

Voice Controlled Wheel Chair for Disable People

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Abstract

In the current day, wheelchairs are still used to help facilitate immobile disabled people to move to places. If a person with a disability can still use their hands and arms normally, they can easily control wheelchairs by pushing the wheels. However, current wheelchairs serve as a challenge for people with limited motor capabilities and missing limbs. Therefore, the objective is to develop a voice operated wheelchair, incorporating a speech recognition system to allow users to command the wheelchair's movements verbally. The voice commands are received through a microphone and processed by an Arduino UNO R3 microcontroller to control the motor circuit. To enhance the safety of the developed wheelchair, ultrasonic sensors are installed to detect obstacles and provide an audible warning. Additionally, an emergency stop button is included. The result from the testing of the voice controlled wheelchair show that it took an average of 98.2 seconds to travel over a distance of 30 meters, and the obstacle detection—in the 50-centimeter range—had an average error rate of 12.3%.

Keywords— physical disability, voice-controlled wheelchair, voice recognition, ultrasonic detection.

Introduction

The wheelchair plays a crucial role in enabling individuals with disabilities to move around freely and independently. There are generally two main types of wheelchairs. The first Type is a self-propelled wheelchair, where the user operates the Wheelchair by using their hands and arms to turn the rims on the Rear wheels. The second type of wheelchair is the assistive Controlled wheelchair, equipped with a joystick that allows Either the caregiver or the user to direct the wheelchair's Movement in the desired direction[1]. Nonetheless, both types Of wheelchairs depend on the muscular strength, dexterity, and Functionality of the hands and arms. As a result, individuals with Impairments affecting their hands and arms face challenges When attempting to utilize these conventional wheelchairs [2]. Hence, numerous researchers have suggested diverse methods For wheelchair control, such as those utilizing eye gaze [3], facial Direction [4], electroencephalography (EEG) [5], me (EOG) [6], electromyography (EMG) [7], Bio-signals [8], tongue pressure [9], and oral gestures [10]. However, an alternative and intuitive method is voice control, as it aligns with the human's natural mode of communication [2, 11-16]. Many researchers have been working on voice Controlled wheelchairs. For example, [17] utilizes a smartphone Connected via Bluetooth and integrates with Google API. However, this system requires an internet connection, leading to Operational delays. The average response time is

approximately 1.838 seconds. It's important to note that this wheelchair is limited to four predefined commands and lacks an obstacle detection feature for user safety. In addition, [18] develops a wheelchair using a laptop as the main control system and an Arduino as the secondary control system. Three control methods are implemented: voice control, joystick control, and gesture control with the leap motion sensor. Voice commands are transmitted from a microphone to the laptop, which then communicates with the Arduino for motor control. The wheelchair incorporates obstacle detection using front and back ultrasonic sensors. However, a drawback is the need for simultaneous input from two control methods, resulting in redundant command instructions. Moreover, [19] developed a wheelchair-manipulating device. This device incorporates a

voice recognition unit that interprets human voice commands to control the wheelchair's movements. It integrates an Arduino, a HC-05 Bluetooth module, a speech-to-text voice recognition Android application, and a motor driver. Users can operate the wheelchair by simply speaking into the wheelchair's microphone. However, this system lacks obstacle detection sensors and an alert mechanism to identify and notify the user about obstructions. Based on previously mentioned references, it's evident that there exists a demand for a wheelchair equipped with voice recognition capabilities to aid individuals with physical limitations, particularly those affecting their hands and arms. Accordingly, this paper outlines the design and implementation of a voice-controlled wheelchair using the Arduino UNO R3 microcontroller. T.

A. Mechanism of Wheel Chair

To process the electrical signals from the microphone, the voice recognition module V3 is utilized. This module is a compact and user-friendly sound recognition board. The module is designed to recognize and respond to voice commands, supporting a maximum of 80 commands. It can handle up to 7 simultaneous commands, and any voice can be trained as a command. Prior to recognizing any specific voice commands, users are required to train the module. The module compares the audio input from the microphone with a predefined set of recorded commands and relays the outcomes. The wheelchair utilizes two DC motors for

its motion, with each motor connected to either the left or right rear wheel.

These motors operate at a voltage of 24 Volts and deliver a power of 350 watts each. As for controlling the torque, it can be achieved by controlling the current flowing through the armature winding and field winding. Currently, Pulse Width Modulator (PWM) circuits are used for control. To control the direction of rotation, it can be done by reversing the polarity of the power supply supplied to the motor. The overall operation principle of the developed voice-controlled wheelchair can be shown in the system diagram as a flowchart in Figure 4. After declaring all the variables, the program will begin to check the operate

The voice-controlled wheelchair consists of the following components:

A. Microphone: +The microphone serves to translate the user's spoken commands into electrical signals, which are subsequently transferred to the voice recognition module.

B. Voice Recognition Module

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C. BTS7960 43A DC Motor Drive Module

The H-Bridge DC Motor Driver Module with integrated BTS7960 IC has a maximum current specification of 43A(peak). It controls the motor's bidirectional rotation using the BTS7960, which is a compact module designed for motor driving (PWM at 25 kHz with Active Freewheeling). It is suitable for controlling high-power motors, operating at 24V, and capable of driving currents up to 43A. The module comes with various protections, including Over-Voltage, Under Voltage, and Over Temperature.

Working :

The voice instructions are recorded via serial communication with the PC using Access Point communication software with baud rate of 9600. After the connection of the voice recognition module is the key feature of this project that is used to setup the desired voice command and output. It consists of three phases, which is voice customization, voice capture and voice recognition. Voice customization is the process of matching the desired voice recorded to the desired output signal. Voice capture is the phase that records the desired persons voice command and saves the voice based on the customization configuration. The voice recognition phase is the final phase where when voice command has been recognized, this module will send a specific signal to the microcontroller for the necessary operation. Figure 2 shows the block diagram of the voice recognition module.

Figure 2. Block diagram of voice module to the PC is successfully implemented, the existing voice instructions are deleted by sending hex command AA 01. The recording is started with the desired voice command in group 1 by sending the hex command AA 11. After this command has been sent, user is required to record a total of five voice commands in order to complete the group recording. On completion of the voice capturing phase, verification is required by sending the hex command AA 21 to import group 1 into the voice recognition module. The recorded voice command is verified again by repeating the five commands that has been recorded earlier.

Conclusion :

Based on the results obtained from the testing conducted to Examine the correlation between the user's voice commands and the corresponding motor movements it was found that the DC motors were able to execute all Commands correctly and demonstrated the intended rotational Direction as per the design. Based on the results of testing the Distance measurement sensor and the obstacle detection alert System within the specified range of 50 centimeters.

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