Voice and Key-Controlled Wheelchair System for Individuals with Disabilities

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Abstract In today's world, we're concerned about helping people with physical challenges move around more easily. The project is about creating a special wheelchair that can be controlled in two ways: by talking and using buttons from a mobile app. Users command the wheelchair through a cellular device, which communicates via Bluetooth to an Arduino-equipped wheelchair.Voice prompts such as "Forward","Back","Left", "Right" and "Stop" initiate corresponding movements. This makes it easier for people to move on their own.

To make things even better,This app has buttons you can tap to control the wheelchair like a remote control. The wheelchair is also equipped with ultrasonic sensors. These sensors continuously scan the surroundings for obstacles to avoid a collision.All these features make moving around much easier for people who might have trouble getting around on their own.

Keywords: Voice Control, Remote Control, Obstacle Detection.

INTRODUCTION

People with mobility impairments, especially those who have difculty using their arms, may struggle to operate a standard wheelchair. A voice-controlled wheelchair can greatly improve their quality of life by reducing the efort required for mobility.This innovative system utilizes voice commands, allowing users to efortlessly control the wheelchair's direction.To use the voice-controlled wheelchair, a person simply talks into a microphone attached to the wheelchair. The computer inside, called Arduino, understands these commands and moves the wheelchair accordingly. It can go forward,backward, turn left or right, stop.This voice-controlled feature signifcantly enhances accessibility and independence for individuals with mobility impairments.

In addition to voice control, the wheelchair system also incorporates manual key controls for added fexibility. Users can utilize key buttons, operated by an Arduino microcontroller, to navigate the wheelchair in situations where voice commands may not be suitable or preferred. The integration of key controls ensures that users have multiple options for controlling the wheelchair, catering to their individual needs and preferences.

Ultrasonic sensors are integrated into the wheelchair to detect obstacles in its path. Upon detecting an obstacle, the wheelchair automatically adjusts its course or halts its movement to avoid collisions. This obstacle detection feature adds an extra layer of security, allowing users to navigate their environment with confdence and peace of mind. By combining voice and key controls with obstacle detection, our wheelchair system ofers a comprehensive solution to improve mobility and safety for individuals with mobility challenges.

LITERATURE SURVEY

[1]The study aims to enhance the performance of adaptive iterative learning control systems by adjusting the system's gain using fuzzy logic control. They compare two types of fuzzy logic controllers (Type-1 and Type-2) combined with iterative learning control (ILC) to stabilize a two-wheeled wheelchair in an upright

position and reduce the root mean square (RMS) error of angle and position. They find that Type-1 fuzzy logic control combined with ILC is more effective in achieving stable and fast control, while Type-2 fuzzy logic control combined with ILC is more effective in maintaining the position of the wheelchair.

[2]The system integrates voice commands with collision avoidance mechanisms based on sensor data. By leveraging sensor information autonomously detect obstacles in its path and navigate around them, enhancing the safety and independence of users.

[3]The system entails a vision - driven command interface that interprets facial gestures to control an electric wheelchair, specifically designed for individuals facing significant disabilities. It utilizes a 2D color face tracking mechanism along with fuzzy logic. This approach prioritizes user comfort by enabling unrestricted head movement while maintaining a non-intrusive nature.

[4]The system is aimed at assisting physically handicapped individuals. Utilizing voice commands, users can control the wheelchair.The system offers various commands for basic movements, short-distance maneuvers, and verification to prevent misrecognition errors.

[5] The proposed wheelchair system features an intuitive interface that leverages the head and gaze motions of the user. Additionally, it assesses the user's level of concentration on the task by analyzing the correlation between head and gaze movements..The system utilizes a stereo camera setup to track facial features and estimate gaze direction in real-time, enabling natural and intuitive interaction with the wheelchair.

[6] This system operates based on voice commands in multiple languages, allowing users to control the wheelchair's movement simply by speaking. It addresses the needs of individuals with conditions like quadriplegia, cerebral palsy, and multiple sclerosis, who may otherwise rely on assistance for mobility.

[7] The system restructured the conventional joystick approach into velocity regulation and direction control. This segmentation facilitated the development of a wheelchair model responsive to electromyography (EMG) signals.

[8]This system presents a method for controlling a wheelchair using electrooculography (EOG), which measures electrical signals generated by eye movements. The article explains EOG as a method for sensing eye movement by recording electrical potentials generated by the movement of the eyeball. It describes the setup for capturing EOG signals using electrodes placed around the eyes.

[9]The system explores the potential of brain computer interface (BCI) technology in enhancing the control systems of electric wheelchairs. By integrating BCI with electric wheelchairs, the authors aim to provide individuals with disabilities greater independence and mobility.

EXISTING SYSTEM

The existing system utilizes only voice control for wheelchair navigation, which may pose limitations for users who have difficulty with vocal commands or speech impairments, lack of flexibility, dependency on speech recognition accuracy, and accessibility concerns. To overcome the limitations of the existing voice-only control system, alternative control methods such as key controls can be implemented. By integrating key controls alongside voice commands, users with difficulty in vocal commands or speech impairments can have a viable alternative for wheelchair navigation. This provides increased flexibility and reduces dependency on speech recognition accuracy, ensuring a more reliable and user-friendly experience.Additionally, the introduction of a dedicated mobile app with a user-friendly interface further enhances accessibility and usability. These enhancements aim to address the drawbacks of the existing system.

PROPOSED SYSTEM

The system consists of a mobile app in which a microphone is utilized to get the verbal instructions from the patient and then change them into the electrical signals.The HC-05 Bluetooth module receives the electrical signals from the microphone via the mobile app. It then transmits these signals wirelessly. The control system,consisting of Arduino microcontroller and motor drivers, interprets the received signals to execute corresponding actions, such as moving the wheelchair in the specified direction or stopping its movement.The mobile app incorporates key controls, enabling users to navigate the wheelchair using physical buttons on a mobile app interface. This dual-control system enhances accessibility and user experience, allowing individuals to choose the control method that best suits their abilities and preferences.

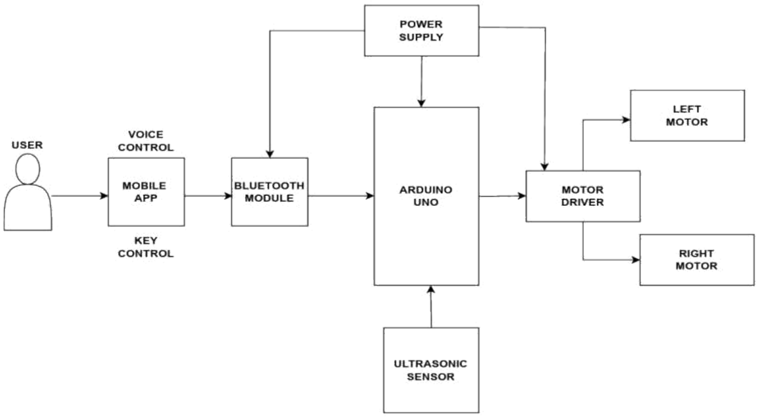

Fig-1: Block Diagram

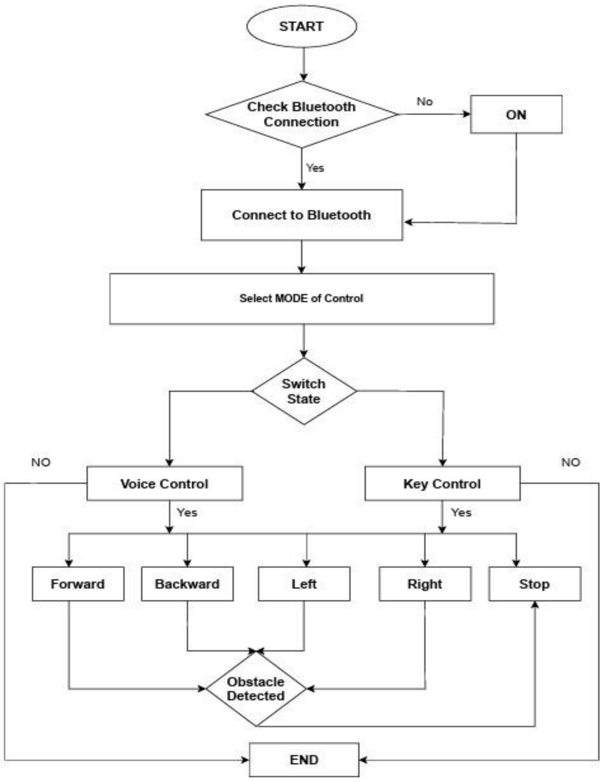

Fig-2: Flow Chart

The system recognizes fve fundamental commands, allowing the wheelchair to move accordingly. The system comprises two main components: the HC-05 Bluetooth module unit and the motor driving unit, both of which interface with an Arduino microcontroller. Initially, the user's verbal commands are captured by a microphone and then transmitted to the HC-05 Bluetooth module unit. The process involves converting the voice command into a string array, which is transmitted to an Arduino Uno board for processing.

After receiving commands from the HC-05 Bluetooth module, the Arduino microcontroller processes the signal motors to rotate in forward direction. Similarly, if the command is to turn left or right, the motor driver shield will adjust the rotation of the motors accordingly.By coordinating the rotation of the DC motors, the Arduino and motor driver shield ensure smooth and accurate movement of the wheelchair in response to user commands.

Moreover, the wheelchair is outftted with ultrasonic sensor for obstacle detection.These sensors continuously scan the wheelchair's surroundings, detecting obstacles in its path. Upon detecting an obstacle, the wheelchair triggers an emergency stop mechanism halting the wheelchair.The ultrasonic sensor emits a high-frequency sound wave, usually above the range of human hearing (ultrasonic). This sound wave travels outward in a cone-shaped pattern from the sensor. When the emitted sound wave encounters an object in its path, it gets refected back towards the sensor. The distance for the sound wave to travel to the object and return is measured. If the calculated distance is below a predetermined threshold,the microcontroller triggers the obstacle detection system. This can involve stopping or altering the wheelchair's movement to avoid a collision and ensure user safety. By combining voice commands, key controls, and obstacle detection capabilities, the wheelchair ofers a comprehensive solution for individuals with mobility impairments, empowering them to navigate their surroundings with ease and confdence.

HARDWARE AND DESCRIPTION

ARDUINO UNO

The Arduino Uno is a popular microcontroller board widely used for various electronics projects. It's based on the ATmega328P microcontroller and features digital and analog input/output pins that can be programmed to interact with sensors, actuators, and other electronic components. The Uno is a relatively easy to use and open-source software development environment. It's a great platform for beginners to learn about electronics and programming.

Fig 3: Arduino Uno Board

BLUETOOTH MODULE:

The HC-05 is a commonly used Bluetooth module in electronics projects. It allows for wireless communication between devices, typically used for establishing a serial communication link between a microcontroller and other devices such as smartphones, tablets, or computers. The HC-05 module supports Bluetooth 2.0 and provides a simple and reliable way to add Bluetooth functionality to projects. It features a range of configurations, including different baud rates and modes, making it versatile for various applications requiring wireless data transfer.

Fig 4: HC05 Bluetooth Module

ULTRASONIC SENSOR:

An ultrasonic sensor is a device that uses sound waves with frequencies higher than the human audible range to detect the distance to an object. It typically consists of a transmitter and a receiver. The transmitter emits ultrasonic waves, which bounce of nearby objects and are then detected by the receiver. By measuring the time it takes for the sound waves to return, the sensor can calculate the distance to the object based on the speed of sound in air.

Fig 5: Ultrasonic Sensor

METAL DC MOTOR:

The Metal DC High Torque motor is a key component in the wheelchair project as it provides the necessary propulsion for the wheelchair's movement.The motor ofers high torque output, making it suitable for powering the wheelchair even on rough or uneven terrain. With a rated speed of 200 revolutions per minute (rpm), the motor allows for precise control over the wheelchair's speed..The motor is designed to operate at 12 volts, which is a common voltage level in electrical systems. This compatibility makes it easy to integrate the motor with other components of the wheelchair's control system, such as motor drivers and microcontrollers.The motor operates quietly, minimizing noise during wheelchair operation. This is benefcial for user comfort and ensures a more pleasant experience when using the wheelchair in various environments.

Fig 6: Metal DC Motor

L298N MOTOR DRIVER:

The L298N motor driver is a crucial component in the wheelchair project.It is used to interface between the microcontroller, such as Arduino, and the DC motors.The L298N motor driver provides a convenient and efcient way to manage the direction and speed of the motors using digital signals from the microcontroller. The L298D shield uses an H-bridge confguration, which enables bidirectional control of motors. This means you can easily control the motors to rotate in both clockwise and counterclockwise directions. Motors often require higher voltage and current than microcontrollers can provide directly. The L293D shield regulates and manages the power supply to the motors, preventing damage to the microcontroller and ensuring stable motor operation.

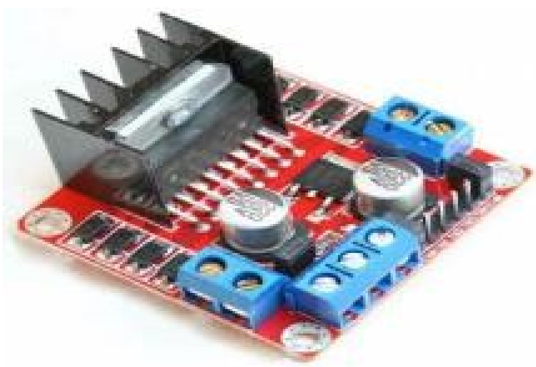

Fig 7: *L298n Motor Driver*

WHEELS:

The wheelchair is equipped with two rear wheels and one caster wheel, all sharing identical diameters. Positioned at the rear on either side of the base, the drive wheels enable the chair to move in response to voice commands. Each wheel directly engages with a gear train to transfer torque from the motor, utilizing two grooves in each wheel and nut for transmission.

MOBILE APP INTERFACE

We have developed this app using MIT app Inventer.It allows users to create mobile applications for Android devices without needing to have prior programming experience. It uses block level programming and features a visual drag-and-drop interface that enables users to design and build their apps by assembling blocks of code.

In the app interface developed using MIT App Inventor for the voice and key-controlled wheelchair project, users will fnd a microphone icon for voice controls and buttons for key controls. The microphone icon allows users to input voice commands, which are then processed by the app to control the wheelchair's movements. Additionally, there are buttons provided for key controls allowing users to manually navigate the wheelchair using these controls.

SOFTWARE

The Arduino Integrated Development Environment (IDE) is a software application used to program Arduino and other compatible microcontroller boards.It provides a user-friendly interface for writing, compiling, and uploading code to the microcontroller.The Arduino IDE supports a simplifed version of C/C++ programming language, making it accessible to beginners and experienced developers alike. The IDE includes a text editor with features like syntax highlighting and auto-completion, a compiler, and tools for uploading code to the Arduino board via USB.Additionally, it ofers a wide range of libraries and examples to help users get started with their projects.

CONCLUSION

In conclusion, The development of the voice and key controlled wheelchair system signifes a progress aimed at aiding individuals with mobility limitations. By integrating voice commands, key controls, and obstacle detection capabilities, the wheelchair ofers users greater autonomy and safety in navigating their environment. The use of HC-05 Bluetooth module enables seamless communication between the wheelchair and the user's smartphone, enhancing accessibility and ease of use. While the current prototype demonstrates promising functionality, there is ample opportunity for future enhancements and refnements to further improvement and user experience of the wheelchair system.This project could make life better for people with disabilities by helping them do more on their own.

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