International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 12 Issue: 12 | Dec 2025 www.irjet.net p-ISSN: 2395-0072

VOICE-CONTROLLED ASSISTANCE FOR ROBOT NAVIGATION USING ANDROID BASED MOBILE DEVICES

Chandana M[1], Nikhilashree M[2], Sneha v[3], Lalitha H[4],

Dept .of E&IE Bangalore Institute of Technology Bengaluru, India
Dept .of E&IE Bangalore Institute of Technology Bengaluru, India
Dept .of E&IE Bangalore Institute of Technology Bengaluru, India
Assistant professor Dept .of E&IE Bangalore Institute of Technology Bengaluru, India

---

Abstract— *this project presents a voice-controlled robotic car that can be operated using an Android mobile application through Bluetooth communication. Instead of using physical switches or remote controls, the user gives simple voice commands such as "forward," "left," "right," "backward," or "stop," which the app converts into text and sends to the robot. The Adriano Uno receives these commands and controls the L298N motor driver to move the car in the required direction. The system uses an HC-05/HC- 06 Bluetooth modules for wireless connectivity and DC motors for smooth movement. To make the system more interactive, a DF Player Mini and speaker can be added to provide audio feedback for each command. This project demonstrates how voice recognition and embedded systems can be combined to create an easy-to-use, low-cost, and user-friendly robotic car, suitable for beginners, educational purposes, and applications where hands-free control is required.*

I. INTRODUCTION

Voice-controlled systems have become an important part of modern technology because they allow users to interact with devices in a more natural and comfortable way. With the rapid growth of smartphones, wireless communication, and embedded electronics, voice recognition has become easier to use and more reliable. Today, mobile applications can quickly convert spoken words into text, making hands-free control possible in many applications such as home automation, robotics, and assistive devices. This project uses these advancements to design a robotic car that can be operated entirely through voice commands given from an Android mobile phone. The aim of this system is to eliminate the need for physical remotes, switches, or joysticks by enabling the user to simply speak commands like "forward," "left," "right," "backward," or "stop." The Android application receives the user's voice, converts it using speech-to-text technology, and sends it to the robot through Bluetooth communication. The HC-05/HC-06 Bluetooth module receives the instruction and passes it to the Arduino Uno, which is programmed to interpret the command and control the L298N motor driver accordingly. As a result, the DC motors rotate in the required direction, allowing the car to move smoothly and accurately in response to the spoken commands.

This project highlights the growing importance of human– machine interaction (HMI), showing how machines can be made easier to operate through simple voice input instead of traditional manual controls. It also demonstrates how embedded systems, mobile applications, and wireless technologies can be integrated to create a powerful real-time control system. Additionally, the implementation is cost-effective, making it suitable for educational purposes, home automation projects, and applications for people with disabilities who may find it difficult to operate physical controls. Beyond its basic functionality, the voice-controlled robotic car can be extended with additional features such as obstacle detection sensors, camera modules, GPS navigation, and IoT connectivity. These possibilities show that voice- controlled robots have a wide range of applications—from smart home delivery robots to assistance robots in healthcare and security. The project thus provides a strong foundation for understanding modern robotics and offers opportunities for further innovation and research.

II. RELATED WORK

Voice-controlled robotic systems have gained significant attention in recent years due to the rapid growth of mobile technology, embedded systems, and human–machine interaction (HMI). Early research in this field mainly explored the use of simple wireless control mechanisms such as RF modules, infrared transmitters, and manual remote controllers. Although these methods enabled basic robotic movement, they were limited by short distance, line-of-sight requirements, and lack of interactive feedback.

With the evolution of smartphones and speech-recognition technologies, researchers began experimenting with voice-based interfaces to operate robots more intelligently and conveniently. One of the earliest approaches used PC-based

speech-recognition software, where the computer processed the user's voice commands and transmitted them to the robot through wired or wireless links. However, this method required a continuous computer connection and was not portable. Later advancements in mobile technology made Android devices a suitable platform for implementing voice-controlled systems because they include built-in microphones, Bluetooth connectivity, and Google Speech- to-Text APIs. Several studies began focusing on using Android applications to interpret voice commands and transmit them to microcontrollers such as Arduino, PIC, and Raspberry Pi.

These works demonstrated that mobile phones could replace traditional remote controls and provide a more user- friendly interface. Research also expanded towards improving the reliability of Bluetooth communication in robotic applications. The HC-05 and HC-06 Bluetooth modules became popular due to their low cost, easy pairing, and compatibility with Arduino. Many existing projects use these modules to send text commands from a mobile app to a robot. These studies highlight advantages such as stable wireless range, low power consumption, and quick Responsiveness. They also show that Bluetooth-based control is well-suited for short-distance personal robotics, home automation, and educational projects. Some researchers also compared Bluetooth with Wi-Fi, RF, and Zig Bee controls, concluding that Bluetooth is the simplest and most practical solution for small robotic vehicles. Another area of related work focuses on motor control and driver circuits. The L298N and L293D motor driver modules are widely used in voice-controlled robots because they allow control of motor direction, speed, and rotation independently. Many previous studies highlight that DC motors controlled using motor driver ICs provide smooth movement and precise directional control when linked with Arduino. This research also includes experiments with different types of robotic chassis, wheel configurations, and power supplies to optimize stability and movement accuracy.

Several advanced models explored integrating voice control with additional sensors to improve robot intelligence. For example, some work incorporates ultrasonic sensors to avoid obstacles automatically while still responding to voice commands. Other research adds IR sensors, gyroscope-based control, or GPS modules to enhance navigation. These studies demonstrate the potential for combining voice interaction with autonomous features to make robots safer and more adaptable in real-world environments. Researchers have also investigated the role of audio feedback and user interaction in robotic systems. Some studies use text-to-speech modules, such as DF Player Mini or software-based voice output, to provide confirmation messages like "Moving Forward" or "Turning Left." These enhancements improve user experience by providing direct feedback and reducing confusion, especially when multiple commands are issued continuously. This is particularly beneficial for visually impaired users or situations where the robot must operate in noisy environments.

Other related works examine the challenges and limitations of voice recognition in robotics. For example, accuracy may decrease in areas with heavy background noise, unclear pronunciation, or multiple overlapping voices. Research suggests that using high-quality microphones, noise- filtering algorithms, and optimized speech-to-text engines significantly improves command accuracy. Android's built- in Google Speech API, as used in many modern projects, has been shown to provide high recognition accuracy, making it suitable for real-time robotic control applications. There is also extensive literature on Internet- of-Things (IoT)-based voice control, where cloud services such as Google Assistant, Alexa, or IBM Watson are used for speech processing. While these systems offer advanced capabilities, they depend on internet connectivity and are not ideal for simple, offline robotic cars. As a result, researchers often prefer Android offline voice recognition or Bluetooth-based text command processing for small educational robots. Recent studies also emphasize the importance of low-cost, easy-to-build robotic systems for engineering education. Many engineering colleges use Arduino-based voice-controlled robots to teach students concepts such as embedded programming, serial communication, motor control, and mobile application development. Research shows that such projects improve students' understanding of real-time systems, communication protocols, and interfacing methods.

Finally, several review papers highlight trends in speech- controlled robotics, noting that the integration of smartphones, Bluetooth modules, and microcontrollers has trans formed robotic control into a more interactive, hands- free experience. The combination of voice recognition, Bluetooth communication, and embedded systems has become a standard approach in designing modern educational robots. In summary, previous research clearly shows that voice-controlled robotic systems have evolved from basic remote- controlled models to smart, Android- based voice-interactive platforms. The advancements in Bluetooth technology, motor driver circuits, and speech recognition have made it possible to design reliable, low-cost, and user-friendly voice- controlled robotic vehicles. The present project builds on these ideas by integrating an Android mobile application, HC-05 Bluetooth module, Arduino Uno, L298N motor driver, and optional DFPlayer Mini audio feedback to create a smooth and efficient voice- operated robotic car suitable for learning and practical applications.

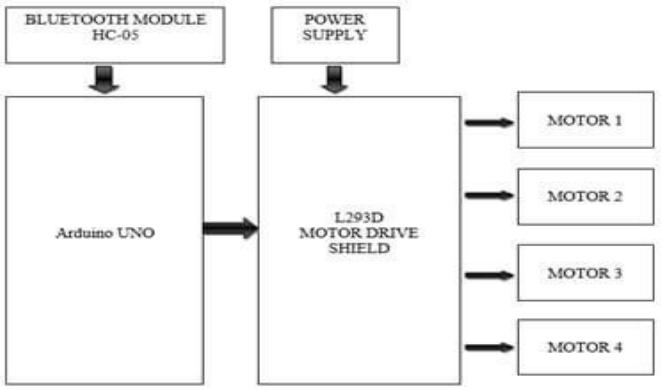

Figure. 1: *voice control and android control robot circuit diagram*

The diagram shows how the voice-controlled robotic car works internally by connecting different components together. The Bluetooth HC-05 module receives the voice- based commands sent from the mobile app and passes them to the Arduino Uno, which acts as the main controller. The Arduino interprets these commands and sends control signals to the L293D motor driver shield. The motor driver provides the required power to the motors, as the Arduino alone cannot drive them directly. A power supply, usually a rechargeable battery, powers all the modules, including the Arduino, Bluetooth unit, and motors. The motors (Motor 1, Motor 2, Motor 3, Motor 4) then rotate according to the instructions, allowing the car to move forward, backward, left, or right.

The section titled System Architecture and Modules explains that the robot is designed in a modular way, meaning each component can be changed or upgraded independently. Parts like the Bluetooth module, Arduino board, motor driver, motors, and battery can be replaced without affecting the entire system.

III .SYSTEM MODULARITY

1. **Easy Upgradation of Components:**Each part of the robot—Bluetooth module, Arduino, motor driver, motors, and battery—can be replaced or upgraded independently without affecting the entire system.

2. **Flexible Addition of New Features:**Extra modules such as ultrasonic sensors, GPS, camera, or audio feedback (DFPlayer Mini) can be added easily because the system ismodular and supports expansion.

3. **Independent Working Blocks:**The system is divided into separate functional blocks (voice input, Bluetooth communication, command processing, motor control), allowing easy troubleshooting and modification of individual sections.

IV. IMPLEMENTATION

The implementation of the voice-controlled robotic car begins by developing an Android mobile application that uses speech-to-text technology to recognize the user's voice commands. When the user gives instructions like "forward," "backward," "left," "right," or "stop," the app instantly converts these spoken words into text and sends them to the robot through Bluetooth. The robot uses an HC- 05/HC-06 Bluetooth module, which continuously stays paired with the mobile phone and receives every command in real time.Once the command reaches the robot, it is sent to the Arduino Uno through serial communication. The Arduino program is written in such a way that it compares the received text with predefined instructions.

If a match is found—for example, "forward"—the Arduino activates specific pins connected to the L298N motor driver. This motor driver controls the DC motors by providing the required voltage and direction, allowing the robot to move forward, reverse, or turn left/right.

For turning movements, the Arduino sends commands to rotate only one motor while keeping the other slow or stopped. The entire system is powered by a rechargeable battery, ensuring portability and continuous operation without external power.

To enhance the user experience, a DF Player Mini audio module can be connected, which plays prerecorded audio clips like "Moving Forward" or "Stopping" whenever a command is executed. This acts as confirmation feedback for the user. The wiring connections between the Arduino, motor driver, motors, Bluetooth module, and battery are arranged on a stable robotic chassis to ensure smooth movement and durability. Finally, the system is tested by sending different voice commands from the Android app.

The robot's response is observed for speed, accuracy, and command recognition. The results show smooth communication, proper command execution, and efficient motor control. This successful implementation proves that voice-based robotic control using mobile applications is simple, effective, and user-friendly.

V. EXPERIMENTAL RESULTS

The voice-controlled robotic car was tested under various conditions to evaluate its responsiveness, accuracy, and wireless communication stability. During the trials, the Android application successfully converted spoken commands into text using speech-to-text processing, and the Bluetooth module (HC-05/HC-06) consistently received these commands without delay. The robot responded instantly to commonly used commands such as "forward," "left," "right," "backward," and "stop," demonstrating smooth and reliable performance. Even when commands were spoken quickly or repeatedly, the system processed them correctly and carried out each action with minimal lag.The Bluetooth connectivity remained stable within an effective range of 8–10 meters, allowing the user to control the robot from a reasonable distance. The motors operated smoothly through the L298N driver, providing controlled directional movements. Forward and backward motions were uniform, while turning actions were accurate due to the proper control of individual motors. The robot was tested on different surfaces like tiles, marble, and smooth flooring, and the results showed that the car maintained good traction and stability across all tested environments. There were no interruptions or sudden disconnections during testing, confirming the robustness of the communication link.

Additional tests were performed using the DFPlayer Mini module for voice feedback. The audio responses such as "Moving Forward," "Turning Left," and "Stopping" played correctly after each command, helping the user confirm that the robot received the instruction. This feature improved the user experience and reduced the chances of repeated or unclear commands. Overall, the experimental results showed that the system is reliable, responds accurately to voice inputs, and performs well in real-time operation. The combination of Android voice control, Bluetooth communication, and Arduino-based command processing proved efficient and effective for hands-free robotic control.

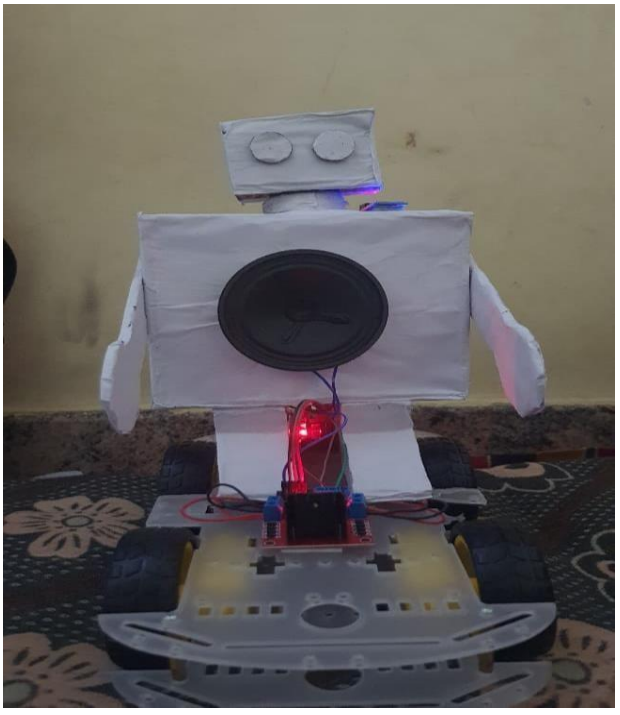

Figure 2: *Shows a live demonstration of the voice controlled and android controlled robot for navigation system*

VI. CONCLUSION AND FUTURE WORK

The voice-controlled robotic car successfully demonstrates how Android voice recognition and Bluetooth communication can be used together to build an easy, hands-free control system. The robot responds correctly to basic commands such as forward, backward, left, right, and stop. With the help of the Arduino Uno and L298N motor driver, the movements are smooth and well- controlled. The system is simple, low-cost, and suitable for beginners learning embedded systems and robotics. Overall, it shows an effective way to interact with machines using voice. During testing, the robot performed reliably and consistently within a good Bluetooth range. Commands were received instantly, and the motors executed them without delay. The optional audio feedback feature improved user interaction by confirming each action. The design uses commonly available components, making it affordable and easy to reproduce. This successful implementation serves as a strong base for further improvements.

In the future, sensors like ultrasonic or IR modules can be added to detect obstacles and avoid collisions automatically. The robot can also be enhanced with IoT or Wi-Fi connectivity for long-distance control. GPS can be integrated for location-based navigation or path- tracking applications. More advanced speech- recognition systems could allow it to understand longer or more complex commands. These upgrades will make the robot more intelligent and efficient.

Additional improvements may include adding a camera module for live video streaming or object tracking. Gesture control, mobile tilt control, or hand-motion sensors can offer new ways to operate the robot. Integrating smart assistants such as Google Assistant or Alexa can enable cloud-based voice control. Solar charging or energy-efficient motors can extend battery life and usability. With these enhancements, the robot can grow into a highly versatile and advanced robotic platform.

VII. REFERENCE

[1] Kumar, A., Prasad, V., & Naik, S. (2022). Voice Controlled Robotic Vehicle Using Bluetooth Module. International Journal of Engineering Research & Technology (IJERT), Vol. 11, Issue 3.

[2] Sharma, R., & Dinesh, P. (2023). Bluetooth- Based Voice Controlled Robot Using Arduino. International Journal of Innovative Science and Research Technology (IJISRT), Vol. 8, Issue 5.

[3] Patel, H., & Meena, V. (2022). Design and Implementation of Wireless Voice Operated RobotUsing Arduino. International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), Vol. 11, Issue 9.

[4] ResearchGate. (2023). Voice Controlled Robot Using Arduino and Bluetooth Module. Retrieved from https://www.researchgate.net/publication/371221 889_Voice_Controlled_Robot.

[5] DFPlayer Mini Datasheet. (2024). DFPlayer Mini MP3 Module Technical Specifications. Retrieved from https://wiki.dfrobot.com/DFPlayer_Mini_SKU_DFR 0299.

[6] YouTube. (2024). Voice Controlled Robot Car Using Arduino and Bluetooth Demo. Retrieved from https://youtu.be/- rHo0PzCPlI?si=fOxR3zT6KqJzGbnO

[7] Arduino Documentation. (2024). Arduino Uno R3 – Technical and Software Reference. Retrieved from https://docs.arduino.cc.

[8] HC-05 Bluetooth Module. (2024). HC-05 Bluetooth Module AT Command Set and Interface Guide. Retrieved from https://components101.com.