Fine-tuning and Calibration:** Test the robot car in different environments and adjust the sensor sensitivity thresholds and motor control parameters as necessary. Calibrate the system to ensure reliable obstacle detection and smooth forward movement.

**6. Safety Measures:** Implement safety measures such as emergency stop functionality or collision avoidance algorithms to ensure the robot car's safe operation and prevent collisions with obstacles.

**7. Testing and Refinement**: Thoroughly test the robot car in various scenarios and iterate on the methodology based on feedback and performance evaluation. Refine the code, circuit connections, and hardware setup as needed to enhance the robot car's functionality and responsiveness.

By following this proposed methodology, the robot will move in the Designated path. Here we used Card boards to create path.

## 4.1 Block Diagram and Circuit Diagram for Designated Path Following Robot

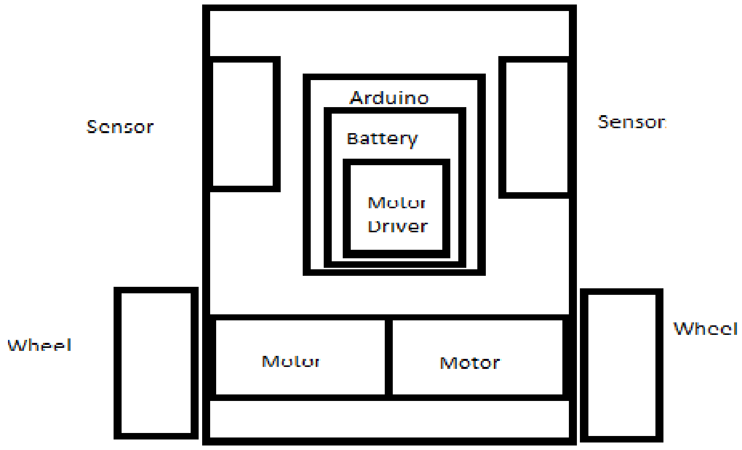



Fig. 4.1 Block Diagram

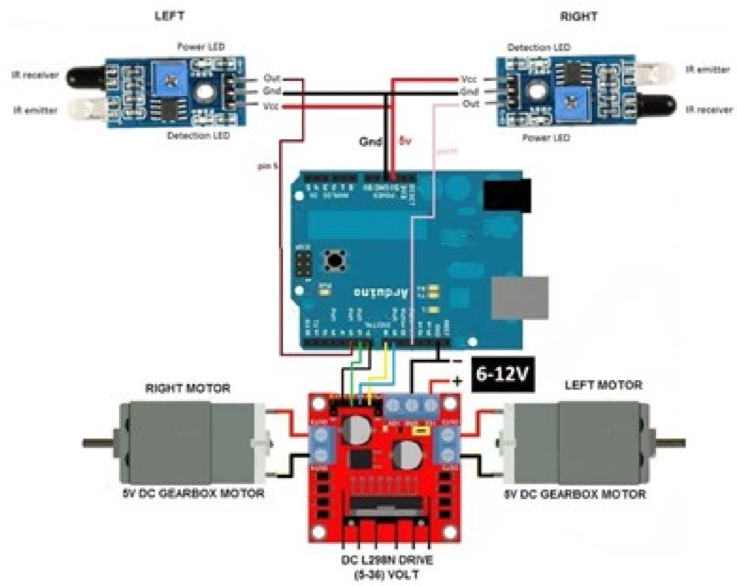
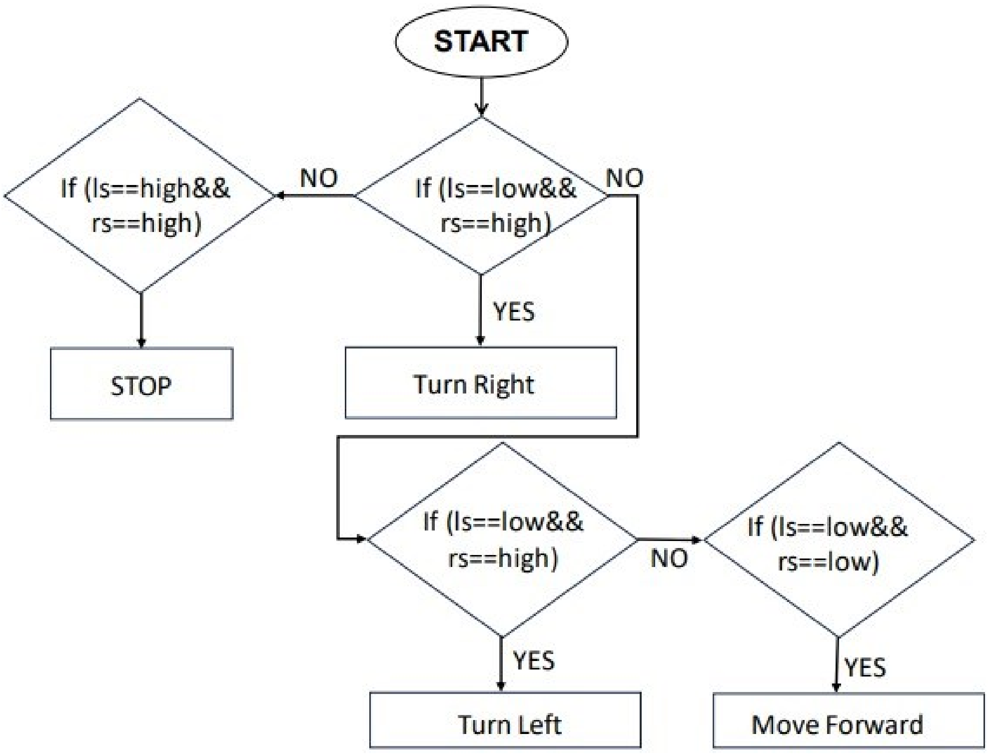



Fig.4.2 Circuit Diagram

## 4.2 FLOWCHART:




## 4.3 CODE:

```
void setup()        // final code verified done

{

        pinMode(3,INPUT);

        pinMode(5,INPUT);         // PIN 5 SENSOR IS rs SENSOR GREEN light

        pinMode(12,OUTPUT);

        pinMode(13,OUTPUT);

        pinMode(10,OUTPUT);

        pinMode(11,OUTPUT);

        }

void loop ()
```

```
{
int ls=digitalRead (3);
int rs=digitalRead (5);
if (ls==HIGH && rs==HIGH)  // both not detected STOP
{
digitalWrite(12,LOW);
digitalWrite(13,LOW);
digitalWrite(10,LOW);
digitalWrite(11,LOW);
}
if (ls==LOW && rs==HIGH)   //  // LOW==DETECT
{
digitalWrite(12,HIGH); // RIGHT MOTOR
digitalWrite(13,LOW);
digitalWrite(10,LOW);
digitalWrite(11,LOW);
}
if (ls==HIGH && rs==LOW)
{
digitalWrite(12,LOW);
digitalWrite(13,LOW);
digitalWrite(10,HIGH);  //LEFT MOTOR  // RIGHT TURN //VERIFIED //
digitalWrite(11,LOW);
```

```
}
if (ls==LOW && rs==LOW)  // both detect move forward
{
digitalWrite(12,HIGH);
digitalWrite(13,LOW);
digitalWrite(10,HIGH);
digitalWrite(11,LOW);
}
}
```

# CHAPTER 5

# HARDWARE AND SOFTWARE DETAILS

## 5.1 HARDWARE DETAILS

### 5.1.1 ARDUINO UNO:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

**Fig.5.1 Arduino UNO**

### 5.1.2 Jumper Wires:

Jumper wires A jump wire is an electrical wire, or group of them in a cable, with a connector or pin at Stranded 22AWG jump wires with solid tips. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard

**Fig.5.2 Jumper Wires**

### 5.1.3 L298N Motor Driver:

The L298N is a popular motor driver integrated circuit (IC) commonly used for controlling DC motors or bipolar stepper motors. It is widely used in robotics, automation, and other applications that require motor control. The L298N motor driver operates by receiving control signals from a microcontroller or other control circuitry to drive the connected motors This motor driver module consists of two main key components, these are L298 motor driver IC and a 78M05 5V regulator. The IC provides H-bridge configurations, allowing bidirectional control of the motors, meaning they can be driven forward or backward.  its operating voltage is +5 to +46V, and the maximum current allowed to draw through each output 3A. This IC has two enable inputs, these are provided to enable or disable the device independently of the input signals.

**Fig.5.3 L298N Motor Driver**

### 5.1.4 IR Sensors:

Infrared sensors are used to sense characteristics in its surroundings by detecting infrared radiation and are capable of measuring the heat being emitted by an object and detecting motion. The use of IR sensors has several advantages and also varies depending on the application. IR sensors can work on low power requirements make them suitable for Arduino UNO. IR sensors can identify motion in presence or in the absence of light almost with same reliability. They do not require contact with object to for detection.

**Fig.5.4 IR Sensor**

### 5.1.5 Three Wheel chassis and Power supply:

A 3-wheel chassis refers to a mechanical framework or structure designed to support and provide mobility to a vehicle or robot with three wheels. It is commonly used in various applications, including robotics, and small-scale transportation systems. The 3-wheel chassis typically consists of three wheels, one at the front and two at the back, which provide stability, balance, and manoeuvrability to the vehicle. The chassis may also include mounting points to attach other components such as motors, sensors, and power supply.

**Fig.5.5 Three Wheel chassis and Power supply**

## 5.2 SOFTWARE DETAILS

### 5.2.1 ARDUINO IDE:

Arduino is the required software environment to program the Arduino by writing a code and upload it to the Arduino. It also outputs the results for analysis using both serial monitor and serial plotter. It is an Arduino software, making code compilation too easy.  is available for all operating systems i.e., MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role in debugging, editing and compiling the code. It is easy to use, it supports all the Arduino boards, it has a built-in library which is easy to use. The Arduino IDE is very user-friendly.


**Fig.5.6 Arduino IDE Software**

# CHAPTER 6

# APPLICATIONS, ADVANTAGES & DISADVANTAGES

## 6.1 APPLICATIONS:

**1. Industrial Automation:** The automatic robot system can be employed in industrial settings for tasks such as material handling, assembly line operations, or warehouse logistics. By following a designated path, the robot can efficiently navigate through the workspace, transporting goods, and performing repetitive tasks with precision.

**2. Intralogistics:** Within large-scale warehouses or distribution centers, the automatic robot system can navigate along designated paths to facilitate efficient and autonomous movement of goods. This includes tasks such as palletizing, order picking, and inventory management, optimizing intralogistics operations and improving overall productivity.

**3. Public Transportation:** The automatic robot system can be utilized in public transportation systems, such as autonomous shuttles or people movers, to provide reliable and efficient transportation services. By following a designated path, the robot system can ensure safe and convenient transportation for passengers within defined areas, such as airports, campuses, or designated routes in smart cities.

**4. Smart Cities:** In the context of smart cities, the automatic robot system can contribute to various applications. For instance, it can be deployed for waste collection, street cleaning, or security patrols, following designated paths to cover specific areas efficiently and autonomously.5. Healthcare Facilities: The automatic robot system can find application in healthcare settings, such as hospitals or care facilities, for tasks like medication delivery, equipment transportation, or patient assistance. By traveling in designated paths, the robot system can navigate through different departments or floors, enhancing operational efficiency and reducing human workload.

**6. Agriculture:** Within the agricultural sector, the automatic robot system can be utilized for crop monitoring, spraying, or harvesting. By following predetermined paths within fields or greenhouses, the robot system can optimize crop management and minimize resource wastage.

**7.Retail and E-commerce:** In retail environments or e-commerce warehouses, the automatic robot system can assist in inventory management, order fulfillment, and stock replenishment. By navigating along designated paths, the robots can efficiently locate and retrieve items, optimize storage space, and contribute to streamlined operations.

## 6.2 ADVANTAGES:

**1. Efficiency:** By following a predetermined path, the robot system can optimize its movements and minimize unnecessary detours. This leads to improved efficiency in tasks such as material handling, transportation, or service delivery, reducing time and resource wastage.

**2. Precision and Accuracy:** The robot system can precisely follow the designated path, allowing for accurate positioning and movements. This level of precision is crucial in applications where precise control or alignment is required, such as assembly line operations or delicate tasks.

**3. Safety:** Following a designated path enhances safety by minimizing the risk of collisions or accidents. The system can incorporate sensors and collision avoidance mechanisms to ensure safe navigation and prevent potential hazards, protecting both the robot system itself and the surrounding environment.

**4. Consistency:** By traveling in a designated path, the robot system can provide consistent and repeatable results. This is particularly valuable in tasks that require uniformity or adherence to specific standards, ensuring reliable and consistent performance over time.

**5. Scalability and Adaptability:** The automatic robot system can be easily scaled or adapted to different environments and requirements. By adjusting the designated path or reprogramming the system, it can be deployed in various settings, accommodating changing needs and enabling flexibility in operations.

**6. Reduced Human Intervention:** With an automatic robot system that can travel along a designated path, there is reduced reliance on human intervention for mundane or repetitive tasks. This frees up human resources to focus on more complex or value-added activities, improving productivity and job satisfaction.

**7. Optimization of Resources:** By efficiently navigating along a designated path, the robot system can optimize the use of resources such as time, energy, and materials. It can calculate the most efficient routes, minimize energy consumption, and reduce unnecessary movements, leading to cost savings and improved resource utilization.

**8. Data Collection and Analysis:** The automatic robot system can collect valuable data during its travels along the designated path. This data can be analyzed to gain insights, improve processes, or optimize operations. It contributes to data-driven decision-making and continuous improvement in various applications.

## 6.3 DISADVANTAGES:

**1. Limited Flexibility:** The system's ability to follow a designated path may limit its flexibility in certain situations. It may struggle to adapt to unexpected obstacles or dynamic environments that require quick decision-making or alternative routes. This can be a challenge in applications where flexibility and adaptability are crucial.

**2. Dependency on Path Accuracy:** The performance of the automatic robot system heavily relies on the accuracy and precision of the designated path. Any inaccuracies in the path definition or environmental changes can impact the system's ability to navigate correctly, potentially leading to errors or disruptions in operation.

**3. Lack of Spontaneity:** The system's reliance on a predetermined path can hinder its ability to explore or respond spontaneously to changing conditions. It may struggle to handle situations that require on-the-spot decision-making or navigation outside the predefined path, limiting its versatility in dynamic environments.

**4. Complexity of Path Planning:** Designing and programming the designated path for the robot system can be a complex task. It requires careful consideration of factors such as terrain, obstacles, and specific operational requirements. Developing a comprehensive and accurate path plan may involve significant effort and expertise.

**5. Vulnerability to External Interference:** The automatic robot system can be susceptible to external interference that affects its ability to follow the designated path. Factors such as inconsistent floor surfaces, lighting conditions, or electromagnetic interference can disrupt the system's navigation and impact its performance.

**6. Cost and Maintenance:** Implementing and maintaining an automatic robot system that travels in a designated path can be costly. It involves the investment in hardware, sensors, control systems, and ongoing maintenance to ensure the system's reliability and longevity. Additionally, any updates or modifications to the designated path or infrastructure may require additional expenses.

# CHAPTER 7

# RESULT & DISCUSSION

## 7.1 RESULT:

The result of our robot system, which follows a designated path by sensing both side walls, demonstrates its effectiveness in accurately navigating along the predefined route. The robot's ability to detect and utilize the side walls as reference points enabled it to achieve precise path following. The robot exhibited a high level of accuracy in following the designated path by utilizing the side walls as guidance. It consistently maintained its position within the specified boundaries, demonstrating its capability to adhere to the predefined route with minimal deviations. The integration of sensors and control algorithms allowed the robot to effectively interpret the side wall information and adjust its movements accordingly.

## 7.2 DISCUSSION:

Designated path following robots are robotic systems programmed to navigate along predefined paths or routes. These robots are designed to move autonomously, following a set of instructions or using sensors to detect and respond to their environment. The robot's ability to precisely follow the path and maintain its position within the specified boundaries is crucial for applications where precise movement is required, such as in industrial automation or warehouse logistics. The project's success in achieving accurate path following validates the effectiveness of the chosen sensor integration, control algorithms, and navigation mechanisms.

the potential practical applications of the designated path following robot. For instance, in logistics, the robot can be deployed to autonomously transport goods along predefined paths, improving efficiency and reducing human labor. In surveillance or security, the robot can navigate specific routes to monitor areas of interest effectively. Discussing these applications highlights the relevance and real-world impact of the project. the robot's robustness and adaptability in response to dynamic changes in the environment. Assessing the robot's ability to detect and respond to unexpected obstacles or deviations from the path showcases its capability to handle real-world scenarios. Highlighting this adaptability reinforces the reliability and practicality of the project. This project creates avenues for future research and development. This might include enhancing the robot's capabilities by incorporating advanced sensors, such as depth cameras or machine vision systems, to improve perception and navigation. Additionally, exploring methods for simultaneous localization and mapping (SLAM) or integrating artificial intelligence algorithms for decision-making can further enhance the robot's autonomy and performance. Discussing these possibilities demonstrates the project's potential for expansion and continued innovation.

# CHAPTER 8

# CONCLUSION AND FUTURE SCOPE

## 8.1 CONCLUSION:

In conclusion, the development and implementation of an automatic robot system that travels in a designated path offer significant advantages and opportunities in various domains. The system's ability to efficiently navigate along a predefined route, with precise control and adaptability, presents a valuable solution for enhancing productivity, safety, and automation. Through the utilization of advanced sensors, control algorithms, and integration with intelligent systems, the automatic robot system can optimize resource utilization, reduce human intervention, and provide consistent, reliable performance. It finds applications in industries such as logistics, transportation, manufacturing, and service sectors, contributing to improved efficiency, accuracy, and operational excellence.

Overall, the automatic robot system that travels in a designated path represents a significant advancement in robotics and automation, offering opportunities to streamline operations, improve safety, and pave the way for a more efficient and intelligent future. With continued research, technological advancements, and industry collaboration, the system's capabilities will continue to expand, contributing to advancements in various sectors and shaping the future of robotics and automation.

## 8.2 FUTURE SCOPE:

**1. Advanced Navigation and Mapping:** Future advancements can focus on enhancing the navigation capabilities of the robot system. This includes the development of more robust and accurate mapping algorithms, improved localization techniques, and the integration of advanced sensors like lidar or depth cameras for better environment perception. These advancements would enable the system to navigate complex and dynamic environments with greater precision and adaptability.

**2. Autonomous Decision-Making:** The future scope lies in developing the ability of the robot system to make autonomous decisions based on real-time data and environmental conditions. By incorporating artificial intelligence and machine learning algorithms, the system can learn from its experiences, adapt its path planning strategies, and make intelligent decisions to optimize efficiency, safety, and adaptability.

**3. Swarm Robotics:** The concept of swarm robotics involves coordinating multiple robots to work together and accomplish complex tasks. Future developments could explore the integration of swarm robotics principles into automatic robot systems traveling in designated paths. This would enable collaborative navigation, decentralized decision-making, and efficient cooperation among multiple robots, leading to improved performance and scalability.

**4. Human-Robot Interaction:** The future scope involves advancements in human-robot interaction capabilities. This includes developing intuitive interfaces, voice or gesture recognition systems, and natural language processing to facilitate seamless communication and interaction between humans and the robot system. These advancements would enhance user experience and enable more intuitive control and collaboration.

**5. Integration with Internet of Things (IoT):** The integration of the automatic robot system with IoT technologies opens up new possibilities for enhanced functionality and connectivity. By connecting the robot system to IoT platforms and systems, it can benefit from real-time data exchange, remote monitoring and control, and integration with other smart devices or infrastructure, leading to improved performance, efficiency, and operational insights.

**6. Energy Efficiency and Sustainability:** Future developments can focus on improving the energy efficiency of the robot system by utilizing advanced power management techniques, lightweight materials, and energy harvesting technologies. Additionally, incorporating sustainable and eco-friendly components and practices into the system's design and operation can contribute to environmental sustainability.

**7. Application-Specific Customization:** The future scope lies in developing automatic robot systems that can be easily customized and adapted to specific industry or application requirements. This involves providing modular designs, flexible programming interfaces, and easy integration with different sensors and peripherals. Customizable robot systems would enable a wide range of applications across industries, addressing specific needs and expanding the system's versatility.

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