

Design and development of a voice recognized automatic Wheelchair based on microcontroller

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Abstract: Mobility assistance for individuals with disabilities or limited movement capabilities is a critical area of innovation in assistive technology. This study presents the design and development of a voice recognition-based autonomous wheelchair using a microcontroller, aimed at enhancing the independence and convenience of users. The system integrates voice recognition technology, motorized control, and obstacle detection to enable hands-free operation.

The wheelchair is equipped with a microcontroller-based control unit that processes voice commands given by the user through a microphone. The system utilizes a speech recognition module to convert spoken instructions into electrical signals, which are then processed to control the movement of the wheelchair. Additionally, ultrasonic sensors are incorporated to detect obstacles and prevent collisions, ensuring safe navigation in both indoor and outdoor environments.

The experimental evaluation focuses on accuracy in voice command recognition, response time, maneuverability, and obstacle avoidance efficiency. The results demonstrate the feasibility of implementing a low-cost, intelligent mobility solution that enhances accessibility for individuals with physical disabilities. This research contributes to the advancement of smart assistive devices, improving the quality of life for mobility-impaired individuals through voice-controlled autonomous navigation.

Keywords: Microcontroller, Speech Recognition, Wheelchair, Handicapped

I. Introduction

Today In biomedical sector, a wheelchair is an important device because of the recent advancements in the industrial populations. The demand of the physically handicapped and the aged are ever rising. as Smart wheelchair will play an significant role in the future welfare society. The use of smart wheelchair inspires the view of the machine as a partner rather than as a instrument. The present wheelchairs do not have combination of technologies for their working. However, only two types of wheelchairs are available in market like hand operated and joystick operated has come into wide use. We are trying to construct a voice controlled wheelchair; the system will recognize and follows natural language voice instructions such as “Start, Stop etc.” The objective of this project is to make wheelchair moving forward, backward, Left & Right with the help of voice commands. A wheelchair fitted with obstacle sensor to achieve some independent mobility when any obstacle is there in front of wheelchair. The obstacle sensor will help the rider control the wheelchair by taking over some of the decision for steering and avoiding objects until user is able to handle the job. The voice command is a person dependent, the voice command we provide to the microcontroller is person dependent this is the major advantage of this speech recognition IC. The system comprises of transmitting section and receiving section. Initially, the voice command is stored in the data base with the help of the function keys. Then the input voice commands are transmitted through wireless. The voice received is processed in the voice recognition system where the feature of the voice command is extracted and matched with the existing sample in the database. The module recognizes the voice and sends control messages to the microcontroller. The proposed Speech Recognition Based Wheelchair Operation allows physically disabled person to control the wheelchair easily without the need to use hands. The movement of the powered wheel chair depends on the motor control and drive system which consists of microcontroller and motor driving. Once the voice recognition system recognizes the voice commands in comparison to the stored memory, the respective coded digital signals would be sent to the microcontroller which then controls the wheelchair accordingly. The voice recognition is done by HM2007 voice recognition IC. The microphone is directly connected at the analog input of voice recognition IC HM2007 keeping the mode selection key in the record mode.

II. Background and Literature Survey

Around many researches done in the field of speech recognition. Due to sophisticated signal processing algorithms and powerful computers available, computer based speech processing system nowadays have reached complex structure with high accuracy. The challenge is to maintain standard performance while using limited computation and memory resources. Researches in the area of wheelchair control system are still going on. Many people with disabilities do not have the skill essential to control a joystick on an electrical wheelchair. This can be a great drawback for the user who is permanently unable to move any of the arms or legs. They can use their wheelchair easier only using voice commands. In the proposed design, the main idea of using voice activated technology for controlling the motion of the wheelchair is to prove that it can be an exclusive solution for severely disabled. The purpose of this project is to implement an speech recognition system to recognize the input words from the user. The approach implemented is based on interfacing a microcontroller with a speech recognition IC from a dependent speaker.

For future technology wheelchair would be fully autonomous that will move automatic based on the user expression and behavior. That should be fully automatic and wireless. In this project firstly we are working on the voice based automatic Wheelchair and after that we will combine software based that will be controlled by computer and GSM mobile phones. After that we are thinking on putting a biometric feature in it that should be little bit secured. A lot of efforts have been made to develop robotic wheelchairs that operate in the same way to an autonomous robot so that the user gives a final target and directs as the smart wheelchair moves to the goal. Other smart wheelchairs limit their assist level to collision avoidance, these systems do not normally require prior knowledge of an area. A voice controlled wheelchair can assist by giving input as a voice commands like right, left, back, forward, etc. here we can also controlled our wheelchair by some angle where user wants to rotate its wheelchair by like 30° , 45° , 60° etc. This implementation is new from the other prototype developed and it is very useful for turning the wheelchair left and right with some angle. And this method can be achieve by using servo or stepper motor of high torques and lessRPM.

III. Block Diagram

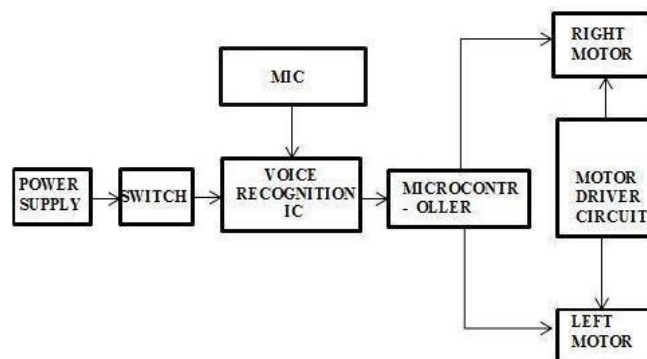


Figure 1: functioning of wheelchair

IV. Working Operation

In our model, voice recognition system is used as user interface. The block diagram of the smart wheelchair system is shown in figure 1. Here we are creating a speech recognition based wheel chair for handicapped patients. The patients who cannot walk and have to use a wheel chair can steer the wheel chair by their voice. Here in our project there is one input device i.e., mic which takes input from the user in the form of speech, speech recognition system recognize the input word spoken from mic. On receiving the Signal the microcontroller directs the motors through the control circuit. In this, two DC high torque stepper motors are used for controlling the two wheels of the chair independently. These stepper motor are very useful for rotating in a particular angles. If a user wants to rotate its motor in 30° just he has to give a command to a motor by a simple program and motor shaft will move to that particular angle. This mechanism will be very useful in rotating the wheelchair left or right at particular angle which user wants to rotate it.

The changed instructions of motions possible are: **Forward:** Both the motors in the forward direction.

Backward: Both the motors in the reverse direction.

Left: Left motor stopped/Right motor in the forward direction.

Right: Right motor stopped/Left motor in the forward direction.

First the user has to mount the wheel chair. Then the patient can give voice commands via a head phone or mic. These commands are processes in the speech recognition system and according signals are then sent to the

microcontroller to drive the wheel chair. We have made a motorized small model of the wheel chair .The wheel chair is operated by 2 DC stepper motors. The microcontroller controls these DC motors and controls the wheel chair accordingly. The voice commands are: Forward, Reverse, Left, Right, stop.

When the user gives the voice input, voice input voice is detected, the wheelchair can be controlled to move in that direction by giving commands to the wheelchair. These commands are transmitted to the wheelchair using electrical signals which are used the drive the left or right motor of the wheelchair. There are basically two motors connected to the left and right wheels of the wheelchair. The electrical signals are transmitted to these motors using some hardware ports. Generally, the communication port is the parallel port. There are some basic predefined pins of this parallel port which accept the commands given to the wheelchair in the form of electrical signals

Four wheels are used in the wheelchair for accurate balancing. The movement of wheels is controlled by DC motors which are attached to the wheelchair. Two wheels located on left side of the wheelchair are controlled by one motor and similarly the wheels on the right side are controlled by the second motor. The other circuitry built into the wheelchair includes the transmitter and receiver circuits and the obstacle recognition circuit. It involves two IR signal emitters which emit IR signals constantly when some hurdle appears in front of the wheelchair, these IR signals are obstructed, and reflected back. These reflected signals are then sensed by the IR sensor present just at the side of the emitters. As the IR signals are sensed, a circuit is connected to the beeper, and the beeper beeps. At the same time, signal is transmitted back to the voice recognition system so as to stop the wheelchair

The voice recognition IC HM2007 is capable of operating in speaker dependent speech recognition mode. In speech recognition mode, first, the voice is recorded to the IC with the help of a directly connected microphone at the analog input terminal of HM2007 keeping the mode selection key in the record mode. In this way 40 0.9- second long words or 20 1.92-second long words or phrases can be recorded into the memory. After training the voice recognition IC like above the mode selection key is switched to voice input mode. Here at a particular instant the speech through the microphone is compared with the recorded sound and according to that digital output is generated. The output of voice recognition IC is then nourished to the digital input ports of the ATMEGA 16 microcontroller. The microcontroller on receiving the Signal directs the motors through the control circuit. The control of speed and direction are done in this way. The change of direction is achieved by changing the direction of current flow through the motor and speed control is achieved by varying the current through the motor. Speech recognition is allocated into two types: 1) speaker dependent 2) Speaker independent. Here the speaker dependent module is taught by the particular user who will be using the system. This module is capable of achieving a high command count and better than 95% precision for word to be recognized. The difficulty to this module is that the system only responds exactly only to the user who trained the system. Speaker independent module is the module who trained to respond to a word irrespective of who speaks. so the system must respond to a huge range of speech pattern of the target word. Speech recognition module receives voice commands of the user and sends binary code corresponding to the received command to the microcontroller.

V. Prototype Model

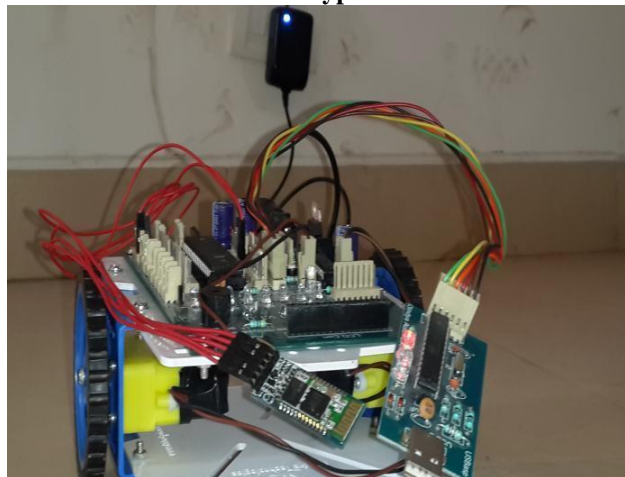


Figure 2: Demo model

VI. Future Scope

For future technology wheelchair would be fully autonomous that will move automatic based on the user expression and behavior. That should be fully automatic and wireless. In this project firstly we are working on the voice based automatic wheelchair and after that we will combine upcoming latest technology like software based that will be controlled by computer and GSM mobile phones. After that we are thinking on putting a biometric feature in it that should be little bit secured for the user

VII. Conclusion

This project pays to the self-dependency of physically challenged, handicapped and paralyzed and older people. It reduces the manual effort for a attaining and distinguishing the command for controlling the motion of a wheelchair by specified commands. Thus the only thing needed to ride the wheelchair is to have a trained voice. Further that, the development of this project is done with less cost and affordable. This wheelchair can be used to help handicapped people, especially those who are not able to move. This project consist of complete addition of the electronic circuits the hardware designing and software knowledge. Various related work in the field of automated wheelchair. We are implementing automatic wheelchair which has various advantages. This wheelchair is affordable to common people. We can also add new technology in this wheelchair. This system can be made highly efficient and effective. The setup for maintaining the wheelchair will be a onetime investment for any real life application. The motor drive and control system of the prototype intelligent wheelchair has been presented. The proposed microcontroller based voice operated smart wheelchair would bring more convenience for the disabled people, also the wheelchair has function of rotating wheelchair by some defined angle that will be very useful for the user for taking left or right turn. In future the wheelchair will be fully smart it take decision by its own

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