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Wheelchairusing Voice Recognition System For Paraplegics

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Abstract
This paper describes the design of a voice controlled wheelchair using embedded system. Proposed design supports voice activation system for severely disabled persons incorporating manual operation based on touch screen. AVR Microcontroller and voice recognition processors (HM2007) as well as touch screen is used for acquiring and distinguishing the command for controlling the motion of a wheelchair. The direction of the wheelchair now can be selected using the specified voice commands. A wheelchair is fitted with an ultrasonic sensor and motors to help driver to achieve some independent mobility. For speech impaired and mentally disabled people, touch screen based and Brain Computer interface(BCI) are used. The design has many advantages like safety, comfort, energy saving, etc. Thus a voice is only needed to move the wheelchair. By improving the system, it directly enhances the life style of the disabled people in the community.

Keywords
Wheelchair, AVR Microcontroller, Voice command, Touch screen

I. Introduction

Many people with disabilities do not have the ability to control a switch on an electrical wheelchair. This design can be great for the quadriplegics who is permanently unable to move any of the arms or legs. For people with quadriplegics, wheelchair can be controlled using voice commands [1].Paralysis is the loss of muscle function in one or more muscles of the body. It can be followed by sensory loss in the affected area if there is sensory as well as motor damage. Paraplegia is the impairment in the motor or sensory function. The aim is to use wheelchair automatically and operate by using voice control for moving forward, backward,left and right [2]. Quadriplegics and multiple sclerosis patients have severe disabilities and cannot drive joystick operated traditional wheelchairs. Traditionally wheelchairs have some drawbacks in content to flexibility, bulkiness and limited function.The previous system helps people to overcome the defects easily by assisting with the intelligent wheel chair system. Also, voice recognition kit (HM2007) that consists of 12 switches among which 4 switches are used for direction control and one switch to stop the wheelchair and a brake control switch is used to avoid collision. To achieve the movement in all direction of the wheel chair, the microcontroller is coded with a wide range of digital values [3]. Resistive type touch screens are easy to interface, cheap and they have fine sensitivity[4]. The Brain Computer Interference (BCI) shows promising future in the designing of the wheelchair suitable for the people. The goal of using BCI is to create a specialised interface which will allow an individual with sever motor disabilities to have effective control of devices such as wheel chairs, computers, robotic devices etc. Further, this research is a multidisciplinary field integrating researches from physiology, engineering, psychology, neuroscience, rehabilitation and other health care disciplines [5]. Team of Japanese researchers put forward a robotic wheelchair that moves with a caregiver. Moving with the caregiver does not mean following the caregiver. When the caregiver moves forward to press a button to call the elevator or to shut the door, the wheelchair waits until the elevator comes or the door is shut [6]. The robotic wheelchair starts to move autonomously towards the destination as soon as the caregiver sets the goal position, e.g., a dining room, by its touch panel interface. However, this model is based on the control given by the caregiver and the wheelchair users have very limited capabilityto control.

II. Proposed System

A real time prototype has been built to prove the design concept and further, the method of voice control, touch screen and BCI unit between people behind and in the wheelchair has been developed with the established prototype.

A. Controller: The operator gives voice as input in order to move the wheelchair to the desired position. Microphone which is placed in the circuit converts the voice signal to the electric signal and the signal is given to the voice recognition module. This voice recognition module converts the analog signal into digital signal and the signal is transferred to the Atmega128 microcontroller of AVR family. The microcontroller will take the decision to move backward or forward or right or left with the help of driver circuit.

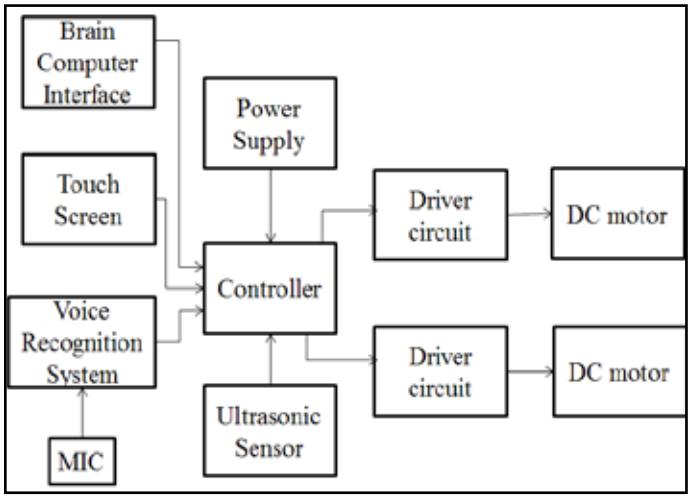

Fig. 1: Block Diagram of Voice controlled wheelchair

B.Voice Recognition System: HM2007 is a single chip voice recognition circuit with on-chip analog front end, voice analysis, recognition process and system control functions. Normally, 40 isolated-word voice recognition systems can consist of external microphone, keyboard and 64k SRAM memory combined with the microprocessor.The speech recognition system is a fully assembled and simple programmable voice recognition circuit. Programmable means that the circuit can be trained to the words or vocal utterances. This board allows you to test with many aspects of speech recognition technology. It has 8 bit data out which can

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be interfaced with the AVR microcontroller for controlling the motor direction.

C.Power Supply: The power supply should deliver constant output regulated power for successfulworking of the wheelchair. A 0-12V/1 mA transformer is used. The primary of the transformer is connected to themain supply through on/off switch and fuse is used for protecting fromoverload and short circuit protection. The secondary isconnected to the diodes to convert 12V AC to 12V DC voltage.And that is filtered by the capacitors which are further regulatedto +5v, by using IC LM7805.

D.Ultrasonic Sensor: It is interfaced with the microcontroller that works on the principle similar to sonar which evaluates attributes of a target by interpreting the echoes from sound waves. Here, it is used to detect obstacles and calculate the distance from the wheelchair and switch off the system automatically.

E.Touch Control:A 5-wire resistive type touch screen is used as input in the proposed system. It is made up of 6 quadrants [7]. In addition to this, a brake control switch is used to stop the wheelchair when used in touch screen mode.

F.Brain Computer Interfacing (BCI) Unit: The EEG recording system consists of amplifiers andsilver electrodes. Electrode-scalp contact impedance should be between 1 kΩ and 10 kΩ to record an accurate signal. The EEG signal is measured as the potential difference over time between signal or active electrode and the reference electrode. EEG signal is captured from the brain [8]. Then, the motor imaginary pattern is detected from the EEG signal. If the detected pattern intends to left or right motion it is then synchronised with the brain signal. If the result is positive, the wheelchair tends to move according to user's wish.

G.Dc Motor: Brushless DC motor is used in this system which converts electrical energy into mechanical energy.It has rotor and stator where the rotor has permanent magnets and stator has electromagnets which behaves so when current flows. As a result, the rotor rotates i.e., mechanical energy.It has long-life span with minimal/or low maintenance. 30 RPM 12V DC geared motor is of high quality and low cost DC geared motor.

H.Driver Circuit: The Motor Driver IC L293D is a monolithic integrated high voltage, high current driver designed to accept standard DTL or TTL logic levels and drive inductive loads and switching power transistors [10].This device can be adaptable for using in switching applications at frequencies up to 5 kHz [9]. The L293D is assembled in a 16 lead plastic package which has 4 centre pins connected together and used for heat sinking.
The given flowchart (Fig. 2) is used as diagrammatic representation for the problem and also provides a complete solution in defining, analysing, designing and programming. The main part of the design is to control the movement of the wheelchair. Four conditions of movement are considered like moving forward, moving in reverse direction, moving to the left or moving to the right.

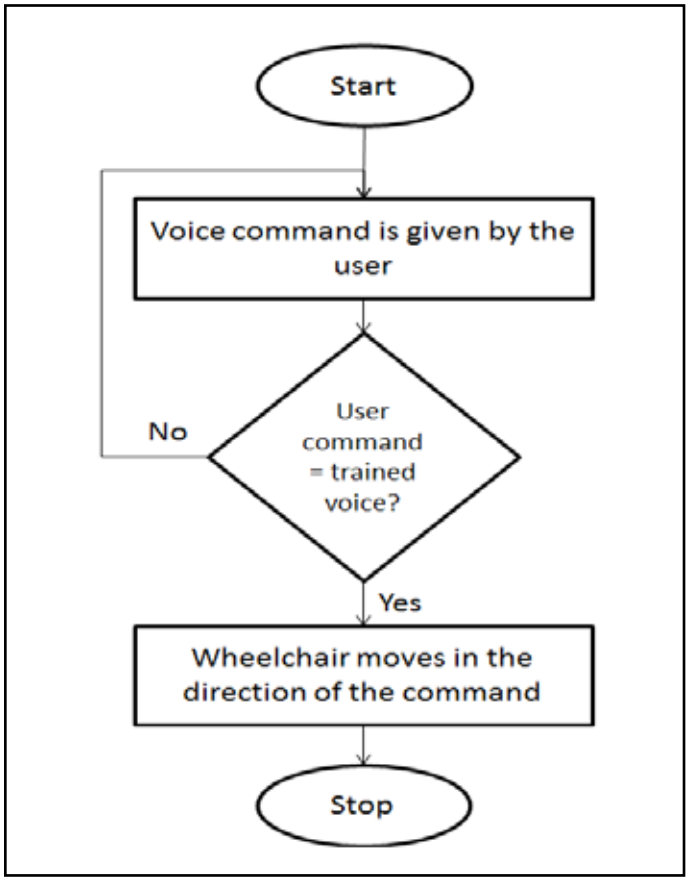

Fig.2 : Flowchart of system design

To control the speed, the user can use slow or fast speed command. The system moves by applying the supply voltage to the speech recognition circuit. In case of moving in fast condition the system will supply high current to the motors. If the user does not want the wheelchair to move in high speed, the slow speed can be set by applying low current supply to the given motors. The direction and speed of wheelchair varies with the user. By forward command the wheelchair move in forward direction and to move in the reverse direction, the opposite movement of wheel rotation will occur.
The left command will enable the right wheel to move in forward and left wheel to move in backward direction. The right command makes left wheel to move forward and right wheel rotate backward. In this system, by setting the word command "stop" the rotation of both motors will stop. The wheelchair system will help to go back to the stand by condition or terminate the whole system by turning off the power supply of the speech recognition board.
Microphone receives the voice signal and the voice recognition kit recognizes the voice commands. This is further taken to the microcontroller for processing. The wheelchair is powered with supply and the distance is measured using the ultrasonic sensor. Also, it detects the objects in the way of the wheelchair. The AVR microcontroller processing the voice signals according to the program fed to it and controls the driver circuits connected to it. The driver circuits help the motor to move in the direction of the command. Thus, the wheelchair is interfaced for the helping the differently abled and meet their needs.

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III. Conclusion

By using this system physically challenged people find it easy to move within the house using wheelchair without any external help. In this paper the design of a voice controlled wheelchair for disabled people using voice recognition system as well as touch control is shown. The direction of the wheelchair can now be selected using the specified voice commands or switch. The design not only reduce the manufacturing cost by 10% compared to present market but also will be a major competitive with other types of electrical wheelchair. The future design can be implemented by neural based algorithm, gesture recognition using eye retina, and tongue operated assistive technology in the wheel chair. By improving this system, the life style of the disabled people in the community is enhanced directly.

IV. Acknowledgement

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