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Voice Controlled Wheelchair using Arduino

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Abstract: The needs of many individuals with disabilities can be satisfied with traditional, manual or powered wheelchairs. A segment of the disabled community finds it difficult or impossible to use wheelchairs. There is extensive research on computer controlled chairs where sensors and intelligent control algorithms have been used to minimize the level of human intervention. Here I describe design of a smart, motorized, voice controlled wheelchair for physically disabled people by using embedded system. Proposed design supports voice activation system for physically disabled persons incorporating manual operation. Arduino microcontroller and speaker dependent voice recognition processor have been used to support the navigation of the wheel chair. The wheelchair does not respond to a false speech command. Depending on the direction selected on the joystick, microcontroller controls the wheelchair directions. This can be controlled through the voice commands also. By using ultrasonic sensors we can avoid obstacles

Keywords: Controlled chairs where sensors and intelligent control, wheelchair, joystick, microcontroller controls

1. INTRODUCTION

"World report on disability" (2011) jointly presented by World Health Organization (WHO) and World Bank says that there are 70 million people are handicapped in the world. Unfortunately, day by day the number of handicapped people is going on increasing due to road accidents as well as the disease which leading paralysis. Among people with disabilities, percentage of physically handicapped person is most. If a person is handicapped, he is dependent on other person for his day to day work like transport, food, orientation etc. So a voice operated wheel chair is developed which will operate automatically on the commands from the handicapped user for movement purpose. Use of electrical wheelchair leads to a large amount of independence for persons with a physical disability who can neither walk nor operate a mechanical wheelchair alone.

Figure 1.1

The problem is that in some cases the disability results in the loss of ability to use hands. The way of controlling a power wheelchair can be using a joystick and it therefore does require certain manual skills or using speech commands for hands-free patients leading to an interesting and promising outcome. The seat adjustment for the user friendly movement is includes as shown figure 1.1

2. METHODOLOGY

2.1 BLOCK DIAGRAM

The proposed block diagram is shown in figure.

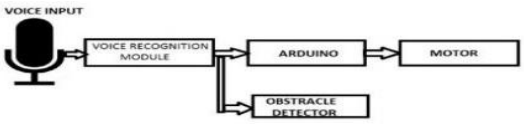

Figure 2.1: Block diagram

2.2 VOICE RECOGNITION SYSTEM

Firstly voice recognition module means a system for computer analysis of the human voice, especially for the purposes of interpreting words and phrases or identifying an individual voice. Here we have to use a voice recognition module to detect and convert detected voice command into binary signal.

2.3 VOICE INPUT

Spell voice input for further processing is the first step of voice recognition. As the proposed system for voice recognition is based on voice of person with

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physically challenged person to move inside the home without any difficulty.

2.4 OBSTACLE DETECTION

A sensor is an electronic instrument which is used to sense certain characteristics of its surroundings by either emitting and/or detecting infra red radiation. With the full fledged Design and Implementation of a Voice Actuated Miniature Model of Wheelchair, Handicapped Person will be able to do his/her day to day activity at own without taking help from others with user safety. This can be done with just a voice command of Handicapped Person which is readily trained to proposed system.

End results of the work would be a wheelchair that operated with speaker dependent voice with high degree of accuracy and reliability.

3. VOICE CONTROLLED WHEEL CHAIR SYSTEM

Mainly this system consists of two modules.

1. Hardware module
2. Software module

3.1 HARDWARE MODULE

Hardware module consists of

1. Microcontroller
2. Motor driver
3. Ultrasonic sensors
4. DC Motors
5. Microphone

3.2 SOFTWARE MODULE

Software module ,mainly consists of two softwares for controlling entire working. They are

1. Visual Basic Software
2. Arduino Compiler

4. HARDWARE MODULE

4.1 WORKING

Figure 4.1 shows a schematic of experimental setup containing hardware as well as software module. Input is taken through microphone. Speech signal is processed with the help of visual basic software and is transfer to the Microcontroller. Microcontroller converts these instructions into certain commands that can be recognized by the motors. This controls the movement and direction of wheel chair through motor driver. Microcontroller decides the operation of the two DC motors depending on the given instruction. Firstly, Voice module is trained with 4 commands. After that the voice command is send by the user. The microcontroller is used to check the signal associated with this command and compare it with the stored commands and performs the task related to this command. The wheel chair directions and movement possible are as given below.

1. Forward: Motor 1 FW and Motor 2 RW.
2. Reverse: Motor 1 RW and Motor 2 FW.
3. Left: Both motors are in FW.
4. Right: Both motors are in RW.
5. Stop: Both motors are stopped.

When the voice is detected, the wheelchair can be controlled to move in that direction by giving commands to the wheelchair. These commands are transferred to the wheelchair using electrical signals which are used to drive the left or right motor of the wheelchair.

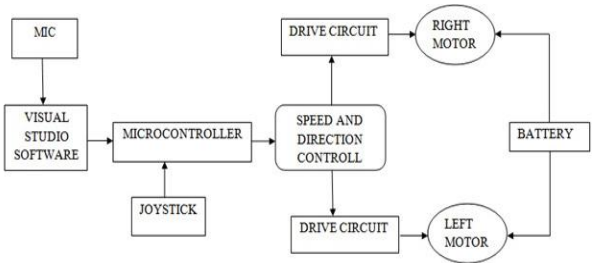

Figure 4.1:Block Diagram

There are basically two motors connected to the left and right wheels of the wheelchair. The electrical signals are transferred to these motors using some hardware ports, called the communication 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 proper 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.

4.2 COLLISION AVOIDANCE FUNCTION

In this work, the user controls the wheelchair by the interactive operation. Then, system prevents the wheelchair from taking incorrect movement by false recognition. How- ever, there is a problem of colliding with the wall or obstacle by delaying the voice command. Therefore, collision avoidance function (CAF)is implemented. CAF consists of the stop movement, the avoidance movement, and deceleration movement by using sensor in- formation. The thresholds of the sensor to each movement is set. If any of the sensor's value becomes less than the threshold, the wheelchair applied assigned movement.

1. Stop movement

The stop movement is set to prevent collision to both the stationary obstacle such as the wall and moving obstacle such as person. This movement works immediately if one of the sensors is less than the threshold.

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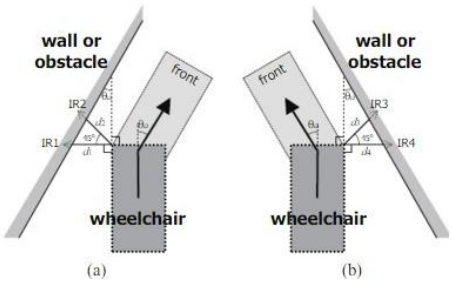

Figure 4 . 2 : Avoidance Movement

2. Avoidance movement

The stop movement increases the running time. Though this movement is useful when wheelchair turns or rotates, it is less convenient when the wheelchair goes forward. The avoidance movement provides the reduction of this problem. This movement rotates the posture of the wheelchair to parallel to the wall or obstacle when the wheelchair diagonally closes the wall or obstacle as shown in figure 4.2. Figure 4.3 shows the avoidance scene. The wheelchair approaches the wall from the diagonal direction (a)-(b).When two sensors IR3 and IR4 detects small distances less than the threshold, CAF is applied as shown figure (c)-(d) respectively, and the wheelchair rotates toward the parallel posture of the wall.

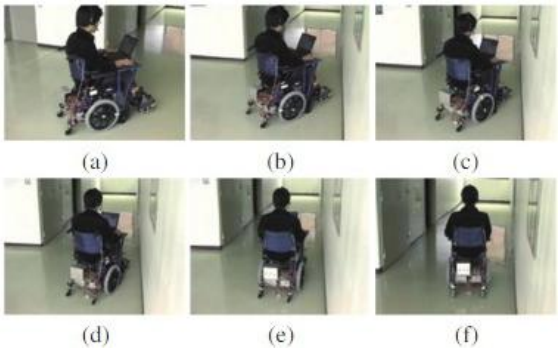

Figure 4.3 : Avoidance Scene

3. Deceleration movement

This movement reduces the moving speed so that the user avoids the wall or obstacle himself by voice command before applying the stop movement when a closed wall or obstacle is reached. The deceleration movement works if one of the sensors is less than the threshold

5. SOFTWARE

In this project, the whole working is controlled mainly by two softwares.

1. Visual basic
2. Arduino compiler

Visual basic software is used to compare process and convert the voice signal given through the microphone to certain instruction that is already stored. These instructions are given to the microcontroller. Arduino compiler will process the instruction received by the microcontroller and convert them into certain commands that can be recognized by the motors.

Software part can be mainly divided into 3 parts according to the working.

1. Sensor part
2. Serial communication
3. Manual control

First ,initializing the public variable will take place. After that all 3 functions mentioned above will start. All these works are processed at a time, so it is called parallel processing. Once the program starts there is no end or a stop, ie it will act as a loop until the power switched off.

6. ADVANTAGES

1. Less Hardware is required i.e. compact.
2. User friendly.
3. A handicapped person with voice or Hand can use this and become Independent.
4. Economical.
5. Reduce manpower

7. LIMITATIONS

The main limitation is taking a Wheelchair Up and Down Stairs and Curbs.

1. Going Up the stairs
2. Going Down the stairs
3. Going up a curb
4. Going down a curb

8. CONCLUSION & FUTURE SCOPE

Recent advancements in the technology are making lives easier for everybody. The system was successfully implemented to move the wheelchair left, right, forward, backward or stay in same position. This work is to help the disabled persons by providing alternative methods to control the equipment either by joystick or through voice, there by serving many disabilities. Thus the wheelchair understands the signals coming from control system and reacts accordingly.

A smart wheelchair using voice and head joystick control is designed and developed. It is easy to understand and process. It contains two modules to control the movement of the wheelchair according to user commands. If any patient is unable to move hand then voice commands can be used for the navigation of the wheelchair independently. The joystick provides help for the manual control. A microphone can be used to give voice commands. This system provides independent mobility as well as many intelligent facilities to the rising disabled population.

Efficiency of the voice command control system can be further improved by implementing neural network

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based algorithms. As the future work, we can provide a friendly atmosphere for disabled persons that is alerting in case of obstacles and updating the whole indoor environment condition to wheel chair and giving controlling of the devices at wheel chair itself which avoids the problem of approaching the switch.

To be able to perform a wheelchair transfer up or down a set of stairs, it is important to have 2 people available to help the user in the process. The user can not attempt this type of transfer if helpers are not available .A wheelchair up and down (step) movement is very difficult ,even if there is a helper. In order to overcome this problem, WHEELCHAIR TREADS can be used. The person using the wheelchair should be seated with their entire body fitting in the chair. A seat belt should be used in order to keep the patient/user in the chair while attempting the transfer.

Figure 8.1: Wheelchair Treads

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