International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 15 Issue 3, March-2026

Voice Controlled Wheelchair

Shreyani Shivaji Lembhade[1], Priyanka Ram Gaikawad[2], Sanajana Nagana Ause[3], Prof. Yadav R.D[4], Sonali Sachin Taware[5]

[1,2,3,4,5]Dept. Information Technology Navashyadri Group of Institute, Pune, India

ABSTRACT

This project focuses on the design and development of a voice-controlled wheelchair to assist physically challenged and elderly individuals who face difficulties in manual wheelchair operation. The primary objective of this system is to provide an easy, reliable, and user-friendly mobility solution using voice command technology. Voice commands such as forward, backward, left, right, and stop are processed through a microcontroller to control the movement of the wheelchair. The proposed system reduces the need for physical effort and external assistance, thereby increasing user independence. Experimental results demonstrate that the wheelchair responds accurately to voice commands under normal environmental conditions. This system is cost-effective, simple to operate, and can be further enhanced by integrating advanced features such as obstacle detection and artificial intelligence, making it suitable for future research and real-world applications.

Keywords—Speech recognition, Voice controlled, user Friendly.

I. INTRODUCTION

The wheel chair plays a crucial role in enabling individuals with disabilities to move around freely and independently. There are generally too many types. The 1st is a traditional wheel chair and the 2nd is a joystick . Both types of wheelchair depend on muscular strength, dexterity and functionality of the hands and arms impairments affecting their hand and arms and face challenges when attempting to utilize these conventional. Hence, The project is meant for such a person to function with voice-based commands, allowing the paralyzed or impaired person to offer direction commands simply by speaking into the microphone provided. Speech recognition is a critical technique for allowing humans to order a wheelchair by voice control.

Many researches have been working on voice controlled wheelchairs for example, utilize a smartphone connected via Bluetooth and integrate with google API however, This system required an internet connection leading to operational delays. The average response time is approximately 1.838seconds. It can be driven either manually or automated using a control system. Manual wheelchairs are difficult to use by physically challenged people as they require force for the motion. To overcome this drawback convention wheelchair powered wheelchairs are available such as joystick-based, eye-controlled, brain-controlled, gesture-controlled, and many more. Even though these powered wheelchairs are designed for user comfort but economically they are quite costly and have complex logic to operate. Also, there is an increase in the demand for wheelchairs in the present and future markets.

There are a lot of developments for automating the wheelchair. To contribute to this development we introduced cost-efficient and reliable smart voice control which makes use of a backpropagation algorithm to train a nuclear network and an android UNO board to control motion. Speech recognition techniques enable the machine to identify the uttered words and convert them into understandable tax. In our proposed work a speaker dependent speech recognition system is used to build up a smart powered wheelchair. This speech recognition technique is implemented using a nuclear network. A Bluetooth model is used to send the data wireless for the system to board those. The main aim of our proposed work was to develop a comfortable,cost-efficient, and versatile model of the wheel chair so that one more physically challenged person would benefit from it.

II.LITERATURE REVIEW

A. Review of existing wheelchairs

Existing wheelchair technologies primarily focus on manual operation or semi-automated control, each with distinct advantages and limitations. Traditional manual wheelchairs are widely used due to their simplicity, low cost, and ease of maintenance; however, they require full physical effort from the user, making them unsuitable for individuals with severe disabilities.

To address this, electric wheelchairs equipped with joystick controls were developed, providing powered motion that reduces physical strain. These systems enable users to navigate easily on flat terrains and indoors, but they still require manual dexterity to operate the joystick, which may be challenging for users with motor impairments affecting their hands or arms.

*B.**Review of selected Work***

1. Voice-Controlled Wheelchair using Arduino Bluetooth
● Researchers implemented a wheelchair controlled via voice commands using an Android Bluetooth application.
● Arduino Uno acted as the controller, and an L298N motor driver controlled the motors.
● Commands like forward, backward, left, and right were used.
2. IoT-Based Voice Controlled Wheelchair using Raspberry Pi
1. The system integrated Raspberry Pi with a microphone for speech recognition and Wi-Fi communication.
2. Offering remote monitoring and advanced voice command features.
Limitations: Higher cost, complex hardware, and power consumption issues.
The review of existing research indicates that assistive wheelchair technologies have evolved from manual and joystick control to voice, gesture, and brain-based interfaces. Among these, **voice-controlled systems using microcontrollers like ESP32** provide an effective combination of **ease of use, cost-efficiency, and reliability**. Key limitations in existing systems include sensitivity to case in commands, environmental noise, and safety features.

The proposed project addresses these limitations by implementing:
1. Case-insensitive voice command processing.
2. Bluetooth-based wireless communication using smartphones
3. Motor control via L298N motor driver
4. Safety mechanism with automatic stop for unrecognized commands
Thus, this project leverages advances in embedded systems and wireless communication to provide a practical, affordable, and safe solution for hands-free wheelchair mobility.

III. Proposed System

The proposed system focuses on developing a **voice-controlled wheelchair** that enables physically challenged users to move independently using simple voice commands. The system converts spoken commands into control signals that drive the wheelchair motors, ensuring ease of use, safety, and reliability.

A. System Overview

The wheelchair operates by recognizing predefined voice commands such as *forward*, *backward*, *left*, *right*, and *stop*. These commands are processed using a voice recognition module or a smartphone-based speech recognition system. The recognized command is transmitted to a microcontroller, which controls the motors through a motor driver circuit to achieve the desired movement.

The system is designed to be:
● User-friendly
Low-cost
Reliable
Suitable for indoor and outdoor environments

B. Block Diagram Description

1. **Voice Input Unit**
Captures the user's voice commands using a microphone or a mobile application with speech recognition capability.

2. Speech Recognition Module
Converts voice commands into digital signals. This can be implemented using:
1.A Bluetooth-enabled smartphone application, or
2.A dedicated voice recognition module

3. Microcontroller Unit
Acts as the central controller (e.g., Arduino or Raspberry Pi). It:

If command = **"forward"** →

➡ MCU sends control to both motors to go forward.

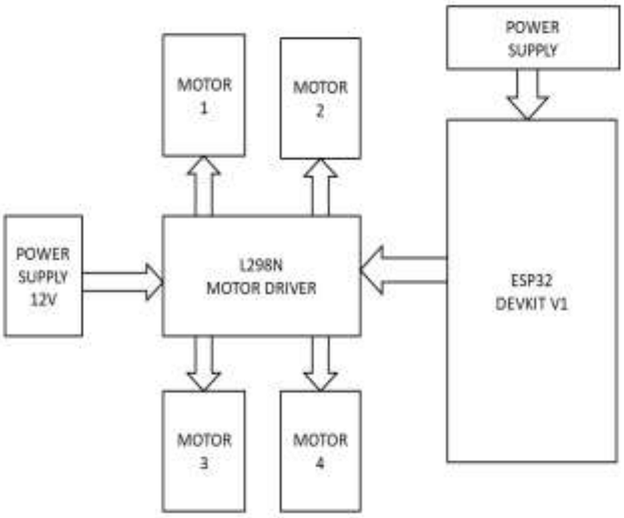
If command = **"left"** →

➡ MCU reduces or reverses one motor to turn. IJERT

If command = **"stop"** →

➡ MCU stops all motors.

IV. METHODOLOGY/SYSTEM DESIGN

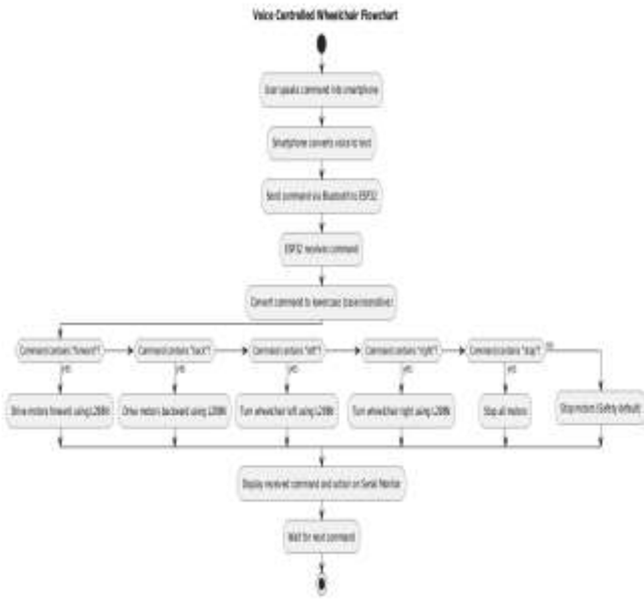


- **Working Principle**

When the user speaks a command, the voice input unit captures it and forwards it to the speech recognition module. The recognized command is converted into a corresponding digital instruction and transmitted to the microcontroller. Based on the received command, the microcontroller activates the motor driver to rotate the motors in the required direction, enabling the wheelchair to move accordingly.

Safety is ensured by prioritizing the *stop* command and maintaining controlled motor speed to prevent sudden movement.

A. Flowchart



The methodology outlines the step-by-step approach followed to design and implement the voice-controlled wheelchair system. The system integrates voice recognition with motor control to provide hands-free navigation for physically challenged and elderly individuals.

a. **Requirement Analysis**

a. Identify user needs for mobility assistance and hands-free control.
b. Define system specifications: voice command recognition, motor control, obstacle avoidance, and safety features.

b. **Hardware Selection**

a. **ESP32**: Main controller for processing voice commands and controlling the motors.

International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 15 Issue 3, March-2026

b. **Microphone Module**: Captures the user's voice commands.
c. **Motor Driver (L298N or similar)**: Drives the DC motors of the wheelchair.
d. **DC Motors**: Provide propulsion for forward, backward, left, and right movement.
e. **Power Supply**: Rechargeable battery to power the system.

c. **Software Development**

a. **Voice Recognition**: ESP32 processes voice input using inbuilt libraries or external APIs to identify commands.
b. **Motor Control Logic**: Each recognized command triggers the motor driver to move in the corresponding direction.
c. **Safety and Stop Functionality**: Emergency stop command implemented to halt the wheelchair immediately.

d. **Integration and Testing**

a. Connect hardware components and ensure proper signal transmission from ESP32 to motor driver.
b. Test voice recognition in different environments to ensure accuracy.
c. Verify that the wheelchair responds correctly to each command and stops safely when needed.

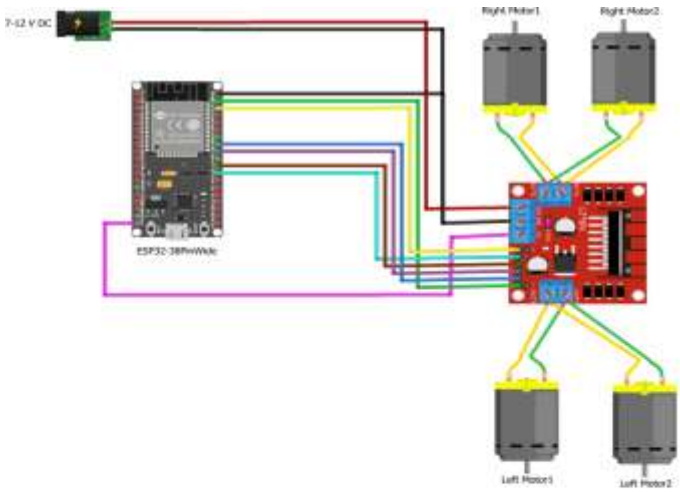
e. **Evaluation**

a. Evaluate the system for response time, accuracy of voice command recognition, reliability, and safety.
b. Collect feedback from users to improve usability and robustness.

D. *The system follows a sequential control algorithm:*

1. Initialize system modules
2. Wait for voice command
3. Recognize and validate command
4. Send command to microcontroller
5. Activate motor driver accordingly
6. Execute movement
7. Stop motors on *stop* command

F. System Design



V. Results and DISCUSSION

The proposed voice-controlled wheelchair system was implemented and tested under various operating conditions to evaluate its performance, accuracy, and reliability. The system was tested using predefined voice commands such as *forward*, *backward*, *left*, *right*, and *stop*.

A. Experimental Setup

The experimental setup consisted of a wheelchair prototype integrated with a speech recognition module, microcontroller, motor driver, and DC motors. Voice commands were given by the user in a normal speaking tone from a short distance. The tests were conducted in an indoor environment to minimize background noise.

B. System Performance

The system successfully recognized and executed most of the voice commands in real time. The wheelchair responded smoothly to directional commands, and the transition between movements was stable. The *stop* command was given the highest priority and was executed immediately in all test cases, ensuring user safety.

C. Accuracy Analysis
The speech recognition module demonstrated high accuracy when commands were spoken clearly. Minor delays were observed when background noise was present, but the system was still able to perform reliably. The average command recognition accuracy was found to be satisfactory for assistive mobility applications.

D. Response Time
The response time between command input and wheelchair movement was minimal. The delay mainly depended on speech processing and communication between the recognition module and the microcontroller. Overall, the system achieved near real-time performance, which is essential for user comfort and safety.

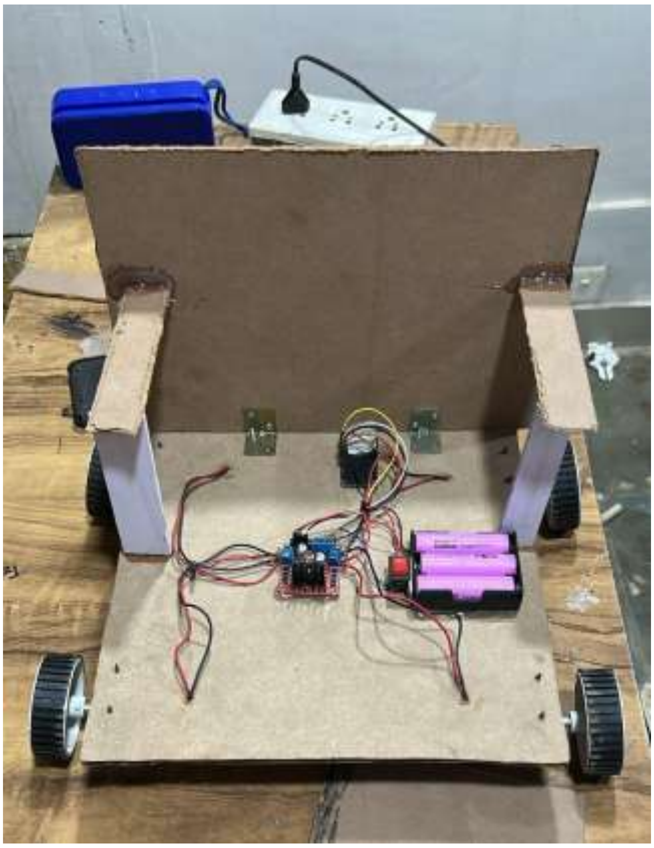
E. Limitations
Despite successful operation, the system has certain limitations:
- Performance may degrade in noisy environments
- Recognition accuracy depends on pronunciation
- Limited vocabulary of commands

These limitations can be addressed using advanced noise-filtering techniques and AI-based speech recognition models.

F. DISCUSSION

The results demonstrate that voice control is an effective alternative to traditional joystick-based wheelchair systems, especially for users with limited hand mobility. The proposed system offers a cost-effective and user-friendly solution while maintaining acceptable performance levels. The modular design allows future enhancements such as obstacle detection, GPS tracking, and mobile application integration.

G .Final Output:



VI. CONCLUSION AND FUTURE SCOPE

A. Conclusion
This paper presented the design and implementation of a voice-controlled wheelchair aimed at improving mobility for physically challenged individuals. The system successfully converts spoken commands into corresponding wheelchair movements using speech recognition, a microcontroller, and motor control circuitry. Experimental results demonstrate that the proposed system is reliable, responsive, and easy to operate under normal environmental conditions.

The hands-free operation eliminates the need for manual control, making the system suitable for users with limited upper-body mobility. The modular and cost-effective design ensures ease of implementation and scalability, making it a practical assistive technology solution.

B. Future Scope

The proposed system can be further enhanced in several ways to improve functionality, safety, and user experience:

- Integration of **obstacle detection sensors** to prevent collisions
- Use of **advanced AI-based speech recognition** for higher accuracy
- Addition of **GPS and IoT features** for real-time tracking
- Development of a **mobile application** for system configuration
- Implementation of **emergency alert mechanisms**

VII. REFERENCES

[1]. https://www.researchgate.net/publication/347594633_Voice_Controlled_Wheelchair

[2]. https://www.ijert.org/research/an-voice-controlled-wheel-chair-for-physically-challenged-people-with-therapy-unit.