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VOICE CONTROL SMART WHEELCHAIR WITH OBSTACLE DETECTION

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ABSTRACT

Mobility assistance is an valuable need for individuals who experience physical disorders or movement limitations. Traditional wheelchairs need manual operation, which may be tough for people with severe physical impairments. The Voice Control Smart Wheelchair with Obstacle Detection is developed to give a more convenient & safe mobility solution by enabling users to control the wheelchair using voice commands or instructions . To enhance safety, the wheelchair is equipped with ultrasonic & infrared sensors that constantly monitor the surrounding environment. These sensors detect obstacles & avoid collisions by stopping or changing the direction of movement. The system also involves a battery monitoring mechanism to ensure reliable operation. Experimental testing displays that the wheelchair can respond precisely to voice commands & safely navigate indoor environments. The introduced system offers an affordable & intelligent assistive mobility solution that can significantly enhance independence & quality of life for people with mobility challenges.

The system uses a microcontroller-based platform to process instructions received through a wireless communication interface. Voice commands are captured using a voice recognition module & transmitted through a Bluetooth communication module to the microcontroller. The microcontroller processes the commands & controls the wheelchair movement through a motor driver module connected to DC motors.

INTRODUCTION

Assistive technologies play an significant role in enhancing the quality of life for individuals with physical disorders. Among these technologies, wheelchairs are one of the most usual mobility aids used worldwide. However, conventional wheelchairs need manual control or physical effort, which may not be possible for people with intense disabilities.

With the development of embedded systems & wireless communication technologies, smart wheelchairs have been designed to give enhanced mobility assistance. A voice-controlled wheelchair enables users to control movement using easy spoken commands like forward, backward, left, & right. This eliminates the require for manual operation & permits users with limited physical abilities to move independently.

The introduced system contains voice recognition, Bluetooth communication, microcontroller-based control, & obstacle detection mechanisms to make a smart & secure mobility solution. The microcontroller processes the received instructions & controls the wheelchair movement through motor drivers & DC motors.

To improve safety, ultrasonic & infrared sensors are used to detect obstacles in the surrounding environment. If an obstacle is detected within a predetermined distance, the system automatically stops or changes the direction to avoid accidents. This system illustrates how embedded technology can be used to design intelligent assistive devices for people with disabilities.

LITERATURE SURVEY

Various research studies have highlighted on the enhancement of intelligent wheelchairs using modern electronic technologies. Early wheelchair systems were primarily manual or joystick-controlled, which needed physical effort from the user.

Studies obtainable through Elsevier discuss the usage of voice recognition & obstacle detection technologies in assistive mobility devices. These systems help users control wheelchairs using speech commands or instructions while maintaining safety through environmental sensing

Research published by IEEE focuses the advancement of smart wheelchair systems that used sensors, microcontrollers, & wireless communication technologies to enhance mobility assistance for disabled individuals.

Other research has explored the usage of ultrasonic sensors , infrared sensors, & Bluetooth communication for wheelchair navigation. These technologies give reliable obstacle detection & enable wireless communication between the wheelchair & consumer devices. The

literature suggests that combining voice control with sensor-based safety mechanisms significantly enhances wheelchair usability & safety.

PROPOSED SYSTEM

The proposed system is a smart wheelchair that can be controlled through voice commands or instructions while ensuring safe and secure movement through obstacle detection sensors.

A. System Overview

The smart wheelchair contains microcontroller-based control system interconnected to motors, sensors, & communication modules. The consumer gives voice instructions through a voice recognition module attached to a Bluetooth interface.

Ultrasonic & infrared sensors constantly monitor the surrounding environment. When an obstacle is detected within a safe distance, the system automatically stops the wheelchair or manages the direction of movement to avoid collision.

The Bluetooth module transfers the command signals to the microcontroller. The microcontroller processes the commands & controls the motor driver module, which drives the DC motors connected to the wheelchair wheels.

B. Key Components

- Microcontroller (Arduino-based platform)
- Voice Recognition Module
- Motor Driver Module
- DC Motors
- Bluetooth Communication Module
- Ultrasonic Sensor

C. Working Principle

1. The system is energized by a power-restorable battery connected to the microcontroller & motor driver.
2. The consumer provides voice commands like “forward,” “backward,” “left,” or “right” using the voice recognition module.
3. The voice recognition module transforms the spoken command into digital signals.
4. These signals are transmitted through the Bluetooth communication module to the microcontroller.

5. The microcontroller obtains the command & processes it based on the programmed instructions.
6. The motor driver module receives control signals from the microcontroller & drives the DC motors consequently.
7. The DC motors rotate the wheels of the wheelchair to move in the required direction.
8. Ultrasonic & infrared sensors constantly measure the distance between the wheelchair & close obstacles.
9. If an obstacle is detected within the predetermined safety range, the microcontroller automatically stops the wheelchair or changes its direction.
10. This ensures secure navigation & avoids collisions during wheelchair functioning.

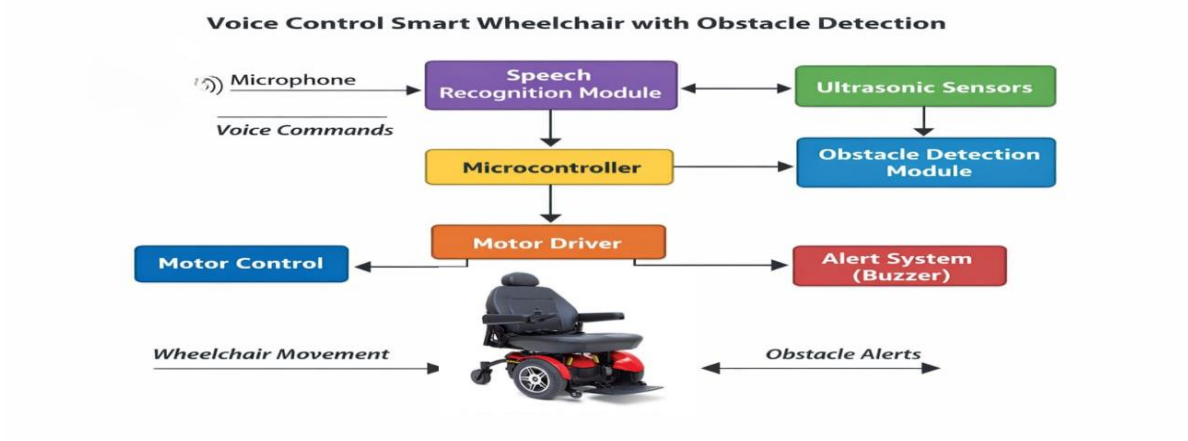
D. Advantages

- Simple to operate & user-friendly system
- Wireless communication using Bluetooth
- Low-cost & energy-efficient solution
- Can be upgraded with additional smart features
- Gives independence for people with physical disabilities
- Contactless wheelchair control using voice commands or instructions
- Enhanced safety through obstacle detection sensors

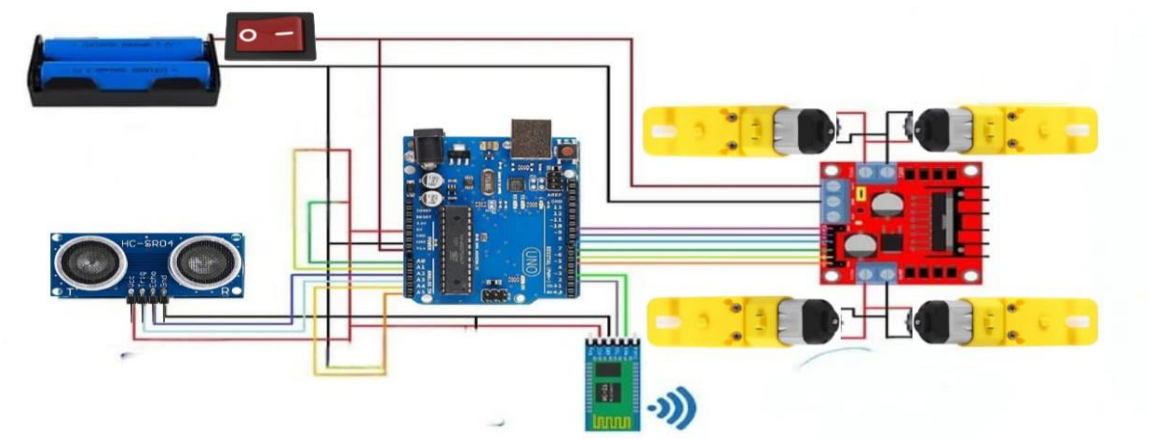
E. Application

- Smart home mobility systems
- Mobility assistance for disabled individuals
- Smart healthcare & rehabilitation centers
- Hospitals & medical facilities
- Assistive technology research & development
- Elderly care assist systems

BLOCK DIAGRAM:



CIRCUIT DIAGRAM:



RESULTS AND DISCUSSION

The designed voice-controlled smart wheelchair was examined in indoor environments to evaluate its operation & reliability. The voice recognition module successfully captured spoken instructions & transmitted them through the Bluetooth communication interface. The microcontroller processed the commands effectively & controlled the motor driver module to move the wheelchair in the desired direction. The DC motors delivered smooth movement, enabling the wheelchair to navigate the test area efficiently. The ultrasonic & infrared sensors constantly monitored the surrounding environment & successfully detected obstacles within the predetermined safety range. Whenever an obstacle was detected, the system automatically stopped the wheelchair to avoid collisions. The experimental results illustrates that the introduced system gives precise command recognition, steady wireless communication, &

reliable obstacle detection. Overall, the system proves to be a practical & affordable mobility solution for individuals with physical movement limitations.

CONCLUSION

The Voice Control Smart Wheelchair with Obstacle Detection gives an intelligent mobility solution for individuals with limited physical abilities. By integrating voice recognition technology with wireless communication & sensor-based safety mechanisms, the system enables consumers to control wheelchair movement simply & safely. The usage of a microcontroller-based platform ensures effective processing of instructions & precise motor control. The incorporation of ultrasonic & infrared sensors improves operational safety by detecting obstacles & avoiding collisions. The designed system illustrates the potential of embedded technologies in assistive healthcare applications. With further enhancements & integration of modern technologies, this system can significantly improve the independence & mobility of individuals with disabilities.

FUTURE WORK

- Advancement of a mobile application for wheelchair control.
- Solar-powered charging system for expanded operation.
- Usage of camera-based vision systems for developed obstacle detection.
- Integration of AI for autonomous navigation.
- Integration of GPS for outdoor navigation.
- Execution of IoT-based remote monitoring.

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