VOICE CONTROLLED ROBOTIC VEHICLE

A PROJECT REPORT

Submitted by:

Asmeet Kaur Kainth	**(21BCS10508)**
Mohammad Basim Siddiqui	**(21BCS9877)**
Raj Faujdar	**(21BCS9535)**
Hetashi Guru Singh Pal	**(21BCS9888)**

in partial fulfillment for the award of the degree of

BACHELOR'S OF ENGINEERING

IN

CSE - Specialization AI & ML

Chandigarh University

MAY 2023

BONAFIDE CERTIFICATE

Certified that this project report **"Voice Controlled Robotic Vehicle"** is the bonafide work of **" Asmeet Kaur Kainth, Mohammad Basim Siddiqui, Raj Faujdar, Hetashi Guru Singh Pal "** who carried out the project work under my/our supervision.

SIGNATURE	**SIGNATURE**
Mr. Aman Kaushik	Mr. Anuj Kumar Raghav
HEAD OF THE DEPARTMENT	**SUPERVISOR**
	Assistant Professor
CSE-AIT	CSE-AIT

Submitted for the project viva-voce examination held on__________________

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

Firstly, I would like to thank our supervisor MR. ANUJ KUMAR RAGHAV SIR who not only guided us but also gave us valuable advice throughout the journey of completion of this project. She really helped us in tough times and guided us really well. Her judgement and quick thinking helped us a lot of times and it is due to her that this project is what it is today.

He helped us in giving advice and providing us with the necessary materials without which we couldn’t have succeeded in completing this project. My special thanks to all my teammates and my best friends who helped a lot in collecting information and doing tasks and work perfectly as planned. Without them our project may not have looked the as it is now.

This project has greatly increased our knowledge about robotics. In the end, we would like thank Chandigarh University for giving us such an opportunity of making this project and helping us gain a lot about how to make a Voice Controlled Robotic Vehicle and learn about its mechanism. Without the inspiration & motivation from our university we may not had a chance of making this project

TABLE OF CONTENTS

List of Figures

List of Tables

ABSTRACT

This project was constructed in a way that allows the robot to be controlled by voice instructions. An android application with a microcontroller is used for critical tasks. The android app and the car can connect thanks to Bluetooth technology. The user can utilise the program's buttons or speak commands to the robot to control it. The microcontroller at the receiver side is coupled to two DC servo motors that allow the robot to move. The Bluetooth RF transmitter transforms the application's commands into digital signals for the robot at a reasonable range (about 100 meters). At the receiver end, the data is decoded and delivered to the microcontroller, which uses it to drive the necessary DC motors. The goal of a voice- controlled robotic vehicle is to carry out the necessary work by paying attention to the user's orders. For the user to operate the robot smoothly, a prior preparation session is required. A code is employed for the same purpose to instruct the controller.

CHAPTER-1

INTRODUCTION

The use of voice control technologies has revolutionised the way we interact with our electronics in recent years. Voice commands have made our lives more convenient and efficient, from smartphones to home appliances. Voice control in robotics has enabled robots to do activities and respond to commands in a more intuitive and natural manner. The development of robotic vehicles is one of the most interesting applications of voice-controlled robotics. A voice-controlled robotic vehicle is one that can be controlled via spoken instructions rather than physical controls, making it more accessible and user-friendly. These vehicles have a wide range of applications, including transportation, exploration, and military operations. A voice-controlled robotic vehicle, for example, may be utilised to navigate dangerous terrain, such as mines or disaster zones, where human operators could be endangered. It might also be utilised for urban transportation, where it could negotiate traffic and prevent collisions better than a human driver.

Advances in artificial intelligence and machine learning have enabled the construction of voice-controlled robotic cars. These technologies enable the car to recognise and interpret spoken orders and to respond appropriately. In addition, the car can learn from previous interactions and adjust to the user's preferences and behaviours. Despite the numerous benefits of voice-controlled robotic cars, there are certain obstacles to overcome. One of the most difficult tasks is assuring the vehicle's safety and reliability, especially in complicated and unpredictable surroundings. Another problem is making technology accessible and usable for individuals of all ages and abilities. Personal mobility for people with disabilities is one potential application for voice-controlled robotic cars. Voice-controlled robotic vehicles could dramatically improve the quality of life for those with mobility disabilities by providing a user-friendly and accessible form of transportation. A person with a physical impairment, for example, may utilise a voice-controlled robotic car to explore their house, office, or community without the assistance of another person. This would boost not only their independence but also their sense of autonomy and control over their everyday activities. Overall, the creation of voice-controlled robotic cars is a significant step forward in the field of robotics, with the potential to revolutionise transportation and other industries.

1.1. Relevant Contemporary Issues:

Automation and robotics have resulted in substantial advances in a variety of areas, ranging from manufacturing to healthcare. They have been shown to improve productivity, accuracy, and safety in a variety of activities. However, given to the intricacy of the activities involved and the requirement for human-machine interaction, deploying robots in real-world circumstances can be difficult. When building robots, one of the primary considerations is ensuring that the control system and user interface are intuitive and simple to use.

Joysticks and touchscreens, for example, may not always provide seamless control over autonomous vehicles. These mechanisms can be cumbersome and may necessitate extensive training to operate efficiently. Furthermore, they may lack the essential flexibility to process complex orders or make on-the-fly adjustments. As a result, adopting traditional manual controls might result in inefficiencies and errors that can be costly and dangerous in particular businesses.

To address these issues, there is a growing demand for more user-friendly and effective control systems. The use of voice control is one possible option. Voice control enables operators to communicate with robotic cars using natural language, making it more intuitive and accessible than traditional manual controls. Operators may issue commands and make adjustments using voice control without having to take their hands off other activities, making it a great solution for complicated and dynamic environments. Another promising approach is the use of gesture control. Gesture control allows operators to interact with robotic vehicles using hand movements, making it more natural and intuitive than traditional manual controls. Operators can issue commands and make adjustments by simply waving their hands, making it an ideal solution for tasks that require a high degree of dexterity.

Finally, while building robotics for real-world applications, the control system and user interface are crucial things to consider. Traditional manual controls may not always be adequate, especially for activities requiring a high level of complexity or human-machine interaction. Robotics can become more intuitive, effective, and accessible to a wider range of operators by using innovative control mechanisms such as voice control and gesture control.

1.2. Problem Identification:

The lack of an effective and simple control system for robotic vehicles is a serious challenge in the business, especially in areas requiring precision and safety, such as manufacturing and transportation. Current regulatory techniques may be inadequate because they lack the flexibility and adaptation required to deal with complex and changing contexts. Inefficiencies, errors, and even risks might arise, which can be costly and risky for both the operator and the organisation.

Customers are looking for solutions that will allow their workforce to drive robotic vehicles with ease while maintaining a high level of safety and precision. Such solutions should include an easy-to-use interface that allows operators to issue precise commands and make adjustments on the fly without taking their hands off other activities. They should also be adjustable and flexible, allowing operators to quickly adapt to diverse locations and scenarios.

Integration of AI-powered control systems is one viable answer. Machine learning algorithms are used in AI-powered control systems to analyse and interpret data from multiple sensors and inputs, allowing for real-time modifications and adaptations to changing conditions. Operators may now deliver accurate commands and make modifications in real time, even in complicated and dynamic contexts.

Another option is to incorporate advanced haptic feedback devices. Haptic feedback systems use vibrations and other tactile cues to offer feedback to operators on their actions and the vehicle's state. This can improve operator awareness and lower the risk of errors and mishaps, especially when visual cues are obscured or difficult to interpret.

Hence, a fundamental difficulty in the sector is the lack of an efficient and simple control system for robotic vehicles. Organisations, on the other hand, can increase operational efficiency, safety, and precision by adopting innovative solutions such as AI-powered control systems and advanced haptic feedback systems.

1.3. Task Identification:

Our goal is to create and build a voice-controlled system that works in tandem with robotic vehicles' existing autonomous mobility capabilities. This system will take advantage of advances in voice recognition technology to give a natural and efficient method of directing the vehicles, making them more versatile and successful in warehouse and distribution centre settings.

Operators may swiftly and easily direct trucks to carry things, supplies, and equipment within the facility by using voice commands, eliminating the need for manual controls or complex programming. Because the system can read and execute commands precisely and fast, this strategy can improve operational efficiency and eliminate errors.

Additionally, the incorporation of voice-controlled technology can aid in the optimisation of logistical processes by allowing for real-time modifications and adaptations to changing conditions. This means that operators can issue new commands or make changes on the go, ensuring that the vehicles are always running at maximum efficiency and production.

Furthermore, the adoption of voice-controlled technologies can improve the safety of both workers and assets. Operators can decrease their exposure to potential hazards like as crashes or accidents by eliminating the requirement for manual controls. This can increase overall facility safety and reduce the chance of accident or equipment damage.

The incorporation of a voice-controlled system in robotic vehicles has the potential to revolutionise warehouse and distribution centre logistical operations. We can design and create a system that optimises efficiency, reduces errors, and enhances people and asset safety by utilising breakthroughs in voice recognition technology and autonomous mobility capabilities.

.

CHAPTER-2

LITERATURE SURVEY

2003 saw a 19% increase in global industrial robot investment. Orders for robots increased by another 18% in the first half of 2004 to reach an all-time high. It is anticipated that global growth will increase at a rate of roughly 7% year between 2004 and 2007. Over 600,000 domestic robots are currently in use, and several millions will be in a few years.

We cite Prof. Bhuvaneshwari Jolad and Mohnish Arora's SPEECH RECOGNITION FOR ROBOTIC CONTROL's voice recognition system as an example. They specify how to identify a robot's voice.

- Systems with a limited vocabulary that can recognize up to 100 words.
- Systems with a medium vocabulary that can recognize between 100 and 1000 words.
- Systems with a large vocabulary that can recognize more than 1000 words.
- Speaker-dependent systems that are specifically designed for each talker.
- Speaker independent systems, the majority of which the system has never seen or been adapted to, that operate on large populations of talkers.
- Speaker adaptive systems that, while the system is in operation, gradually modify their expertise to each unique user.
- We cite the voice-controlled robotic vehicle, author Rohan Ganu, and Chetna Bhatia's communication system. They outline Robot communication.
- One-way communication: Each user's verbal input is processed one at a time.
- System-driven dialogue systems: In these systems, the system alone initiates a dialogue and verbally requests information from the user.
- Natural dialogue systems: These engage in conversation with the speaker, seek feedback, respond to user input, and sometimes even attempt to resolve ambiguity.

There are a few other papers that we referred to, below is the table for the literature survey of thise papers :

Year and Citation	Article/ Author	Tools/ Software	Technique	Source
2017, Jolad, Bhuvaneshwari, et al. "Voice controlled robotic vehicle." International Research Journal of Engineering and Technology (IRJET) 4.06	Prof. Bhuvaneshwari Jolad1, Mohnish Arora2, Rohan Ganu3, Chetan Bhatia4	Transceiver controller (MAX 232).	Micro-controller	IRJET
2016, Surjeet and Nishu Gupta 2021 J. Phys.: Conf. Ser. 1817 012016	A Novel Voice Controlled Robotic Vehicle For Smart City Applications	Raspberry Pi	Google Assistant with IFTTT and microcontrollers	Iop.org
2020, Saravanan, M., Selvababu, B., Jayan, A., Anand, A., & Raj, A. (2020, December). Arduino based voice controlled robot vehicle. In IOP Conference Series: Materials Science and Engineering (Vol. 993, No. 1, p. 012125). IOP Publishing.	Arduino Based Voice Controlled Robot Vehicle	Adruino UNO Board	Micro-controller	Iop.org

2017, Chikhale, Mr V., et al. "Voice Controlled Robotic System using Arduino Micro-controller." International Journal of New Technology and Research, vol. 3, no. 4, Apr. 2017.	Voice Controlled Robotic System using Arduino Micro-controller	Adruino UNO Board	Micro-controller	Neliti.com
2012, Blessington, P., Madhav, B. T. P., Babu, M. S., Reddy, R. R., Kumar, D. M., Raju, I. N., & Babu, N. A. (2012). Acoustic Controlled Robotic Vehicle. International journal of Emerging Technology & Advanced Engineering., 2(4).	Acoustic Controlled Robotic Vehicle	AT89552 microconroller	Micro-controller	Psu.edu
2020, Srivastava, Shubh, and Rajanish Singh. "Voice controlled robot car using Arduino." International Research journal of Engineering	VOICE CONTROLLED ROBOT CAR USING ARDUINO	Arduino UNO	Micro-controller	Academia.edu

and Technology 7.5 (2020): 4033-4037.				
2019, Diwakar, Dipesh, et al. "Voice Controlled Robotic Vehicle." (2019).	Diwakar Dipesh	L293D, Arduino UNO	Micro-controller	Academia.e du

Table 2.1 : Literature Survey

CHAPTER-3
DESIGN FLOW

3.1. SEARCHED FOR OTHER RESEARCH PAPERS FOR AN IDEA:

Voice-controlled robots have been a topic of interest for researchers and technologists for several years. However, in recent years, the development and proliferation of digital assistants such as Siri, Alexa, and Google Assistant have accelerated the advancement of voice-controlled robots. Despite the progress made, a number of flaws and weaknesses remain in the current state-of-the-art systems.

One of the major flaws of current voice-controlled robots is their limited vocabulary and language understanding. Most voice-controlled robots are programmed to recognize a limited set of commands or keywords, making them unable to understand complex sentences and questions. This limited understanding restricts their functionality and makes them less useful in everyday life. Furthermore, different accents, speech patterns, and languages can cause difficulty in communication between humans and robots.

Another weakness in current voice-controlled robots is their lack of emotional intelligence. While they can respond to specific commands, they lack the ability to understand the emotional context of human speech. This means that they are unable to empathize with users or respond appropriately to emotional cues, limiting their usefulness in fields such as healthcare and therapy.

Furthermore, many voice-controlled robots rely on cloud-based processing, which can lead to issues with latency and privacy concerns. The need to transmit data to a cloud server for processing means that the robot cannot function offline, and there is a risk of sensitive data being intercepted and used maliciously.

Another weakness in voice-controlled robots is their lack of adaptability to changing environments. Most voice-controlled robots rely on specific environmental conditions, such as a quiet room or a specific distance between the user and the robot, to function properly. This means that they may not be suitable for use in noisy or crowded environments, or in situations where the user is not within a certain range of the robot.

Finally, current voice-controlled robots are often designed with a narrow focus on specific tasks, limiting their usefulness in other areas. For example, a voice-controlled robot designed for home automation may not be suitable for use in a healthcare setting or a manufacturing environment.

In conclusion, while voice-controlled robots have made significant progress in recent years, there are still several flaws and weaknesses in the current state-of-the-art systems. These include limited vocabulary and language understanding, lack of emotional intelligence, reliance on cloud-based processing, lack of adaptability to changing environments, and narrow focus on specific tasks. Addressing these issues will be critical to realizing the full potential of voice-controlled robots in various fields, including healthcare, manufacturing, and home automation.

3.2. ANALYSIS OF THE PAPERS:

Voice-controlled robotic vehicles have been a topic of interest for researchers and engineers for several years. Several papers have been published on this topic, each highlighting different approaches and techniques for developing such systems.

One such paper published in the International Journal of Innovative Technology and Exploring Engineering (IJITEE) proposed a voice-controlled robotic vehicle using Bluetooth and Arduino technology. The system used a mobile app to convert the user's voice commands into Bluetooth signals, which were then received by the Arduino board mounted on the robotic vehicle. The vehicle's movements were controlled by the Arduino board based on the received signals. The paper demonstrated that the proposed system was effective in controlling the vehicle through voice commands, although limitations such as the range of Bluetooth and the need for a clear line-of-sight between the user and the vehicle were highlighted.

Another paper published in the Journal of Advanced Research in Dynamical and Control Systems (JARDCS) proposed a voice-controlled robotic vehicle using a neural network-based approach. The system used a microphone to capture the user's voice commands, which were then processed by the neural network to recognize the intended action. The output of the neural network was then used to control the vehicle's movements. The paper demonstrated that the proposed system was effective in recognizing and responding to the user's voice commands, even in noisy environments. However, the complexity of the neural network and the need for extensive training data were highlighted as limitations of the proposed system.

A third paper published in the International Journal of Advanced Research in Electrical, Electronics, and Instrumentation Engineering (IJAREEIE) proposed a voice-controlled robotic vehicle using a Raspberry Pi board and Google Assistant. The system used the Google Assistant API to convert the user's voice commands into text, which were then processed by the Raspberry Pi board to control the vehicle's movements. The paper demonstrated that the proposed system was effective in controlling the vehicle through voice commands, with the added advantage of being able to control the vehicle remotely through a mobile device. In conclusion, the papers analyzed demonstrate that voice-controlled robotic vehicles can be developed using different approaches and technologies, each with its own advantages and limitations. While the proposed systems were effective in controlling the vehicle through voice commands, limitations such as range, complexity, and reliance on cloud-based processing need to be addressed to realize the full potential of voice-controlled robotic vehicles in various applications such as agriculture, military, and search and rescue operations.

3.3. REQUIREMENT ANALYSIS:

The experimental setup for a voice controlled robotic vehicle using Internet of Things (IoT) would typically involve the following components:

1. Micro-controller:

A microcontroller is a small, integrated circuit chip that contains a microprocessor, memory, and input/output peripherals on a single chip. It is a type of computer on a chip that is designed to perform a specific task, typically within an embedded system . The microcontroller has a central processing unit (CPU) that controls the operation of the device. It is usually a small, low-power, low-cost CPU that is designed to consume minimal power and perform simple tasks efficiently. The CPU is typically supported by a small amount of memory, which is used for program storage and data storage. Microcontrollers are widely used in embedded systems, such as in consumer electronics, automotive, medical devices, and industrial control systems. They can be programmed to perform a wide range of tasks, from simple control functions, such as turning on and off a device, to more complex operations, such as data processing and communication. Microcontrollers are designed to be low-cost, low-power, and easy to use, which makes them an ideal choice for many applications. They are often used in products that require a high degree of reliability and durability, such as in medical devices and automotive systems. In summary, microcontrollers are small, low-power, low-cost computer chips that are designed to perform specific tasks in embedded systems. They are widely used in a variety of industries and applications, and can be programmed to perform a wide range of tasks, from simple control functions to complex data processing and communication operations. The movement of the robot, sensor reading, and communication with the Android application are all managed by a microcontroller. Popular microcontrollers used in automation include Arduino, Raspberry Pi, and STM32.

There are many different types of microcontrollers available on the market, each with its own specific features and capabilities. Some of the most commonly used microcontrollers are:

1. Arduino - Arduino is an open-source electronics platform based on a simple microcontroller board. It is designed to be easy to use and accessible to beginners.

2. Raspberry Pi - Raspberry Pi is a low-cost, credit-card-sized computer that can be used for a wide range of projects, including robotics, gaming, and home automation.

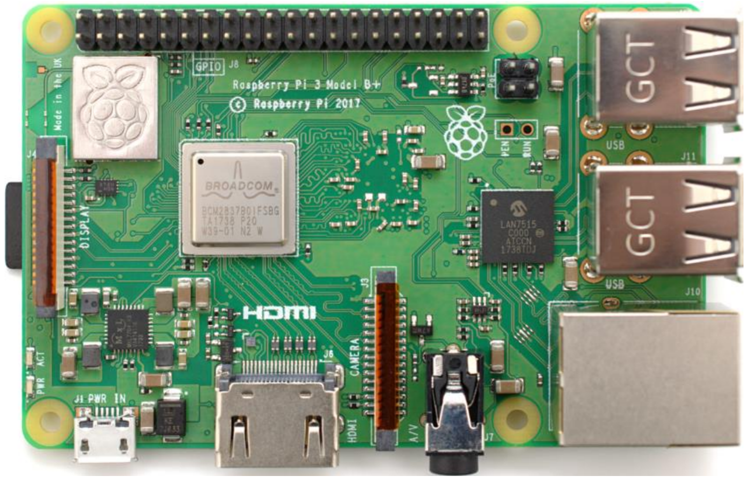


Figure 3.3.1. Raspberry Pi

3. PIC - The PIC (Peripheral Interface Controller) is a family of microcontrollers developed by Microchip Technology. They are widely used in industrial control systems, automotive systems, and consumer electronics.

Figure 3.3.2. Peripheral Interface Controller (PIC)

4. STM32 - The STM32 is a family of 32-bit microcontrollers developed by STMicroelectronics. They are designed for a wide range of applications, including automotive, industrial control, and medical devices.

In summary, there are many different types of microcontrollers available on the market, each with its own specific features and capabilities. The choice of microcontroller depends on the specific application requirements, such as performance, power consumption, and cost.

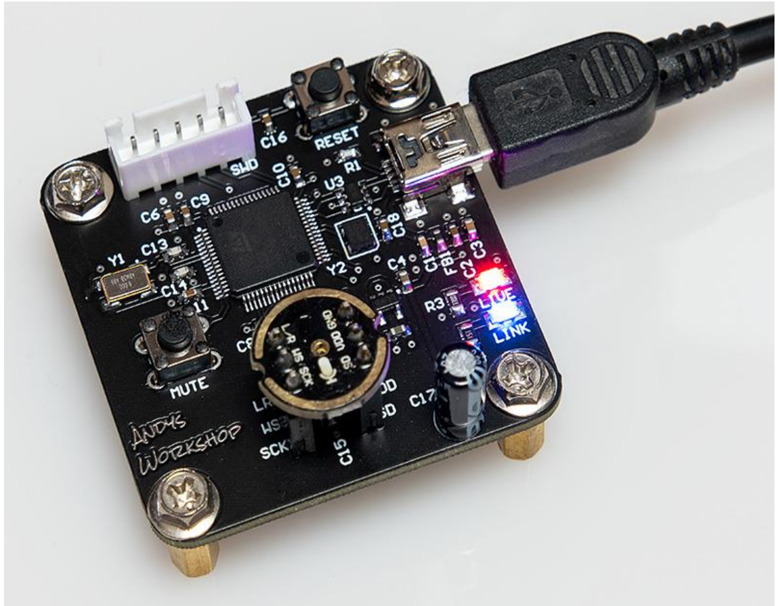


Figure 3.3.3. STM32

For the sake of simplicity we will be using **Arduino UNO.**

Figure 3.3.4. Micro-controller

Table 3.3.1 Here are some general specifications for the Arduino Uno:

Microcontroller:	ATmega328P
Operating voltage:	5V
Input voltage:	7-12V (recommended), 6-20V (limits)
Digital I/O pins:	14 (6 of which provide PWM output)
Analog input pins:	6
Flash memory:	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM:	2 KB (ATmega328P)
EEPROM:	1 KB (ATmega328P)
Clock speed:	16 MHz
Dimensions:	68.6mm x 53.4mm

2. Bluetooth Module: A Bluetooth module is a small electronic device that enables wireless communication between electronic devices using Bluetooth technology. Bluetooth is a wireless communication protocol that allows devices to exchange data over short distances, typically up to 10 meters. Bluetooth modules are usually small and can be easily integrated into electronic devices, such as smartphones, computers, and IoT devices, to enable wireless communication with other devices that also have Bluetooth capabilities. They can also be used to create wireless communication networks, such as Bluetooth mesh networks, for a wide range of applications. Bluetooth modules typically include a microcontroller, a Bluetooth radio, and an antenna. They can be configured to support various Bluetooth profiles, such as **Advanced Audio Distribution Profile (A2DP)**, which is used for streaming audio, and **Human Interface Device (HID)**, which is used for wireless keyboards and mice. Bluetooth modules are widely used in a variety of applications, such as wireless audio devices, home automation systems, and industrial control systems. They are also commonly used in mobile robotics, where they can be used to enable wireless communication between a robot and a remote control device. In summary, a Bluetooth module is a small electronic device that enables wireless communication between electronic devices using Bluetooth technology. They are widely used in a variety of applications, such as wireless audio devices, home automation systems, and mobile robotics.

There are many different types of Bluetooth modules available on the market, each with its own specific features and capabilities. Here are some of the most commonly used Bluetooth modules:

1. HC-05 - The HC-05 is a popular Bluetooth module that supports Bluetooth 2.0 and can be used for wireless communication with smartphones, computers, and other devices.
2. HC-06 - The HC-06 is a similar module to the HC-05, but it supports only the Slave mode of Bluetooth operation.

Figure 3.3.5. HC-06

3. RN4020 - The RN4020 is a Bluetooth Low Energy (BLE) module that supports Bluetooth 4.1 and can be used for low-power wireless communication with smartphones and other devices.

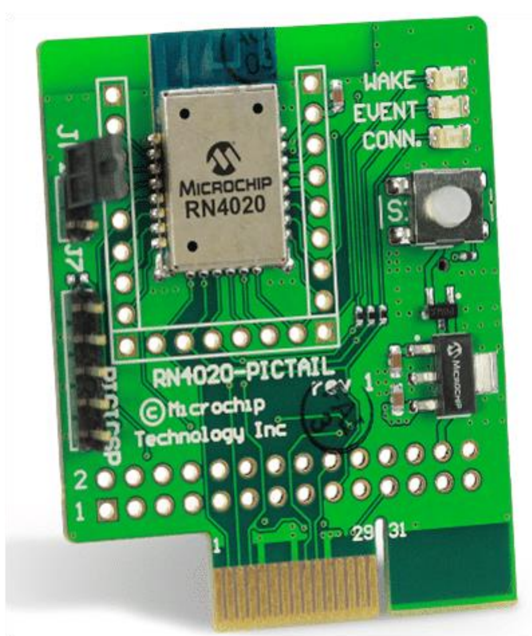


Figure 3.3.6. RN4020

4. CC2540 - The CC2540 is another BLE module that supports Bluetooth 4.0 and is widely used in industrial and medical applications.

Figure 3.3.7. CC2540

5. Bluegiga WT32i - The Bluegiga WT32i is a high-end Bluetooth module that supports Bluetooth 3.0 and can be used for wireless audio streaming and other high-bandwidth applications.

Figure 3.3.8. Bluegiga WT32i

6. HM-10 - The HM-10 is a BLE module that supports Bluetooth 4.0 and can be used for low-power wireless communication with smartphones and other devices.

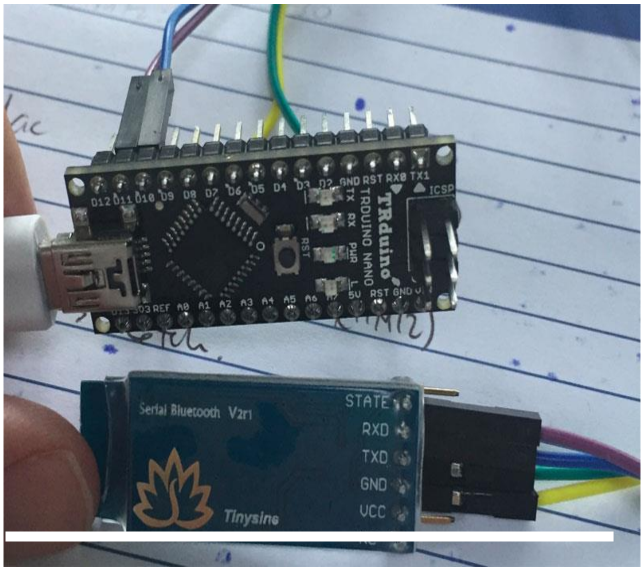


Figure 3.3.9. Bluetooth Module HM-10

7. NRF51822 - The NRF51822 is another BLE module that supports Bluetooth 4.0 and is widely used in wearable devices and other low-power applications.

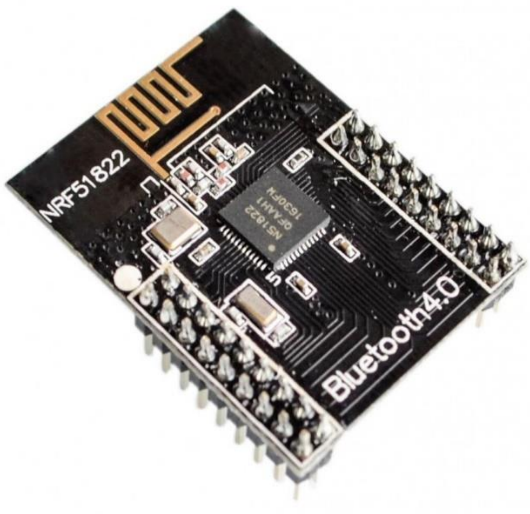


Figure 3.3.10. Bluetooth Module NRF51822

In summary, there are many different types of Bluetooth modules available on the market, each with its own specific features and capabilities. The choice of Bluetooth module depends on the specific application requirements, such as range, power consumption, and data bandwidth. The vocal commands are returned to the Arduino via a Bluetooth module,HC-05 which then directs the robot to go forward, backward, or turn left and right. Due to the voice control of the vehicle, we use a Bluetooth module to move the robots. The standard orders are forward, backward, left, and right.

Figure 3.3.11. Bluetooth Module HC-05

Table 3.3.2. Here are some general specifications for the HC-05 Bluetooth module:

Bluetooth version:	Bluetooth v2.0 + EDR (Enhanced Data Rate)
Frequency range:	2.4GHz ISM band
Modulation method:	GFSK (Gaussian Frequency Shift Keying)
Transmit power:	Class 2, up to 4dBm maximum
Operating voltage:	3.3V DC
Operating current:	< 40mA
Standby current:	< 2.5mA
Transmission distance:	up to 10m
Default baud rate:	9600 bps
Dimensions:	28mm x 15mm x 2.35mm

3. Motor Driver: A motor driver is an electronic device that controls the speed, direction, and torque of an electric motor. It is a type of power amplifier that receives low-power control signals from a microcontroller or other electronic device and uses those signals to drive a motor A motor driver typically consists of a driver circuit, a power amplifier, and some form of protection circuitry. The driver circuit receives the control signals and generates the necessary signals to drive the power amplifier. The power amplifier then amplifies the signals and sends them to the motor, which responds by rotating at the desired speed and direction. Motor drivers are commonly used in robotics, industrial control systems, and automotive applications, where they are used to control the speed and direction of electric motors in various devices and machines. There are many different types of motor drivers available on the market, including H-bridge drivers, brushed DC motor drivers, and stepper motor drivers. The choice of motor driver depends on the specific requirements of the motor and the application, such as the voltage and current rating of the motor, the desired speed and torque, and the available power supply. In summary, a motor driver is an electronic device that controls the speed, direction, and torque of an electric motor. They are commonly used in robotics, industrial control systems, and automotive applications, and there are many different types of motor drivers available to suit different motor and application requirements. A motor driver controls the robot's movement. The L293D is a popular dual H-bridge motor driver IC used to control the speed and direction of DC motors in small-scale robotics and electronics projects. It has two H-bridge circuits capable of driving a DC motor in both forward and reverse directions, and can handle voltages from 4.5V to 36V and currents up to 600mA per channel. It can be controlled using TTL or CMOS logic inputs and is widely used due to its low cost and ease of use. However, for more demanding applications, higher-rated motor drivers may be necessary. It receives inputs from the microcontroller and transforms them into instructions that the motors can understand. There are two popular motor drivers used in automation: L293D and TB6612FNG. We'll be using L293D in our product.

Table 3.3.3 Here are the specifications for the L293D motor driver:

Supply voltage	: 4.5V to 36V
Output current per channel	600mA continuous, 1.2A peak
Total output current	1.2A continuous, 2.4A peak
Maximum input voltage	2.3V (high state), 0.4V (low state)
Logic supply voltage	4.5V to 7V
Low quiescent current:	0.6mA per channel
Package	16-pin DIP or SOIC
Operating temperature	0°C to 70°C

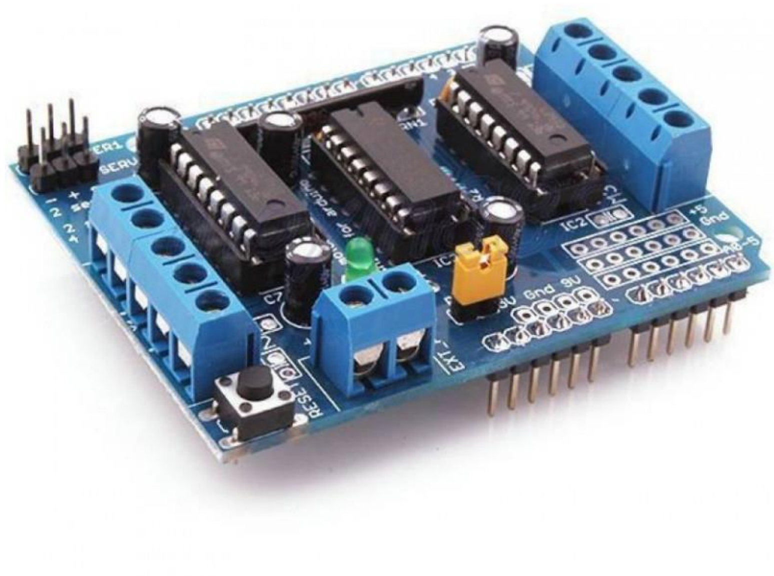


Figure 3.3.12. Motor Driver(L293D)

4. Motors: A motor is a device that converts electrical energy into mechanical energy. It is a type of machine that produces rotational or linear motion by using electromagnetic principles Electric motors typically consist of a stator, which is a stationary component containing wire coils that generate a magnetic field, and a rotor, which is a rotating component that contains permanent magnets or electromagnets. When an electric current is passed through the wire coils in the stator, a magnetic field is generated that interacts with the magnetic field of the rotor, causing it to rotate. Motors are used in a wide range of applications, from small electronic devices such as fans and toys, to large industrial machines such as conveyor belts and elevators. They are also used in vehicles such as cars, trains, and planes to provide propulsion. There are many different types of motors available, including AC motors, DC motors, stepper motors, and servo motors. The choice of motor depends on the specific application requirements, such as the required speed, torque, and efficiency..

There are several types of motors available, each designed for specific applications. The two different type of motor used in the project are:

1. Gear Motors - A gear motor is a type of motor that combines a motor and a gearbox to produce high torque output. The gearbox is used to reduce the speed of the motor and increase the torque output, making it ideal for applications that require high torque, such as robotics, industrial machinery, and automotive systems. The gear motor typically consists of a motor and a set of gears enclosed in a casing. The motor drives the gears, which in turn rotate the output shaft. The gear ratio of the motor determines the speed and torque output of the motor. Gear motors are available in various types and configurations, such as spur gears, helical gears, planetary gears, and worm gears. Each type of gear provides a different balance between torque, speed, and efficiency, allowing the gear motor to be customized for specific applications. Gear motors are commonly used in applications that require high torque, such as robotics, conveyor belts, elevators, and heavy machinery. They are also used in automotive applications, such as power windows, power seats, and windshield wipers. Due to their high torque output and versatility, gear motors are a popular choice for a wide range of industrial and commercial applications.

Figure 3.3.13.Gear Motor

. **Table 3.3.4. Here are some general specifications for a typical gear motor:**

Operating voltage:	3V - 24V DC
Rated speed:	20 - 3000 RPM (revolutions per minute)
Rated torque:	0.1 - 50 kg.cm (kilogram centimeters)
Gear ratio:	10:1 to 1000:1 (ratio of the output shaft speed to the input shaft speed)
Shaft diameter:	2mm to 10mm
Motor type:	DC motor or stepper motor
Dimensions:	varies depending on the model
Weight:	varies depending on the model

2. Servo Motor - These motors are designed to provide precise control over position, speed, and torque, and are commonly used in robotics and industrial automation. They typically use a closed-loop feedback system to ensure precise control

Figure 3.3.14. Servo Motor

A servo motor is a type of motor commonly used in robotics and industrial automation applications that require precise control over position, speed, and torque. Unlike other types of motors that rotate continuously, servo motors rotate to a specific position and hold that position until instructed to move again. Servo motors typically use a closed-loop feedback system that includes a position sensor, a controller, and an actuator. The position sensor detects the current position of the motor and sends a signal to the controller. The controller then adjusts the position of the motor using the actuator to ensure that it remains at the desired position. Servo motors are available in various sizes and torque ratings, with different operating voltages and control interfaces. They are commonly used in robotics, CNC machines, and other automated systems that require precise and accurate control over motion. Due to their high accuracy and controllability, servo motors are preferred in applications where a high degree of precision is required, such as robotic arms, CNC machines, and industrial manufacturing processes.

The automaton is propelled in various directions by motors. Servo motors and DC motors are frequently used in robotics. We used 4 gear motors for our robots movements as it provides high torque and a servo motor for direction detection

Table 3.3.5. Here are some general specifications for a typical servo motor:

Operating voltage	: 4.8V - 6V DC (for hobby servo motors)
Control signal:	1ms - 2ms pulse width modulation (PWM)
Torque:	0.1 - 50 kg.cm (kilogram centimeters)
Speed:	0.1 - 0.3 seconds per 60 degrees of rotation
Rotation angle:	typically 180 degrees, but can range from 90 to 360 degrees depending on the model
Gear type:	typically metal or plastic gears
Dimensions:	varies depending on the model
Weight:	varies depending on the model

5. Sensors: An ultrasonic sensor is a device that uses sound waves to detect the distance between the sensor and an object. It emits high-frequency sound waves that bounce off an object and return to the sensor, allowing it to calculate the distance based on the time it takes for the sound waves to travel back and forth. Ultrasonic sensors are commonly used in robotics, automation, and security systems to detect the presence of objects and measure distances. They are also used in automotive parking systems to detect obstacles and avoid collisions. Ultrasonic sensors are available in various types, such as through-beam, reflective, and proximity sensors. Through-beam sensors use a separate transmitter and receiver to detect the presence of an object, while reflective sensors use a single sensor to emit and detect sound waves. Proximity sensors emit sound waves at a specific frequency and measure the distance based on the frequency shift of the reflected waves. Ultrasonic sensors have several advantages over other types of sensors, such as infrared and laser sensors. They are less affected by ambient light and can detect objects regardless of their surface color or reflectivity. They are also safe to use and do not pose a health hazard to humans or animals. In summary, ultrasonic sensors are a popular choice for detecting the presence of objects and measuring distances in a wide range of applications. They offer several advantages over other types of sensors and are safe and reliable to use.

HC-SR04

The HC-SR04 is a popular ultrasonic sensor that is commonly used in robotics and automation projects. It is a low-cost sensor that is easy to use and can be interfaced with a wide range of microcontrollers.

The HC-SR04 sensor is designed to detect obstacles and measure distances by emitting a high-frequency sound wave and measuring the time it takes for the sound wave to bounce back from the object. The sensor consists of two main components: the ultrasonic transmitter and the ultrasonic receiver.

The ultrasonic transmitter emits a high-frequency sound wave, usually at a frequency of 40 kHz. The sound wave travels through the air and bounces off the object it encounters. The ultrasonic receiver then picks up the sound wave and measures the time it took for the sound wave to travel to the object and back Based on the time measurement, the HC-SR04 sensor can determine the distance to the object using the formula:

Distance = (Time x Speed of Sound) / 2

where Time is the time it took for the sound wave to travel to the object and back, and Speed of Sound is the speed at which sound travels through the air. The HC-SR04 sensor has a range of 2cm to 400cm and a resolution of 0.3cm. The accuracy of the sensor can be affected by factors such as temperature, humidity, and the surface of the object being detected. In addition, the HC-SR04 sensor has a narrow beam angle of around 15 degrees, which means that it can only detect objects within a relatively small area. The HC-SR04 sensor is powered by a 5V DC power supply and requires two pins for communication with the microcontroller: one for triggering the ultrasonic transmitter and one for receiving the signal from the ultrasonic receiver. The sensor also has two additional pins for providing a 5V power supply and ground connection. The HC-SR04 sensor is compatible with a wide range of microcontrollers, including Arduino, Raspberry Pi, and other microcontrollers with digital input/output pins. The sensor can be programmed using the software provided by the microcontroller manufacturer or by using third-party libraries and code examples. One of the advantages of the HC-SR04 sensor is its low cost, which makes it accessible to hobbyists and students who are working on robotics and automation projects. In addition, the HC-SR04 sensor is easy to use and can be integrated with a wide range of microcontrollers without requiring specialized hardware or software. However, the HC-SR04 sensor also has some limitations that should be considered when using it in a project. For example, the narrow beam angle of the sensor means that it may not be suitable for applications where a wider field of view is required. In addition, the accuracy of the sensor can be affected by environmental factors such as temperature and humidity, which may require calibration or compensation in the software. Overall, the HC-SR04 sensor is a versatile and useful component that can be used in a wide range of robotics and automation projects. Its low cost and ease of use make it an accessible option for hobbyists and students who are learning about robotics and automation, while its performance and reliability make it suitable for more advanced projects as well.

Figure 3.3.15. Sensor HC-SR04

Table 3.3.6. Here are some general specifications for the HC-SR04 ultrasonic sensor:

Operating voltage:	5V DC
Operating current:	15mA
Operating frequency:	40kHz
Measurement range:	2cm - 400cm
Accuracy:	up to 3mm
Trigger pulse width:	10µs
Echo pulse width	: proportional to the distance of the object detected
Dimensions:	45mm x 20mm x 15mm

6. Android Application: An Android app for voice-controlled robotic vehicle is a mobile application that enables users to control a robotic vehicle using voice commands. The app connects to the robotic vehicle via a wireless communication protocol such as Bluetooth or Wi-Fi, and converts the voice commands into instructions that are sent to the vehicle's microcontroller. The app typically consists of a user interface that displays the available commands and allows the user to select the desired action. The user can then speak the command into the app, which will interpret the speech and send the appropriate instructions to the vehicle. The voice-controlled robotic vehicle can be used in a variety of applications, such as surveillance, exploration, and entertainment. It can also be used in hazardous environments, such as in disaster response operations, where it is not safe for humans to enter. To create an Android app for voice-controlled robotic vehicle, a developer must have a good understanding of programming languages such as Java and Kotlin, and must be familiar with Android development tools such as Android Studio. The developer must also have experience in wireless communication protocols such as Bluetooth and Wi-Fi, and must be able to interface with microcontrollers such as Arduino or Raspberry Pi. In summary, an Android app for voice-controlled robotic vehicle is a useful tool that enables users to control a robotic vehicle using their voice. It has a wide range of applications and requires a developer with knowledge in programming, wireless communication, and microcontroller interfacing.

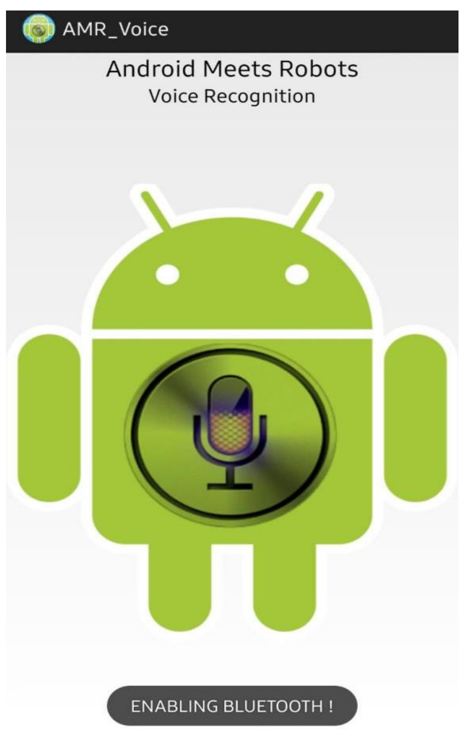


Figure 3.3.16. Android Application

7. Power Source: The power source for a voice-controlled robotic vehicle is a critical component that can significantly impact the performance and functionality of the robot. There are several factors to consider when selecting a power source, including the required voltage and current, the capacity and runtime, the weight and size of the battery, and the cost and availability of the battery.

One of the most common power sources for robotic vehicles is batteries. Batteries provide a convenient and portable power source that can be easily integrated into the robot. There are many types of batteries available, including alkaline, nickel-cadmium (NiCad), nickel-metal-hydride (NiMH), and lithium-ion (Li-ion) batteries. Alkaline batteries are commonly used for low-power applications, but they have a relatively short lifespan and are not rechargeable. NiCad and NiMH batteries are rechargeable and have a longer lifespan than alkaline batteries, but they are heavy and have a lower energy density. Li-ion batteries have a high energy density and are lightweight, making them a popular choice for high-power applications such as robotic vehicles. When selecting a battery for a voice-controlled robotic vehicle, it is important to consider the required voltage and current of the robot. The voltage and current requirements will depend on the specific components used in the robot, such as the motors, sensors, and microcontroller. It is essential to select a battery with the appropriate voltage and current output to ensure that the robot operates efficiently and reliably. The capacity and runtime of the battery are also critical factors to consider when selecting a power source for a robotic vehicle. The capacity of a battery is measured in ampere-hours (Ah) and indicates how much energy the battery can store. The runtime of the battery will depend on the capacity and the current draw of the robot. It is essential to select a battery with sufficient capacity and runtime to ensure that the robot can operate for the desired duration without needing to be recharged. The weight and size of the battery are also important factors to consider when selecting a power source for a robotic vehicle. The weight of the battery will impact the overall weight of the robot, which can affect its mobility and stability. The size of the battery will also impact the size and design of the robot, and it is essential to select a battery that can be integrated into the robot without adding excessive weight or size. The cost and availability of the battery are also important factors to consider when selecting a power source for a robotic vehicle. Li-ion batteries are more expensive than other types of batteries, but they offer a higher energy density and longer lifespan. It is essential to select a battery that is within the budget and readily available to ensure that the robot can be built and maintained without difficulty. In addition to batteries, other power sources that can be used for robotic vehicles include solar panels, fuel cells, and external power sources such as **wall outlets** or generators. Solar panels can be used to recharge batteries and provide an environmentally friendly and renewable energy source. Fuel cells can provide a high-power density and long runtime, but they can be expensive and require specialized infrastructure. External power sources can provide a reliable and constant power source, but they can limit the mobility of the robot and may not be suitable for all applications.

In conclusion, the power source for a voice-controlled robotic vehicle is a critical component that should be carefully selected based on the specific requirements of the robot. Batteries are a popular choice for robotic vehicles due to their convenience, portability, and availability, but other power sources such as solar panels, fuel cells, and external power sources can also be used depending on the specific application. When selecting a power source, it is essential to consider the voltage and current requirements, capacity and runtime, weight and size, and cost and availability to ensure that the robot operates efficiently and reliably.

Table 3.3.7. Here is a specification table for a typical 9V 2A adapter:

Input voltage	100-240V AC, 50/60Hz
Output current	:2A
Output power	: 18W
Connector type:	Barrel plug with 5.5mm outer diameter and 2.1mm inner diameter
Polarity:	Center-positive
Efficiency	: >80%
Ripple and noise:	<100mVp-p
Operating temperature:	0-40°C

Figure 3.3.17. Power Source

3.4. FEATURE IDENTIFICATION:

A voice-controlled robotic vehicle can have several features and character identification options. Here are some ideas:

1. Voice Recognition: Voice recognition is a critical feature in voice-controlled robotic vehicles. It refers to the ability of the vehicle to recognize and interpret voice commands accurately. Voice recognition technology has come a long way in recent years, and it is now an essential part of many voice-controlled devices.

In a voice-controlled robotic vehicle, voice recognition technology enables the driver to perform various functions by speaking commands rather than using buttons or switches. The technology works by analyzing the user's speech patterns and converting them into digital signals that the vehicle's computer can interpret.

There are several components involved in voice recognition technology, including:

a) **Microphone**: The microphone is the primary input device for voice recognition technology. It captures the user's voice and converts it into an electrical signal that can be processed by the vehicle's computer.

b) **Speech Recognition Software**: The speech recognition software is responsible for converting the analog voice signal into a digital signal that can be interpreted by the vehicle's computer. The software analyzes the user's speech patterns and attempts to match them to a pre-existing database of voice commands.

c) **Natural Language Processing (NLP):** Natural language processing is a subfield of artificial intelligence that focuses on the interaction between computers and human languages. NLP technology enables voice-controlled robotic vehicles to understand and interpret the meaning behind human language rather than just recognizing individual words.

d) **Machine Learning Algorithms:** Machine learning algorithms are used to improve the accuracy of voice recognition technology over time. The algorithms analyze data from previous interactions and adjust the recognition software to improve accuracy.

Voice recognition technology has several benefits for voice-controlled robotic vehicles, including:

a) **Hands-Free Operation**: Voice recognition technology allows drivers to perform various functions without taking their hands off the steering wheel. This improves safety and reduces distractions while driving.

b) **Improved Accessibility**: Voice recognition technology makes it easier for individuals with disabilities or limited mobility to control the vehicle. It enables them to perform various functions without requiring physical buttons or switches.

c) **Faster Response Times**: Voice recognition technology enables drivers to perform functions quickly and efficiently. This is particularly useful when performing functions that require multiple button presses or switches.

d) **Increased Comfort:** Voice recognition technology makes driving a more comfortable experience. It eliminates the need to stretch or reach for buttons or switches, reducing fatigue and discomfort

However, voice recognition technology is not without its limitations. Some of the challenges associated with voice recognition technology include:

a) **Background Noise**: Background noise can interfere with voice recognition technology, making it difficult for the vehicle to accurately recognize voice commands.

b) **Accents and Dialects**: Different accents and dialects can make it challenging for voice recognition technology to accurately recognize voice commands.

c) **Limited Vocabulary**: Voice recognition technology relies on a pre-existing database of voice commands. This can limit the range of functions that can be performed through voice commands.

d) **Privacy Concerns**: Voice recognition technology requires the collection and storage of voice data, which can raise privacy concerns for some users.

In summary, voice recognition technology is a critical feature in voice-controlled robotic vehicles. It enables drivers to perform various functions quickly and efficiently, while also improving safety and comfort. However, it is essential to be aware of the limitations and challenges associated with voice recognition technology and to continue to develop and refine the technology to improve accuracy and functionality.

2. Intelligent Navigation: Intelligent navigation is a crucial aspect of voice-controlled robotic vehicles. It involves the use of sensors, algorithms, and software to enable the vehicle to move autonomously while avoiding obstacles and reaching its destination. One of the most common sensors used for navigation in robotic vehicles is the ultrasonic sensor. Ultrasonic sensors emit high-frequency sound waves and measure the time it takes for the waves to bounce back after hitting an object. This information is used to determine the distance between the vehicle and the obstacle. Ultrasonic sensors are inexpensive, easy to use, and can detect a wide range of objects. Another type of sensor commonly used in navigation is the infrared sensor. Infrared sensors emit infrared light and measure the amount of light that is reflected back to the sensor. This information is used to determine the distance between the vehicle and the obstacle. Infrared sensors are also inexpensive and can detect a wide range of objects, but they can be affected by ambient light. Another important sensor used in navigation is the camera. Cameras capture images of the environment, and image processing algorithms are used to extract information about the position and orientation of the vehicle relative to the surroundings. Cameras can provide high-resolution images and can be used to detect features such as lines, colors, and shapes, which can be used for navigation. In addition to sensors, algorithms and software are also critical components of intelligent navigation in robotic vehicles. Path planning algorithms are used to determine the optimal path for the vehicle to reach its destination while avoiding obstacles. Localization algorithms are used to determine the position and orientation of the vehicle relative to the surroundings. Control algorithms are used to adjust the movement of the vehicle based on the sensor data and the desired path. One approach to intelligent navigation in voice-controlled robotic vehicles is the use of Simultaneous Localization and Mapping (SLAM). SLAM is a technique that enables a robot to create a map of its environment while simultaneously determining its location within the map. SLAM algorithms use sensor data to estimate the position and orientation of the robot relative to the surroundings, and this information is used to update the map. SLAM can be used to enable a robot to navigate autonomously in an unknown environment. Another approach to intelligent navigation is the use of Machine Learning (ML) algorithms. ML algorithms can be used to analyze sensor data and learn patterns in the environment. For example, ML algorithms can be used to learn the location of obstacles and create a map of the environment. ML algorithms can also be used to learn the optimal path for the vehicle to reach its destination. Voice commands can also be used to control the navigation of robotic vehicles. Voice commands can be used to specify the destination and provide feedback on the navigation. For example, a user could say "go to the kitchen" and the robot would navigate to the kitchen while avoiding obstacles. The user could also say "stop" to stop the robot or "turn left" to change the direction of the robot.

In conclusion, intelligent navigation is a critical aspect of voice-controlled robotic vehicles. It involves the use of sensors, algorithms, and software to enable the vehicle to move autonomously while avoiding obstacles and reaching its destination. Ultrasonic sensors, infrared sensors, and cameras are commonly used for navigation. Path planning, localization, and control algorithms are used to enable the robot to navigate autonomously. SLAM and ML algorithms can be used to create maps of the environment and learn patterns in the environment. Voice commands can be used to control the navigation of the robot. The development of intelligent navigation systems is crucial for the advancement of voice-controlled robotic vehicles and for their use in a wide range of applications, including transportation, search and rescue, and surveillance.

3. Multi-Sensor Integration: Multi-sensor integration is a critical component of many voice-controlled robotic vehicles, allowing the vehicle to operate effectively in complex environments and navigate autonomously. By combining multiple sensors, such as ultrasonic sensors, cameras, and GPS, the vehicle can gather a comprehensive picture of its surroundings and make intelligent decisions based on the data it collects. One common application of multi-sensor integration is obstacle detection and avoidance. Ultrasonic sensors can detect the distance and shape of objects in the vehicle's path, while cameras can provide additional information about the environment and obstacles. By combining this data, the vehicle can make intelligent decisions about its path and avoid obstacles as it moves. Another application is indoor navigation. GPS can be unreliable indoors, so multi-sensor integration can be used to provide accurate indoor navigation. By combining sensors such as inertial measurement units, magnetometers, and Wi-Fi signals, the vehicle can determine its location and navigate autonomously within an indoor environment. To implement multi-sensor integration in a voice-controlled robotic vehicle, the system must be carefully designed to ensure compatibility and accuracy between the various sensors. This often requires complex algorithms and data fusion techniques to combine the sensor data and provide accurate and reliable information to the vehicle's control system. Multi-sensor integration can also be used to enhance the accuracy and reliability of voice recognition technology. By combining microphones and noise-cancelling algorithms, the system can isolate and recognize speech in noisy environments. This can be particularly useful in applications such as vehicles operating in busy urban environments. In summary, multi-sensor integration is a critical component of many voice-controlled robotic vehicles, allowing the vehicle to navigate autonomously and make intelligent decisions based on its surroundings and user commands. By combining multiple sensors, the vehicle can gather a comprehensive picture of its environment and make accurate decisions about its movements. However, this requires careful design and implementation to ensure accuracy and reliability, and may not be suitable for all applications or environments.

4. Communication Capabilities: Voice-controlled robotic vehicles require various communication capabilities to function correctly, including wireless communication and communication with other devices and systems. These capabilities are essential to enable the vehicle to receive voice commands from the user, process the commands, and respond accordingly. In this context, we will discuss the different communication capabilities of voice-controlled robotic vehicles.

Wireless communication is a critical requirement for voice-controlled robotic vehicles. It enables the vehicle to communicate with the user and other systems, such as the internet or other vehicles. Bluetooth, Wi-Fi, and cellular networks are common communication technologies used in voice-controlled robotic vehicles. Bluetooth is a low-power wireless technology that is commonly used in short-range communication applications. It is widely used in voice-controlled robotic vehicles to enable communication between the vehicle and the user's smartphone or other Bluetooth-enabled devices. Wi-Fi, on the other hand, is a high-bandwidth wireless technology that can provide connectivity over more extended distances. It is commonly used in voice-controlled robotic vehicles to provide internet connectivity, enabling the vehicle to access data and information from the internet. Cellular networks, such as 4G and 5G, are also used in some voice-controlled robotic vehicles, allowing them to communicate with other vehicles and access data and information over cellular networks.

Another important communication capability of voice-controlled robotic vehicles is the ability to communicate with other devices and systems. This capability allows the vehicle to receive and process data from other systems, such as GPS, cameras, and sensors. This information is critical for the vehicle to navigate, avoid obstacles, and make intelligent decisions. Communication with other devices and systems can be achieved using various technologies such as Bluetooth, Wi-Fi, Ethernet, and serial communication protocols such as I2C, SPI, and UART Moreover, voice-controlled robotic vehicles require an interface that enables the user to control the vehicle through voice commands. This interface requires a microphone to receive voice commands from the user and a speech recognition system to process the commands. The speech recognition system must be accurate, reliable, and capable of recognizing various voice commands. The user interface should be intuitive and straightforward, allowing the user to control the vehicle efficiently.

Finally, voice-controlled robotic vehicles require communication capabilities to interface with other autonomous vehicles or systems, such as traffic lights, road signs, and other road infrastructure. This communication enables the vehicle to operate efficiently and safely, avoiding collisions and navigating in complex environments. Various communication protocols are used for this purpose, such as Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication protocols.

In summary, voice-controlled robotic vehicles require various communication capabilities to function correctly. Wireless communication, communication with other devices and systems, an intuitive user interface, and communication with other autonomous vehicles and systems are critical components of the vehicle's communication capabilities. To ensure reliable and efficient communication, the vehicle's communication system must be carefully designed and implemented, using appropriate communication protocols and technologies.

5. Safety Features: Safety is a critical consideration in the design of voice-controlled robotic vehicles. These vehicles operate autonomously, and any malfunction or accident can result in severe consequences. As such, safety features are essential to ensure the safety of passengers, other road users, and the surrounding environment. In this context, we will discuss some of the key safety features that are necessary in voice-controlled robotic vehicles.

a) Collision Avoidance System: A collision avoidance system is a critical safety feature in voice-controlled robotic vehicles. This system uses sensors such as ultrasonic, infrared, or LIDAR sensors to detect obstacles and other vehicles on the road. The system then provides the vehicle with the necessary data to avoid collisions and navigate safely.

b) Emergency Stop Button: An emergency stop button is a physical button that can stop the vehicle in the event of an emergency. This button is typically located in a visible and easily accessible location within the vehicle. When pressed, the vehicle stops immediately, preventing any further damage or danger.

c) Redundancy: Redundancy is another essential safety feature in voice-controlled robotic vehicles. The vehicle's critical systems, such as the navigation, communication, and control systems, should have backup systems in case of failure. This ensures that the vehicle can continue to operate safely even in the event of a malfunction or system failure.

d) Safe Operating Limits: Safe operating limits define the maximum speed, acceleration, and deceleration limits for the vehicle. These limits are set to ensure the safe operation of the vehicle and prevent any accidents. The safe operating limits also take into consideration the vehicle's load capacity, road conditions, and weather conditions.

e) **Fail-Safe Mode**: A fail-safe mode is a critical safety feature that activates when the vehicle's primary systems fail. This mode is designed to ensure that the vehicle remains in a safe and stable state until the systems can be restored. The fail-safe mode can activate emergency braking, slow the vehicle's speed, or move the vehicle to a safe location.

f) **Regular Maintenance**: Regular maintenance is essential to ensure the safety and reliability of voice-controlled robotic vehicles. The vehicle's sensors, control systems, and other critical components must be regularly inspected, calibrated, and maintained to prevent malfunctions and accidents.

In conclusion, safety features are critical components of voice-controlled robotic vehicles. Collision avoidance systems, emergency stop buttons, redundancy, safe operating limits, fail-safe modes, and regular maintenance are essential to ensure the safe and reliable operation of these vehicles. As the technology advances and voice-controlled robotic vehicles become more prevalent, it is crucial to continue developing and improving safety features to ensure the safety of passengers, other road users, and the surrounding environment..

6. Personalization: Personalization is an essential aspect of voice-controlled robotic vehicles. It refers to the ability of the vehicle to adapt to the user's needs, preferences, and behavior patterns. Personalization enhances the user experience, improves the vehicle's functionality, and creates a more intuitive and seamless driving experience.

There are several ways in which voice-controlled robotic vehicles can be personalized. These include:

a) **User Profiles**: User profiles are unique settings that store the user's preferences, such as seating position, climate control settings, music preferences, and navigation settings. User profiles can be set up through the vehicle's user interface or by voice commands. Once set up, the vehicle automatically adjusts to the user's preferences when they enter the vehicle.

b) **Customized Commands**: Customized commands enable users to create custom voice commands for specific functions, such as opening the sunroof, adjusting the volume, or changing the temperature. Customized commands can be set up through the vehicle's user interface or by voice commands. These commands make it easier for users to control the vehicle and perform specific functions quickly.

c) **Voice Recognition**: Voice recognition technology enables the vehicle to recognize the user's voice and respond to their commands. This technology uses machine learning algorithms to analyse the user's speech patterns, tone, and other characteristics to improve accuracy over time. The vehicle can also be trained to recognize specific voice commands unique to the user.

d) **Predictive Analytics**: Predictive analytics technology uses data analysis to predict user behavior and preferences. The vehicle can analyse data such as driving patterns, music preferences, and climate control settings to anticipate the user's needs and make recommendations or adjustments accordingly.

e) **Mobile Apps**: Mobile apps enable users to control the vehicle from their mobile device. The app can be used to adjust settings, view real-time data, and access personalized features such as music playlists or navigation preferences. The app can also provide personalized recommendations based on the user's behavior patterns and preferences.

Personalization is an essential feature for voice-controlled robotic vehicles. It enhances the user experience, improves functionality, and creates a more intuitive and seamless driving experience. As the technology continues to advance, we can expect to see even more personalized features that make driving a voice-controlled robotic vehicle a truly unique and personalized experience.

3.5. NOTED DOWN THE CONSTRAINTS OF THE VOICE CONTROLLED ROBOTIC VEHICLE:

There may be a number of limitations for voice-controlled robotic vehicles to take into account. For a voice-controlled robotic vehicle, the following are some constraint identification points :

1. **Speech Recognition Accuracy**: Speech recognition technology has come a long way in the last few decades, and with the advent of artificial intelligence and machine learning, it has become even more sophisticated. Today, speech recognition accuracy is one of the key factors that determine the success of many voice-controlled applications, including robotic vehicles. In this article, we will explore the importance of speech recognition accuracy for voice-controlled robotic vehicles and how it can be achieved. Speech Recognition and Voice-Controlled Robotic Vehicles Speech recognition is the process of converting spoken words into text or commands that a computer or device can understand. Voice-controlled robotic vehicles rely on speech recognition technology to receive commands from the user and perform actions accordingly. These vehicles are typically used in industries such as manufacturing, logistics, and healthcare to automate tasks that are dangerous or tedious for human workers. The accuracy of speech recognition is crucial for voice-controlled robotic vehicles because any error or misinterpretation can result in the vehicle performing the wrong action or not responding at all. This can lead to safety hazards, production delays, and other problems.

Factors Affecting Speech Recognition Accuracy

Several factors can affect the accuracy of speech recognition technology. These include:

a) **Background Noise**: One of the biggest challenges in speech recognition is dealing with background noise. Robotic vehicles are often used in noisy environments, such as factories or warehouses, where there is a lot of machinery noise. This can make it difficult for speech recognition software to distinguish between the user's voice and other sounds.

b) **Accent and Dialect**: Speech recognition software is typically trained on a specific accent or dialect. If the user has an accent or dialect that is different from the one the software was trained on, the accuracy of the system can be affected.

c) **Vocabulary and Syntax:** Speech recognition software is designed to recognize specific words and phrases. If the user speaks in a way that is not recognized by the software, or if the user's vocabulary is different from what the software is trained on, the accuracy of the system can be affected.

d) Speech Rate: Speech recognition software works best when the user speaks at a normal pace. Speaking too fast or too slow can affect the accuracy of the system.

e) Audio Quality: The quality of the audio recording can also affect the accuracy of speech recognition. Poor quality audio, such as background noise or a low-quality microphone, can make it difficult for the software to recognize the user's voice.

Improving Speech Recognition Accuracy

To improve the accuracy of speech recognition technology for voice-controlled robotic vehicles, several techniques can be used. These include:

a) **Acoustic Modeling**: Acoustic modeling is a technique used to improve the accuracy of speech recognition in noisy environments. It involves training the speech recognition software on a large dataset of audio recordings with varying levels of background noise.

b) **Language Modeling**: Language modeling is a technique used to improve the accuracy of speech recognition for specific languages or dialects. It involves training the speech recognition software on a large dataset of text in the target language or dialect.

c) **Personalization:** Personalization is a technique used to improve the accuracy of speech recognition for individual users. It involves training the speech recognition software on a specific user's voice and vocabulary.

d) **Adaptive Learning:** Adaptive learning is a technique used to improve the accuracy of speech recognition over time. It involves analyzing the user's speech patterns and adjusting the software's algorithms to improve recognition accuracy.

e) **Audio Processing:** Audio processing techniques, such as noise reduction and echo cancellation, can be used to improve the quality of the audio recording and, as a result, the accuracy of speech recognition.

2. **Vocabulary Limitations**: The speech recognition technology in the car might not be able to recognize or comprehend certain words or phrases. The variety of commands that can be provided to the car may be limited as a result, and users may need to learn particular words or phrases to control it effectively. Vocabulary limitations can be a major challenge for voice-controlled robotic vehicles. These vehicles rely on speech recognition technology to receive commands from users and perform actions accordingly. However, speech recognition software is designed to recognize specific words and phrases. If the user speaks in a way that is not recognized by the software, or if the user's vocabulary is different from what the software is trained on, the accuracy of the system can be affected. One of the biggest limitations of speech recognition technology is its inability to recognize slang, jargon, or specialized terminology that may be used in specific industries or fields. For example, a robotic vehicle used in the healthcare industry may need to recognize medical terminology, while one used in the logistics industry may need to recognize shipping and inventory terms. If the speech recognition software is not trained on these specific vocabularies, it may not recognize commands from the user. Another limitation is the software's ability to recognize accents and dialects. Speech recognition software is typically trained on a specific accent or dialect, and if the user has an accent or dialect that is different from the one the software was trained on, the accuracy of the system can be affected. This is particularly true in multilingual environments, where users may speak multiple languages or have accents that are difficult for the software to recognize. Furthermore, speech recognition software can struggle with homophones, which are words that sound the same but have different meanings. For example, the words "to," "too," and "two" sound the same but have different meanings. If the speech recognition software is not able to differentiate between these words, it may misinterpret commands from the user. To address these limitations, speech recognition software needs to be trained on a wide variety of vocabularies, accents, and dialects. This can be achieved through acoustic modeling and language modeling techniques, which involve training the software on a large dataset of audio recordings and text in different languages, dialects, and industries. Personalization can also help to improve accuracy by training the software on a specific user's voice and vocabulary.

In conclusion, vocabulary limitations can be a significant challenge for voice-controlled robotic vehicles. The ability of speech recognition software to recognize specialized terminology, accents, and homophones is critical for the success of these vehicles. To address these limitations, speech recognition software needs to be trained on a wide variety of vocabularies and language models, as well as using adaptive learning and personalization techniques to improve the system's accuracy over time. With ongoing advancements in artificial intelligence and machine learning, we can expect speech recognition technology to continue to improve and overcome these limitations in the future.

3. **Noise and Environmental Factors:** Background noise and other environmental elements, such as wind, traffic, or other sounds, can affect voice control. These outside variables could obstruct voice commands, making it more difficult for the car to recognise and understand user requests. Noise and environmental factors can have a significant impact on the accuracy of voice-controlled robotic vehicles. These vehicles rely on speech recognition technology to receive commands from users and perform actions accordingly. However, external noise sources and environmental factors such as reverberation and interference can affect the accuracy of the speech recognition system. One of the main challenges with external noise sources is that they can interfere with the microphone's ability to pick up the user's voice. This can be particularly problematic in noisy environments such as factories or construction sites, where the vehicle may need to operate. If the speech recognition software cannot distinguish between the user's voice and the background noise, it may misinterpret commands or fail to recognize them altogether. Reverberation is another factor that can affect the accuracy of the speech recognition system. Reverberation occurs when sound waves reflect off surfaces in a room, causing multiple sound waves to reach the microphone at different times. This can make it difficult for the speech recognition software to isolate the user's voice and distinguish it from the reflected sound waves, leading to errors in the recognition process. Interference from other wireless signals can also affect the accuracy of voice recognition technology. In environments with multiple wireless devices, such as Wi-Fi networks, Bluetooth devices, and cellular networks, these signals can interfere with the microphone's ability to pick up the user's voice. This interference can cause the speech recognition software to misinterpret commands or fail to recognize them altogether. To address these challenges, speech recognition software needs to be designed to filter out external noise sources and environmental factors. This can be achieved through various techniques such as noise reduction algorithms, echo cancellation, and beamforming. These techniques are designed to improve the signal-to-noise ratio of the user's voice, making it easier for the speech recognition software to recognize commands. Another approach is to use microphones that are designed to pick up specific frequencies associated with the human voice while filtering out unwanted noise. These microphones can be directional, meaning they only pick up sound from a specific direction, or omni-directional, meaning they pick up sound from all directions.

In conclusion, noise and environmental factors can pose significant challenges for voice-controlled robotic vehicles. The ability of speech recognition software to filter out external noise sources and environmental factors is critical for the success of these vehicles. Through the use of noise reduction algorithms, echo cancellation, beamforming, and specialized microphones, the accuracy of the speech recognition system can be improved. As technology continues to evolve, we can expect speech recognition systems to become even more advanced, allowing voice-controlled robotic vehicles to operate more efficiently and effectively in a variety of noisy environments.

4. **Response Time**: Another restriction to take into account is how quickly the autonomous vehicle responds to spoken commands. It's possible for there to be a lag between giving a command and the vehicle carrying it out. It's essential to reduce this response time for a seamless and intuitive user experience.

Response time is a critical factor in the performance of voice-controlled robotic vehicles. These vehicles rely on speech recognition technology to receive commands from users and perform actions accordingly. The time it takes for the system to recognize the command and respond can have a significant impact on the overall efficiency of the vehicle. One of the main factors that can affect response time is the processing power of the speech recognition system. The more complex the speech recognition system, the longer it may take to process the user's command and respond accordingly. This can be particularly problematic in real-time applications, where the vehicle may need to respond quickly to changes in its environment or to the user's commands. Another factor that can affect response time is the quality of the microphone and the signal processing algorithms used to extract the user's voice from the background noise. If the microphone is of low quality or the signal processing algorithms are not optimized for the specific environment, it may take longer for the system to recognize the user's command and respond accordingly. The design of the user interface can also impact response time. If the interface is not intuitive or the commands are not easy to understand, it may take the user longer to issue commands, leading to slower response times. Additionally, if the system requires the user to provide too much information or navigate through too many menus, it can lead to frustration and slower response times. To address these challenges, speech recognition systems for voice-controlled robotic vehicles need to be designed to optimize response time. This can be achieved through various techniques such as optimizing the processing power of the system, improving the quality of the microphone and signal processing algorithms, and designing intuitive user interfaces. Additionally, the use of natural language processing (NLP) can help to improve response time by allowing users to issue more complex commands using natural language. NLP enables the system to recognize the intent behind the user's command, rather than just the specific words used. This can lead to faster response times and a more intuitive user experience. In conclusion, response time is a critical factor in the performance of voice-controlled robotic vehicles. The ability of the speech recognition system to process commands quickly and respond in real-time is critical for the efficiency and effectiveness of these vehicles. Through the use of optimized processing power, high-quality microphones and signal processing algorithms, intuitive user interfaces, and natural language processing, response time can be improved, leading to faster and more efficient operation of voice-controlled robotic vehicles.

5. Security and Privacy: Security and privacy are important considerations in the design and implementation of voice-controlled robotic vehicles. These vehicles rely on speech recognition technology to receive commands from users, which means that sensitive information may be transmitted and stored in the system. As such, it is important to ensure that appropriate measures are taken to protect the security and privacy of this information. One of the primary security risks associated with voice-controlled robotic vehicles is the potential for unauthorized access to the system. If a malicious actor gains access to the vehicle's speech recognition system, they may be able to issue commands to the vehicle or obtain sensitive information stored within the system. To mitigate this risk, voice-controlled robotic vehicles should be designed with robust security measures such as encryption, multi-factor authentication, and access controls. Another important security consideration is the potential for data breaches. Voice-controlled robotic vehicles store data related to user commands and interactions, which can include sensitive personal information. To ensure the privacy of this data, it is important to implement appropriate data protection measures such as encryption, access controls, and data minimization. Privacy is also a key consideration in the design of voice-controlled robotic vehicles. The collection and processing of user voice data can raise concerns about privacy, particularly if the data is being shared with third parties. To address these concerns, voice-controlled robotic vehicles should be designed with privacy in mind, with appropriate controls in place to ensure that user data is only collected and processed for authorized purposes. One approach to ensuring the privacy of user data is to implement on-device processing of voice data. This can reduce the need to transmit voice data to remote servers for processing, reducing the risk of data breaches and unauthorized access. Additionally, voice-controlled robotic vehicles should be designed with clear privacy policies and user consent mechanisms to ensure that users are aware of how their data is being collected and used. In conclusion, security and privacy are important considerations in the design and implementation of voice-controlled robotic vehicles. These vehicles rely on speech recognition technology to receive commands from users, which means that sensitive information may be transmitted and stored in the system. To ensure the security and privacy of user data, appropriate measures such as encryption, multi-factor authentication, access controls, data minimization, and clear privacy policies should be implemented. By addressing these concerns, voice-controlled robotic vehicles can be designed to operate safely and securely in a variety of environments.

6. Limited Voice Command Complexity: One of the limitations of voice-controlled robotic vehicles is the complexity of voice commands that can be recognized by the system. While speech recognition technology has advanced significantly in recent years, it still has limitations when it comes to understanding complex sentences or natural language. This limitation can be especially problematic in environments where users may need to issue complex commands to the vehicle. For example, if a user needs to provide detailed instructions on how to navigate a complex terrain or perform a specific task, the limitations of the voice recognition system may make it difficult to issue these commands in a timely and efficient manner. Additionally, the limitations of voice command complexity can also impact the usability of the system. If users are required to issue commands in a specific format or using specific terminology, it can be difficult for new or infrequent users to navigate the system effectively. This can lead to frustration and a decrease in user satisfaction. To address these limitations, developers of voice-controlled robotic vehicles can implement natural language processing (NLP) technology, which allows the system to understand complex sentences and natural language. This can enable users to issue more complex commands, making the system more versatile and useful. Another approach to addressing the limitation of voice command complexity is to provide users with alternative input methods, such as a touch screen or a physical joystick. These alternative input methods can enable users to issue more complex commands and provide more detailed instructions to the vehicle In conclusion, the complexity of voice commands that can be recognized by the system is a limitation of voice-controlled robotic vehicles. While natural language processing technology and alternative input methods can address this limitation to some extent, it remains an important consideration for developers of these systems. By understanding these limitations and designing systems that can accommodate a variety of user input methods, voice-controlled robotic vehicles can be made more accessible and useful to a broader range of users.

7. Training and Customization: Training and customization are important considerations in the development of voice-controlled robotic vehicles. To ensure that the system can accurately recognize and respond to user commands, it is important to train the system using a diverse range of voice samples and to customize the system to the needs of the user. Training involves the process of feeding large amounts of voice data into the system to train it to recognize a range of voices and speech patterns. This data can come from a variety of sources, including user-generated data, public voice data sets, and pre-recorded speech samples. The more data the system is trained on, the more accurate its speech recognition capabilities will be. Customization involves tailoring the system to the specific needs of the user. This can include adjusting the system's language model to better understand a specific dialect or accent, as well as adjusting the system's vocabulary to recognize specific commands that are relevant to the user's needs. Customization can be especially important in environments where the user may need to issue specialized commands or operate the system in a unique way. One approach to training and customization is to use machine learning algorithms to optimize the system's speech recognition capabilities. Machine learning algorithms can be used to automatically identify patterns in the data, which can be used to improve the system's ability to recognize and respond to user commands. Additionally, machine learning can be used to adapt the system to the user's specific needs over time, ensuring that the system is always optimizing its performance based on user input. Another approach to training and customization is to provide users with the ability to manually input new voice commands into the system. This can enable users to teach the system to recognize commands that are specific to their needs or environment. For example, if a user needs to operate the vehicle in a unique environment or perform a specialized task, they may be able to input new voice commands into the system to improve its functionality in these areas.

In conclusion, training and customization are important considerations in the development of voice-controlled robotic vehicles. By training the system using a diverse range of voice data and customizing the system to the user's specific needs, developers can ensure that the system accurately recognizes and responds to user commands. Machine learning algorithms and manual input methods can be used to optimize the system's performance and improve its functionality in unique environments or specialized tasks.

8.Language Support: One of the main constraints of language support in voice-controlled robotic vehicles is the availability and quality of training data in different languages. To accurately recognize and respond to voice commands in multiple languages, the system must be trained on a diverse range of voice data in each language. However, obtaining high-quality training data in some languages may be more difficult than in others. Another constraint is the complexity of supporting multiple languages in the system. Supporting multiple languages can significantly increase the complexity of the system, requiring additional resources and development time. This can impact the overall cost and feasibility of developing a voice-controlled robotic vehicle that supports multiple languages. Another constraint is the performance of the system in recognizing and responding to voice commands in different languages. Even with sufficient training data, the system may not be able to accurately recognize and respond to voice commands in all languages, especially in cases where there are significant differences in pronunciation, grammar, or syntax between languages. Additionally, supporting multiple languages may require customizing the system's language model for each language, which can be a time-consuming process. This can further increase the development time and cost of the system, making it less feasible for some developers or organizations. Finally, there may be legal or regulatory constraints on the use of certain languages in voice-controlled robotic vehicles. For example, some countries or regions may require that certain languages be supported or may have regulations regarding the use of voice-controlled systems in public spaces. In conclusion, language support can be a significant constraint in the development of voice-controlled robotic vehicles. Constraints include the availability and quality of training data, the complexity of supporting multiple languages, the system's performance in recognizing and responding to voice commands in different languages, and legal or regulatory requirements. Developers must carefully balance the benefits of supporting multiple languages with the practical realities of developing and maintaining a complex system.

3.6. IMPLEMENTATION PLAN AND FLOWCHART:

1. Voice Controlled:

The block diagram of the voice controlled robotic vehicle is as follows. The Figure 10. Shows the connections in the circuit are made as per the following diagram.

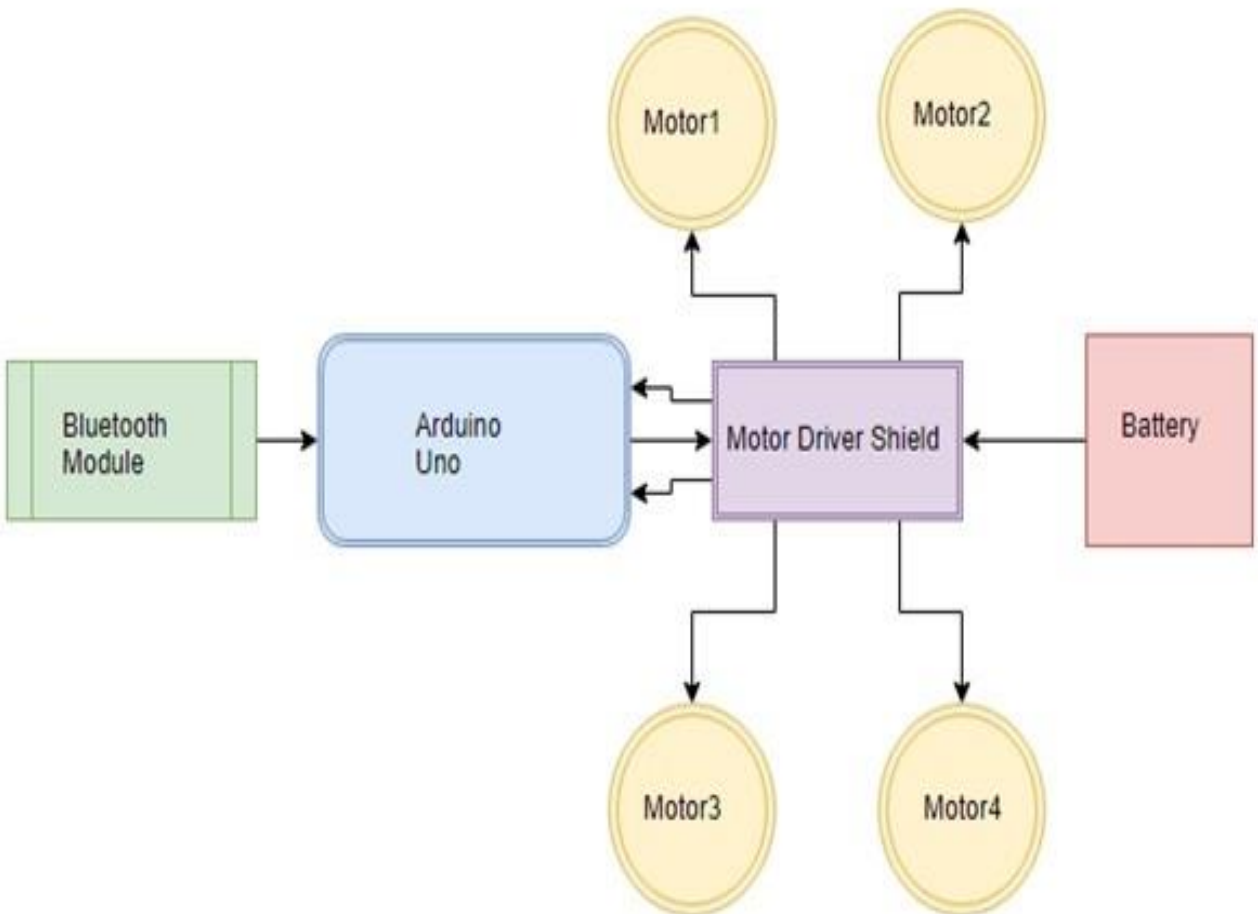


Figure 3.6.1. Block Diagram

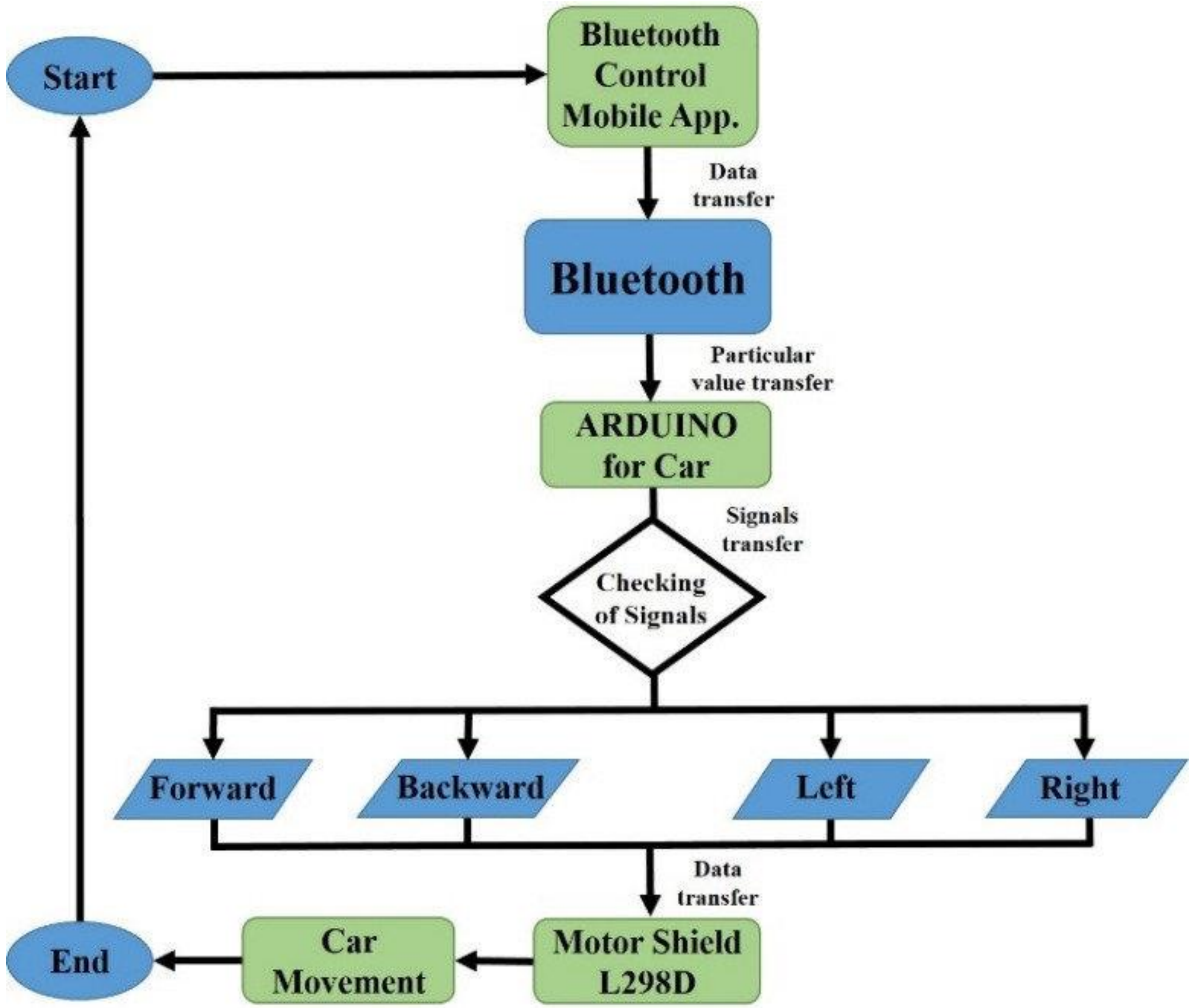


Figure 3.6.2. Flowchart

2. Obstacle Avoidance :

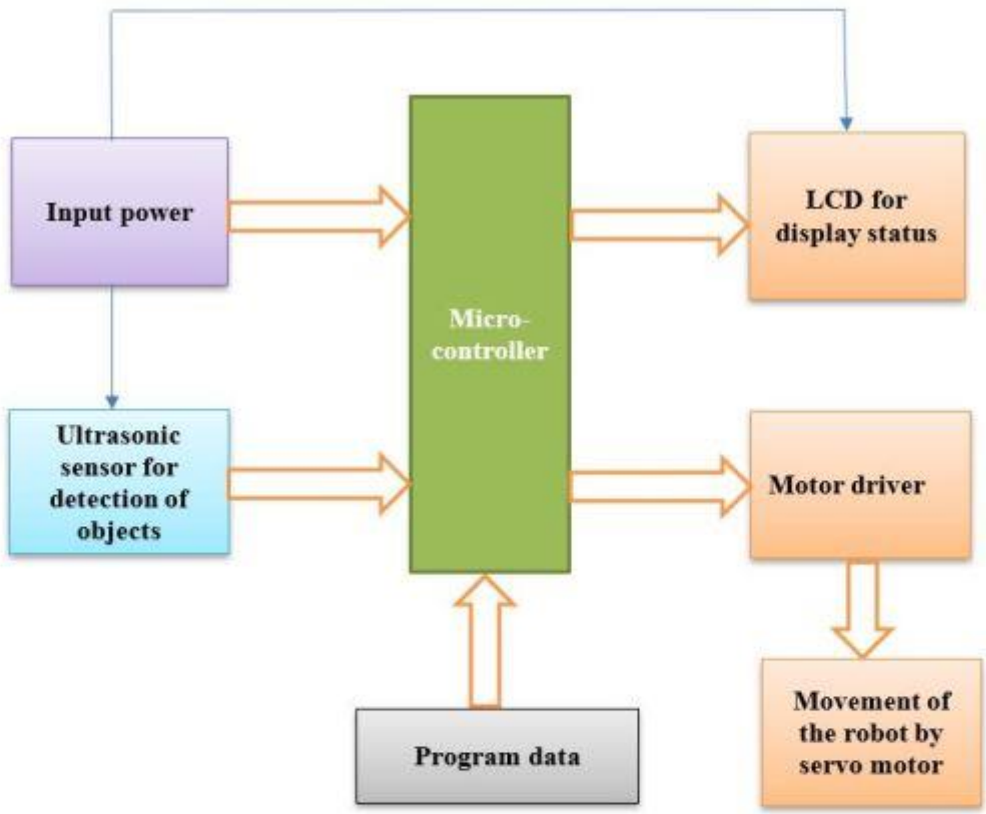


Figure 3.6.3. Block Diagram

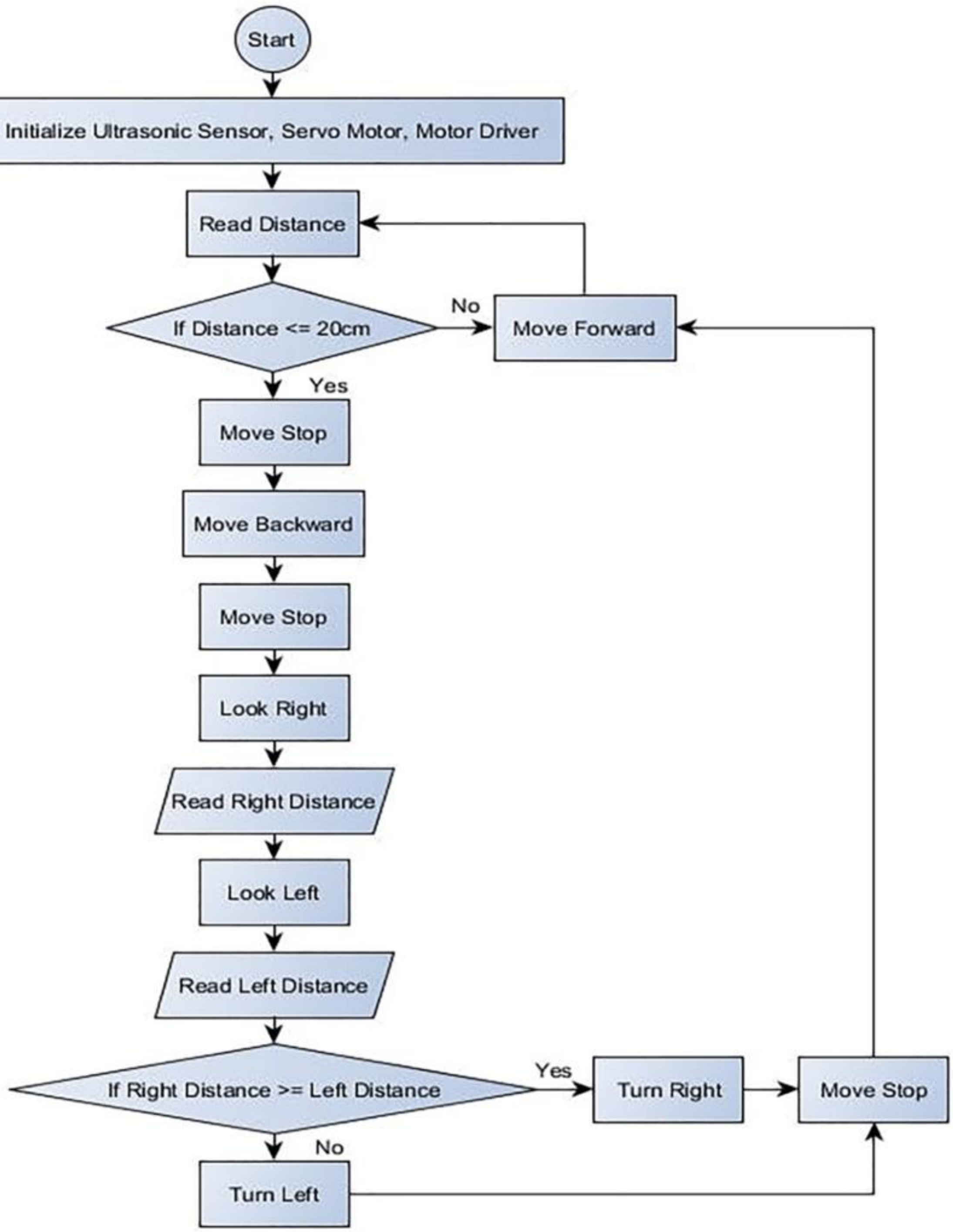


Figure 3.6.4. Flowchart

3.7. CODE:

1. Voice Controlled Vehicle

```
#include <AFMotor.h>
#include <Servo.h>// include the needed libraries

String command;

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

Servo myservo;
void setup()
{
Serial.begin(9600);
myservo.attach(10);// set the servo to look forward
myservo.write(100);
}

void loop()
{

 delay(10);
 while(Serial.available())
{
  command = "";
  command = Serial.readString();

    Serial.print(command);
}
  if(command == "*move forward#")
{
    forward();//this command tells the robot to move forward
  }
if(command == "*move backward#")
{
    backward();//this command tells the robot to move backward
  }
 if(command == "*turn left#")
{
    turnLeft();//this command tells the robot to move left
  }
if(command == "*turn right#")
```

```
{
  turnRight();//this command tells the robot to turn right
  }
if(command == "*stop#")
 {
    Stop();// command to stop the robot in middle
 }
  command = "";
}
void forward()
 {
  motor1.setSpeed(255);//we can set the max speed as 255 the speed ranges from 0 to
255
  motor1.run(FORWARD);
  motor2.setSpeed(255);
  motor2.run(FORWARD);
  motor3.setSpeed(255);
  motor3.run(FORWARD);
  motor4.setSpeed(255);
  motor4.run(FORWARD);
  delay(10000);// this will determine how long the car will move
  motor1.run(RELEASE);// the RELEASE command stops all the motor from running
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);

}
void backward()
{
  motor1.setSpeed(255);
  motor1.run(BACKWARD);
  motor2.setSpeed(255);
  motor2.run(BACKWARD);
  motor3.setSpeed(255);
  motor3.run(BACKWARD);
  motor4.setSpeed(255);
  motor4.run(BACKWARD);
  delay(10000);// determines how long the car will move
  motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);
}

void turnLeft() // to turn the robot left
{
```

```
   myservo.write(180);turn the servo motor to look left
  delay(200);
  myservo.write(90);
  delay(700);// delay for the robot
   motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(BACKWARD);
  motor4.run(BACKWARD);
  delay(700);
   motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);
}

void turnRight()// to turn the robot right
 {
   myservo.write(0);// turn the servo motor to look right
  delay(200);
  myservo.write(90);//look forward again
  delay(700);
  motor1.run(BACKWARD);
  motor2.run(BACKWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
  delay(700);

   motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);
}
void Stop() //Stop function to stop the robot
{
  motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);
}
```

2. Obstacle Avoidance

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

#define TRIG_PIN A0 //Trigger pin
#define ECHO_PIN A1 // Echo pin
#define MAX_DISTANCE 200 // set max distance
#define MAX_SPEED 190 // sets speed of DC  motors
#define MAX_SPEED_OFFSET 50

NewPing sonar(TRIG_PIN, ECHO_PIN, MAX_DISTANCE);

AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ);
Servo myservo;   //define the servo motor

boolean goesForward=false;
int distance = 50;
int speedSet = 0;

void setup()
{

  myservo.attach(10);
  myservo.write(100);
  delay(2000);
  distance = readPing();//read the distance via the ultrasonic sensor
  delay(100);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
}

void loop()
{
 int distanceR = 0;
 int distanceL =  0;
 delay(30);
```

```
 if(distance<=25)//check the distance
 {
  moveStop();// call the stop function
  delay(200);
  moveBackward();//move backward
  delay(500);
  moveStop();// Stop
  delay(300);
  distanceR = lookRight();//look right
  delay(300);
  distanceL = lookLeft();//look left
  delay(300);

  if(distanceR>=distanceL)//check which distance is more then turn in that direction
  {
    turnRight();
    moveStop();
  }
else
  {
    turnLeft();
    moveStop();
  }
 }
else
 {
  moveForward();
 }
 distance = readPing();
}

int lookRight()
{
    myservo.write(50);
    delay(300);
    int distance = readPing();
    delay(100);
    myservo.write(115);
    return distance;
}

int lookLeft()
{
    myservo.write(170);
    delay(300);
    int distance = readPing();
```

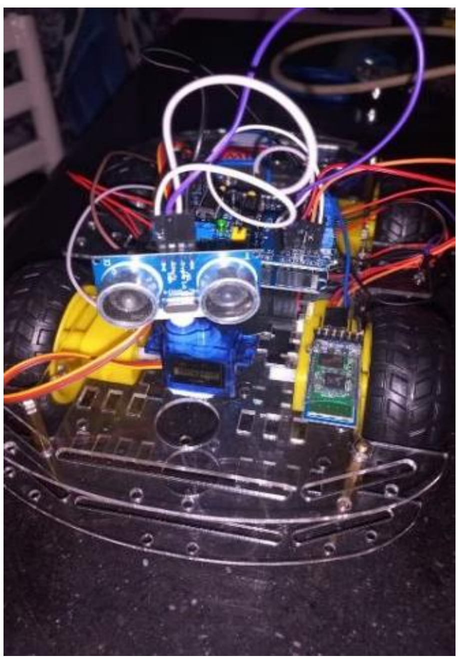
```
    delay(100);
    myservo.write(115);
    return distance;
    delay(100);
}

int readPing()
{
  delay(70);
  int cm = sonar.ping_cm();
  if(cm==0)
  {
    cm = 250;
  }
  return cm;
}

void moveStop()
{
  motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);
  }

void moveForward()
 {

 if(!goesForward)
  {
    goesForward=true;
    motor1.run(FORWARD);
    motor2.run(FORWARD);
    motor3.run(FORWARD);
    motor4.run(FORWARD);
    motor1.setSpeed(150);
    motor2.setSpeed(150);
    motor3.setSpeed(150);
    motor4.setSpeed(155);
    delay(5);

  }
}
```

```
void moveBackward()
{
    goesForward=false;
    motor1.run(BACKWARD);
    motor2.run(BACKWARD);
    motor3.run(BACKWARD);
    motor4.run(BACKWARD);

    motor1.setSpeed(155);
    motor2.setSpeed(155);
    motor3.setSpeed(155);
    motor4.setSpeed(155);
    delay(5);
  // }
}

void turnRight()
{
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(BACKWARD);
  motor4.run(BACKWARD);
  delay(500);
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
}

void turnLeft()
{
  motor1.run(BACKWARD);
  motor2.run(BACKWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
  delay(500);
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
}
```

CHAPTER – 4
RESULT ANALYSIS AND VALIDATION

Human voice is identified using a microphone in the androidsmart phone. This voice is analyzed and converted into English words using the android operating system codes and Artificial Intelligence software.

The Figure 4.1 shows the assembly image for voice control robot using Arduino software. The project was completed according to the specification and needs. Simple movements can be controlled with the voice. The proposed system is basically based on Voice Controlled Robotic Vehicle helps tocontrol robot through voice commands received via android application. The Voice Controlled Vehicle is controlled through voice commands given by the user who is operating the project. These voice command needs to be given through an android app which is installed on the users android mobile. Speech recognition is done within the android app and then a respective command is sent to the voice controlled robot vehicle. Microcontroller fitted on the Vehicle decodes these commands and gives an appropriate command to the motors connected to the vehicle.



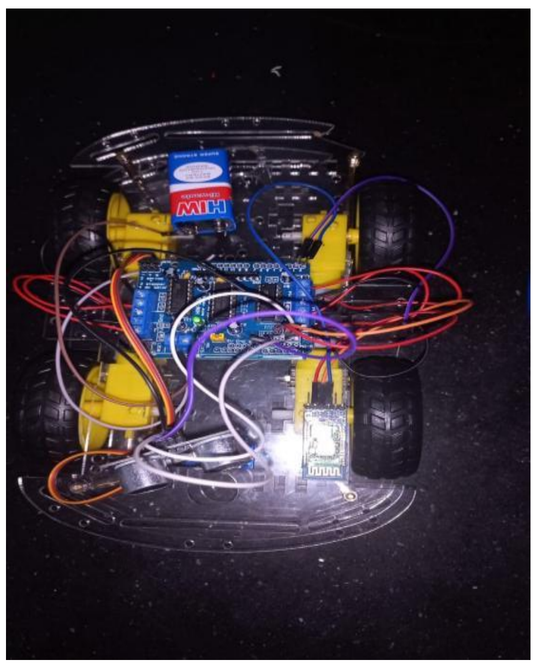


Figure 4.1. Final Product

CHAPTER – 5

CONCLUSION AND FUTURE WORK

Voice-controlled robotic vehicles are a technology that combines the ability to move with the power of voice recognition, allowing for a more natural and intuitive interaction between humans and machines. The technology behind voice-controlled robotic vehicles is rapidly advancing, and there is a great deal of potential for its future use in a variety of industries and applications. The use of voice-controlled robotic vehicles can offer numerous benefits to many industries, including transportation, agriculture, and mining. These vehicles can help improve efficiency, reduce labor costs, and increase safety by allowing workers to control the vehicle from a safe distance. In agriculture, for example, voice-controlled robotic vehicles can be used to automate tasks such as planting, fertilizing, and harvesting, making the process more efficient and reducing the need for human labor. Another promising application of voice-controlled robotic vehicles is in the entertainment industry. Theme parks, for example, could use these vehicles to create immersive experiences for visitors, such as interactive tours or rides that respond to user commands. Museums could also use these vehicles to enhance exhibits, providing visitors with an interactive and engaging way to learn about different topics. One of the key advantages of voice-controlled robotic vehicles is their ability to offer a more natural and intuitive user interface. Unlike traditional user interfaces, which can be complex and difficult to navigate, voice control allows users to interact with the vehicle using the same language they use in everyday life. This makes it easier for people of all ages and backgrounds to use the vehicle, regardless of their level of technical expertise. The technology behind voice-controlled robotic vehicles is also rapidly advancing, with the development of more sophisticated voice recognition algorithms and machine learning systems. These advancements are making it possible to understand more complex commands and adapt to different users' preferences, making the technology even more useful in a variety of applications. However, there are also some challenges that need to be addressed in the development of voice-controlled robotic vehicles. One of the most significant challenges is ensuring the safety of the vehicle and the people around it. Since these vehicles are controlled by voice commands, there is a risk of misinterpretation or miscommunication, which could lead to accidents or other safety issues. Developers must work to ensure that the vehicles are reliable and responsive, and that they can detect and respond to potential hazards in their environment. Another challenge is ensuring the privacy and security of the data collected by the vehicle. Since these vehicles are equipped with sensors and cameras, they can collect a large amount of data about their environment and the people around them. Developers must work to ensure that this data is protected from unauthorized access and that it is used only for its intended purpose.

In conclusion, voice-controlled robotic vehicles have the potential to revolutionize the way we interact with machines and devices, offering a more intuitive and natural user interface that can be useful in a variety of applications. While there are some challenges that need to be addressed in their development, the technology behind these vehicles is rapidly advancing, and their future looks promising. With continued investment and innovation, we can expect to see voice-controlled robotic vehicles used in an increasingly wide range of industries and applications in the years to come.

REFERENCES

1. 2017, Jolad, Bhuvaneshwari, et al. "Voice controlled robotic vehicle." International Research Journal of Engineering and Technology (IRJET) 4.06

2. 2016, Surjeet and Nishu Gupta 2021 J. Phys.: Conf. Ser. 1817 012016

3. 2020, Saravanan, M., Selvababu, B., Jayan, A., Anand, A., & Raj, A. (2020, December) Arduino based voice controlled robot vehicle. In IOP Conference Series: Materials Science and Engineering (Vol. 993, No. 1, p.012125). IOP Publishing.

4. 2017, Chikhale, Mr V., et al. "Voice Controlled Robotic System using Arduino Microcontroller." International Journal of New Technology and Research, vol. 3, no. 4, Apr. 2017

5. 2012, Blessington, P., Madhav, B. T. P., Babu, M. S., Reddy, R. R., Kumar, D. M., Raju, I. N., & Babu, N. A. (2012). Acoustic Controlled Robotic Vehicle. International journal of Emerging Technology & Advanced Engineering., 2(4).

6. 2020, Srivastava, Shubh, and Rajanish Singh. "Voice controlled robot car usin Arduino." International Research journal of Engineering and Technology 7.5 (2020): 4033-4037.

7. 2019, Diwakar, Dipesh, et al. "Voice Controlled Robotic Vehicle." (2019)

APPENDIX-I

PLAGIARISM REPORT

Voice Controlled Robotic Vehicle

ASMEET KAUR KAINTH
Department of Computer Science and Engineering, Apex Institute of Technology, Chandigarh University, Mohali, Punjab, India
21BCS10508@cuchd.in

MOHAMMAD BASIM SIDDIQUI
Department of Computer Science and Engineering, Apex Institute of Technology, Chandigarh University, Mohali, Punjab, India
21BCS9877@cuchd.in

GURU SINGH PAL
Department of Computer Science and Engineering, Apex Institute of Technology, Chandigarh University, Mohali, Punjab, India
21BCS9888@cuchd.in

RAJ FAUJDAR
Department of Computer Science and Engineering, Apex Institute of Technology, Chandigarh University, Mohali, Punjab, India
21BCS9535@cuchd.in

I. *Abstract* -
This project is about a robot that can controlled by voice commands. An android application and a microcontroller is used for performing critical tasks. The android app and car can connect with the help of Bluetooth technology. The user can utilise the program's buttons or speak commands to the robot to control it. The micro controller at the receiver side is coupled to two DC servo motors that allow the robot to move. The application's commands are converted into digital signals by the Bluetooth RF transmitter. At the receiver's end, the data is decoded and delivered to the micro controller, which uses it to drive the necessary DC motors. Main objective of a voice controlled robotic vehicle is to listen to the user's instructions and act out accordingly. Before using the robot with ease, the user needs to get ready in advance. A code is employed for the same purpose to instruct the micro controller.

Keywords: Robotic vehicle, Micro controller, Voice Command, Sensor, Automation.

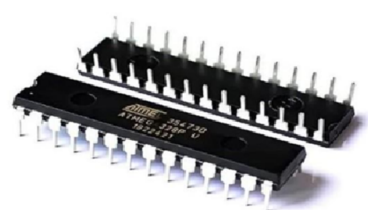
I. Introduction (Problem Definition)

We aim to direct the robotic vehicle in the intended path. The main aim of the project is to provide spoken control of the robot. It is possible to interact with robots and humans. The voice- controlled robot's job is to hear what the user says and do it. The suggested system comprises of two blocks: a transmitter and a receiving block, and is powered by a battery. We may control the robotic car by utilising a cell phone and this app. The project is intended to remotely manage a robotic vehicle utilising voice instructions and manual input.

II. Methodology

Employing an Android phone to design robot controls. This project aims to provide solid computational android platforms for robots with simpler hardware design. The characteristics of Bluetooth technology, how to control a robot with a mobile device using Bluetooth connection, and the components of the mobile and robot are all covered in this essay. It gives an overview of robots that can move forward, backward, leftward, and rightward with the help of an Android app like Arduino or Bluetooth.

• Robot Operated by Smartphone Using ATMEGA328 Microcontroller. In this study, a robot that can be controlled by an android phone application has been created. It communicates control commands via Bluetooth, which includes several functions like regulating the motor's speed and sensing and sharing information with the phone regarding the robot's direction and distance from the closest barrier.



FIG[1]

• Bluetooth robot controlled by an Android mobile phone using an 8051 microcontroller. A robot is often an electromechanical gadget that is manipulated by electronics and computer programming. For manufacturing, a lot of robots have been created by factories all over the world and serve a purpose. This paper creates remote buttons for an Android app that may be used to control a robot's motion.

FIG[2]

III. Experimental setup

The experimental setup for a voice controlled robotic vehicle using Internet of Things (IoT) would typically involve the following components:

1. **Microcontroller:** The movement of the robot, sensor reading, and communication with the Android application are all managed by a microcontroller. Popular microcontrollers used in automation include Arduino, Raspberry Pi, and STM32. We'll be using Arduino

FIG[3]

2. **Bluetooth Module**: The vocal commands are returned to the Arduino via a Bluetooth module, which then directs the robot to go forward, backward, or turn left and right. Due to the voice control of the vehicle, we use a Bluetooth module to move the robots. The standard orders are forward, backward, left, and right.

FIG[4]

3. **Motor Driver**: A motor driver controls the robot's movement. It receives inputs from the microcontroller and transforms them into instructions that the motors can understand. There are two popular motor drivers used in automation: L293D and TB6612FNG. We'll be using L293D in our product.

FIG[5]

4. **Motors:** The automaton is propelled in various directions by motors. Servo motors and DC motors are frequently used in robotics. We used 4 gear motors for our robots movements and a servo motor for direction detection.

FIG[6]

FIG[7]

5. **Sensors**: The robot's sensors gather information about its surroundings and feed it to the microcontroller. Examples of typical sensors used in automation include light sensors, infrared sensors, and ultrasonic sensors. In our product we used HC-SR04 for distance detection and obstacle avoidance.

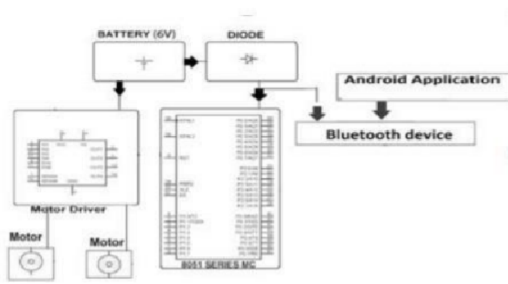
FIG[8]

6. Android Application: An Android app offers a user-friendly interface for interacting with the robot. The programme receives status updates from the robot, gives voice instructions to the microcontroller, and displays information to the user.

7. Power Source: To provide electricity to the various parts of the robot, a power source is required. Common power sources include batteries and power banks.

FIG[9]

8. Circuit Diagram: FIG[10] shows the circuit diagram that we have referred to for making the connections in our device.



FIG[10]

IV. Feature and Character Identification

A voice-controlled robotic vehicle can have several features and character identification options. Here are someideas:

1. **Voice Recognition**: To effectively understand and respond to voice orders from the driver, the car needs be fitted with cutting-edge speech recognition technology.
2. **Intelligent Navigation**: The robotic vehicle should be able to navigate on its own or in response to user commands. It ought to be able to map its surroundings, avoid hazards, and devise the best paths to take in order to get where it's going.
3. **Multi-Sensor Integration**: To learn more about its surroundings, the vehicle may be fitted with a variety of sensors, including cameras, lidar, radar, and ultrasonic sensors. The perception and decision-making abilities of the vehicle can be improved with the help of this data.
4. **Communication Capabilities**: The robotic vehicle may come equipped with built-in communication tools to engage with the user or other gadgets. It may communicate status updates, respond to commands or inquiries, and give immediate feedback.
5. **Safety Features**: A robotic vehicle's top objective should be safety. To guarantee that the vehicle functions safely in a variety of situations, it may incorporate collision detection and avoidance systems, emergency stop capability, and fail-safe mechanisms.
6. **Personalization**: To give the car a distinctive personality, customization choices might be included in the design. This can involve altering the car's voice, choosing from various personas or avatars, and making changes to the way the vehicle looks.

V. Constraint Identification

There may be a number of limitations for voice-controlled robotic vehicles to take into account. For a voice-controlled robotic vehicle, the following are some constraint identification points :

1. **Speech Recognition Accuracy**: Speech recognition accuracy is one of the main limitations. For the robotic vehicle to carry out the specified operations, the spoken commands must be clearly understood and translated. Speech recognition errors might cause vehicles to move inadvertently or incorrectly.
2. **Vocabulary Limitations**: The speech recognition technology in the car might not be able to recognise or comprehend certain words or phrases. The variety of commands that can be provided to the car may be limited as a result, and users may need to learn particular words or phrases to control it effectively.
3. **Noise and Environmental Factors:** Background noise and other environmental elements, such as wind, traffic, or other sounds, can affect voice control. These outside variables could obstruct voice commands, making it more difficult for the car to recognise and understand user requests.
4. **Response Time**: Another restriction to take into account is how quickly the autonomous vehicle responds to spoken commands. It's possible for there to be a lag between giving a command and

the vehicle carrying it out. It's essential to reduce this response time for a seamless and intuitive user experience.

5. **Security and Privacy**: Robotic vehicles that can be operated by voice may cause privacy and security issues. It's crucial to check that the voice recognition system in the car is safe and difficult to manipulate or hack. Furthermore, user privacy should be safeguarded, and private voice data should be handled and stored securely.
6. **Limited Voice Command Complexity:** The robotic vehicle may have a limited ability to recognise and carry out sophisticated speech orders. Complex jobs or multi-step instructions may be difficult for the system to comprehend and accurately complete. Due to this restriction, commands may need to be simplified or new technologies may need to be added to handle more difficult tasks.
7. **Training and Customization:** To adjust to certain user voices or accents, some voice-controlled robotic vehicles may need initial training or calibration. In order to get the best voice recognition accuracy, user training and customisation are required.
8. **Language Support:** A limitation that must be taken into account is the voice recognition system's language capability. The controlling capacity of a robotic vehicle in a particular language may be restricted by the linguistic capabilities of distinct robotic vehicles.

These are only a few instances of the constraints that voice-controlled robotic vehicles may have. To ensure dependable and user-friendly operation, these constraints must be identified and addressed during the design and development process.

Consider the following tactics to get over the constraints imposed by voice-controlled robotic vehicles:

:

I. Improve speech recognition

- To improve the precision of recognising and understanding voice instructions, use cutting-edge speech recognition techniques and technologies, along with machine learning.
- Continuously enhancing our speech recognition system's performance, training it with a variety of samples of speech and data.
- Include error-handling features that enable a vehicle to request additional information or confirmation when uncertain about a directive.

II. Expand Vocabulary:

- Frequently update the speech recognition system's vocabulary database to incorporate regularly used terms and expressions as well as commands relevant to particular domains.
- Offer a user interface or documentation that specifies the supported commands to assist users in learning and remembering the available vocabulary.

III. Noise and Environmental Factors:

- Use noise cancellation methods to lessen the effect of background noise and other environmental influences on the precision of voice recognition.
- Focus on recording the user's speech while minimising background noise while designing the vehicle's microphone and audio processing system.

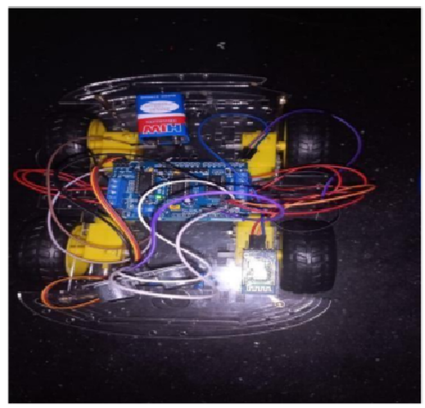
IV. Optimize Response Time:

- Utilise technology and algorithms that are effective in order to decrease the processing time needed for voice recognition and action execution.
- Use parallel processing and optimisation strategies to reduce the time between a command and the response of the vehicle.

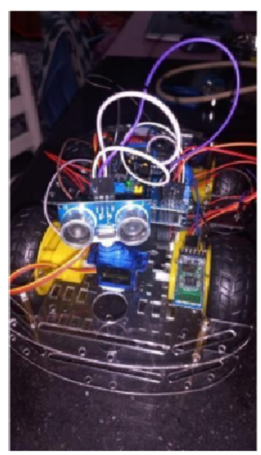
VI.RESULT

This project uses an Android app to recognise and analyse human voice through the phone's microphone. The app converts the voice into English words and sends them to a robot vehicle that can move according to the voice commands.

The robot vehicle has a micro controller that decodes the commands and controls the motors. The assembly image of the voice-controlled robot using Arduino software is shown in FIG 11 and FIG 12. The project meets the requirements and specifications. The voice can control simple movements. The system is mainly based on Voice Controlled Robotic Vehicle, which allows voice instructions from an Android app to drive robots. The user needs to have the app installed on their Android phone to give voice commands to the vehicle.



FIG[11]



FIG[12]

VII. CONCLUSION

A robotic automobile with navigation and speech recognition capabilities is designed to help people with disabilities. This speech control system, despite its simplicity, shows how speech recognition techniques can be applied in control applications. Our robot is capable of understanding and responding to spoken orders for control. Simply explained, this technology recognises human speech, converts it to text, and then uses the text to control robotic motion using an Android programme. It is also capable of independent movement, for which we employ an ultrasonic sensor to detect obstacles. It has been shown that the methods work in real-time.

VII. REFERENCES

[1] 2017, Jolad, Bhuvaneshwari, et al. "Voice controlled robotic vehicle." International Research Journal of Engineering and Technology (IRJET) 4.06

[2] 2016, Surjeet and Nishu Gupta 2021 J. Phys.: Conf. Ser. 1817 012016

[3] 2020, Saravanan, M., Selvababu, B., Jayan, A., Anand, A., & Raj, A. (2020, December). Arduino based voice controlled robot vehicle. In IOP Conference Series: Materials Science and Engineering (Vol. 993, No. 1, p. 012125). IOP Publishing.

[4] 2017, Chikhale, Mr V., et al. "Voice Controlled Robotic System using Arduino Microcontroller." International Journal of New Technology and Research, vol. 3, no. 4, Apr. 2017

[5] 2012, Blessington, P., Madhav, B. T. P., Babu, M. S., Reddy, R. R., Kumar, D. M., Raju, I. N., & Babu, N. A. (2012). Acoustic Controlled Robotic Vehicle. International journal of Emerging Technology & Advanced Engineering., 2(4).

[6] 2020, Srivastava, Shubh, and Rajanish Singh. "Voice controlled robot car using Arduino." International Research journal of Engineering and Technology 7.5 (2020): 4033-4037.

[7] 2019, Diwakar, Dipesh, et al. "Voice Controlled Robotic Vehicle." (2019)

4._Research_Article_final.docx

ORIGINALITY REPORT

4%	4%	3%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.researchgate.net Internet Source	2%
2	Rahul Rastogi, Nikhil Aggarwal. "A Review on Virtualization and Cloud Security", 2022 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM), 2022 Publication	1%
3	www.jae-tech.com Internet Source	<1%
4	www.ijnrd.org Internet Source	<1%

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		

APPENDIX-II

USER MANUAL

Step 1. To get started with our voice controlled robotic car, plug the car adapter into the socket.

Step 2. Turn on the switch on the car.

Step 3. The L293d indicator light would turn on indicating you are ready to go.

.

Step 4. Download the application named AMR voice from Play Store on your mobile.

Step 5. In the application,   connect to the Bluetooth module named HC-05.

Step 6. When successful connection is established, the application would show “Device connected”.

Step 7. Tap on the mic button and give the command as you please and the robot will follow.