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Voice Controlled Wheelchair

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Abstract

This paper presents the design and development of a voice-controlled wheelchair aimed at supporting individuals with physical impairments. The system enables the user to direct movement using voice commands, reducing dependence on physical controls. The architecture integrates an embedded microcontroller, speech recognition hardware, and motor drivers to process commands and control motion. Additional safety features such as obstacle detection and emergency stop mechanisms enhance reliability. The system was tested in various conditions to evaluate accuracy and responsiveness, demonstrating its potential to significantly improve user independence and quality of life.

Keywords: Voice recognition, Assistive device, Speech control, Wheelchair automation, Obstacle avoidance, Embedded systems

Introduction

For individuals with limited physical movement, especially in the arms or hands, conventional wheelchairs may not offer sufficient autonomy. To address this gap, voice-controlled mobility solutions have emerged as a practical alternative. These systems use speech recognition to execute commands, enabling hands-free control. In this work, we propose a voice-activated wheelchair that translates user speech into movement through embedded control systems. The device supports common navigation commands and integrates basic safety measures, making it suitable for daily use in both indoor and outdoor settings.

Literature survey

Several recent studies have explored innovative ways to enhance wheelchair usability using voice and smart technologies. Sethukarasi et al. (2023) proposed a hybrid system combining voice and gesture inputs to navigate a motorized wheelchair. Their work demonstrated real-time tracking and command execution but struggled with recognition errors under noisy conditions. Amin et al. (2024) implemented a system using both voice commands and an Android interface. While their approach offered flexibility, the effectiveness of the user interface varied across users. Environmental noise and user speech differences remained key limitations. Iskanderani (2024) developed a cost-efficient voice-controlled wheelchair using Bluetooth and Arduino. Though practical, their system's recognition accuracy was affected by user variability and lacked adaptability to complex environments.

These studies confirm the feasibility and growing interest in voice-enabled wheelchairs. However, they also highlight the need for better noise handling, simplified interfaces, and improved reliability in uncontrolled environments.

Problem Statement

People with severe physical disabilities face challenges operating standard mobility devices, often relying on caregivers for navigation. This lack of independence affects their daily routine and emotional well-being. There is a clear need for a system that allows intuitive, voice-based control of wheelchairs to restore autonomy and improve quality of life.

Objectives

- To develop a wheelchair system that responds to basic voice commands.
- To implement reliable speech recognition in varied environmental conditions.
- To integrate smooth communication between the control unit, motors, and sensors.
- To ensure safety through obstacle detection and emergency stop features.
- To evaluate system usability in real-world scenarios.

Proposed methodology

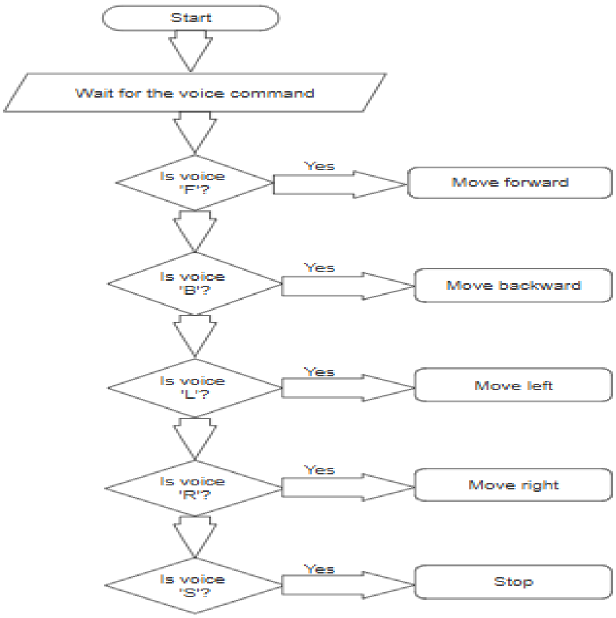

Fig.1 Flowchart of voice controlled wheelchair

The proposed system is built around an Arduino controller linked with a Bluetooth-enabled voice recognition module and a motor driver. The user's voice input, captured via a mobile app or microphone, is sent wirelessly to the controller. The Arduino decodes these commands and initiates motor actions accordingly. Movement directions include forward, backward, left, right, and stop. Obstacle sensors are included to detect potential collisions, and an emergency stop feature is implemented to improve safety.

Result and Discussion

Testing showed that the system effectively recognized and responded to voice commands in quiet and moderately noisy environments. Users were able to navigate the wheelchair with minimal delays and reported improved ease of use. The integration of obstacle sensors prevented unintended collisions, enhancing confidence in usage. While performance dropped slightly in loud environments, it remained functional, indicating the need for improved noise filtering in future versions.

Fig.2 Voice controlled wheelchair

Conclusion

The voice-controlled wheelchair developed in this study has the potential to transform mobility support for users with physical disabilities. It offers a practical solution that reduces dependency and supports autonomous movement. Although current limitations such as sensitivity to background noise exist, these can be addressed with further refinement of the voice recognition algorithm and hardware. Overall, the project demonstrates that speech-activated mobility systems are a feasible and beneficial addition to assistive technologies.

Future Scope

Upcoming iterations could employ advanced natural language processing to improve voice command flexibility and accuracy. Integration with smart environments could allow users to control home appliances in addition to the wheelchair. Additionally, including biometric feedback and health monitoring features may expand the system's utility in healthcare settings.

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