Wheel Chair Design with Voice Recognition and Easy to Climb Staircase

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Abstract

Many scientists have been working for this solution for a long time. The invention of wheel chair is a great boon to them but it still restricts their motion. This project describes the design of a voice controlled wheelchair and home appliances using embedded system. Proposed design supports voice activation system for severely disabled persons incorporating manual operation with switch. The system comprises of transmitting and receiving module. 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 idea is implemented for the parallelized persons by voice controlled wheelchair through speech processing using digital signal processor. Two DC motors are used as the actuator for driving the wheelchair. The dc motor connected to gear of wheelchair using chain. So when the dc motor rotated the wheelchair rotated as well. The 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 It is intended for the disabled for the transportation and for the business. This project aims at developing a mechanism for easy transportation of heavy loads over stairs. The need for such a system arises from day-to-day requirements in our society.

1. Introduction

Nowadays one can witness the extension of aggregate people passing on some sort of physical absence of capacity, impacting speed. Automatic speech recognition by machine has been a goal of research for more than four decades. However, in spite of the glamour of designing an intelligent machine that can recognize the spoken word and comprehend its meaning, and in spite of enormous research efforts spent in trying to create such a machine, it is far from achieving the desired goal of a machine that can understand spoken discourse on any subject by all speakers in all environments In perspective of World Health Organization (WHO) data, it is evaluated that around 15 % of the aggregate people (200 million people) live with physical hindrances. These inventions have eased human significantly in all aspects of their daily lives. One of these inventions that give great impacts and implications to the lifestyles of disabled and handicapped people is the implementation of motorized wheelchair. For motion recognition the accelerometer data is calibrated and filtered. The accelerometers can measure the magnitude and direction of gravity in addition to movement induced acceleration. This project utilizes two DC Motors. 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. a wheelchair which is controlled using human brain signals, where the human brain signal readings using mind wave module. Voice control wheelchair has the potential to provide these people with effectiveness to alleviate the impact of their drawbacks, by compensating for their specific impairments. 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. The resulting design is used to control a wheelchair and home appliances for a handicapped person based on the vocal command.

2. Propose System

To develop a system of improved facilities in the main aim of proposed system. The proposed system can overcome all the limitations of existing system. The proposed system will ensure that there is no need of any other human operator or care taker. The proposed system helps wheelchair to communicate with each other .This Communication is used to task know whether the task assigned to wheelchair is complete or not [1]. The voice recognition time of the smart phone was measured for a number of voice commands. You will also need to go through wheelchairs and staircase. You can also use audio and also useful for staircase.

3. Voice Controlled Wheel Chair System

Mainly this system consists of two modules.
1. Hardware module
2. Software module

Hardware module consists of
1. Microcontroller
2. Motor driver
3. Ultrasonic sensors
4. DC Motors
5. Microphone
6. IC

Software module, mainly consists of two software for controlling entire working. They are
1. Visual Basic Software

2. Arduino Compiler

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. 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. 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 [3].

3.1. Micro Controller

The P89V51RB2/RC2/RD2 are 80C51 microcontrollers with 16/32/64 kB flash and 1024 B of data RAM. A key feature of the P89V51RB2/RC2/RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (six clocks per machine cycle) to achieve twice the throughput at the same clock frequency.

3.2. Motor Driver

The DC Gear motor, consisting of a DC electric motor and a gearbox, is at the heart of several electrical and electronic applications. Precision Microdrive have been designing and developing such high quality mini DC gear motors in an easy-to-mount package for a range of products and equipment. Motor driver is used to drive the two DC motors for the wheelchair movements. The output of controller is given to the inputs of motor driver and depending upon the inputs given to the motor driver the motor output pins rotates the motors by which the wheelchair moves. 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 [4]. These stepper motor are very useful for rotating in a particular angles. This project utilizes two DC Motors. The DC motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary permanent magnets, and rotating electrical magnets, battery. The Microcontroller is programmed with the help of embedded C instructions.

Figure 1. Motor Driver

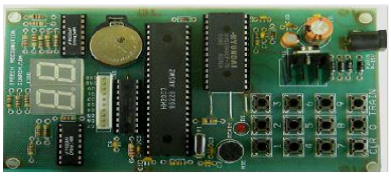
3.3. Voice module

HM 2007 is a single chip CMOS voice recognition LSI circuit with the on-chip analog front end, voice analysis, recognition process and system control functions. HM2007 is a speech recognition kit which is used to train voice commands for the wheel chair operations. Voice module consists of 8 output pins D0-D7. Whenever a command is given, the binary value of the address where that particular command is trained, is given to the output pins D0-D7. The voice recognition module converts the analog signal into digital signal and the signal is transferred to the pic microcontroller. The user can operate fan& light as per the requirement with help of relay switching unit [5].

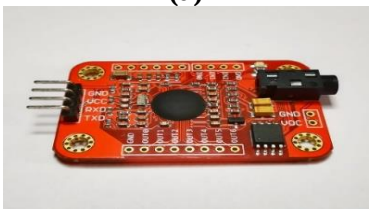
3.4. HM2007 (Voice Recognition Kit)

HM2007 is a single chip CMOS voice recognition LSI circuit with the on-chip analog front end, voice analysis, recognition process and system control functions. A 40 isolated-word voice recognition system can be consists of external microphone, keyboard, 64K SRAM memory combined with the microprocessor. 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 [6]. 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.



(a)



(b)

Figure 2. Voice Recognition Kit and V3 Arduino

3.5. IR Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called as a sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. The IR sensor is used for activating the home appliances with the help of the remote device [7]. When we press the button it receives the signal from the remote sensor and sends to Arduino .It activates the relay pin where the load is connected and switched ON or OFF the home appliances.

3.6. Flow Chart of Wheel Chair System Design

The design and development of the system involves the implementation of both hardware and software. These approaches must be well implemented so that it will produce satisfactory outcome of the system which is to produce the correct wheelchair movement upon receiving the voice input command.

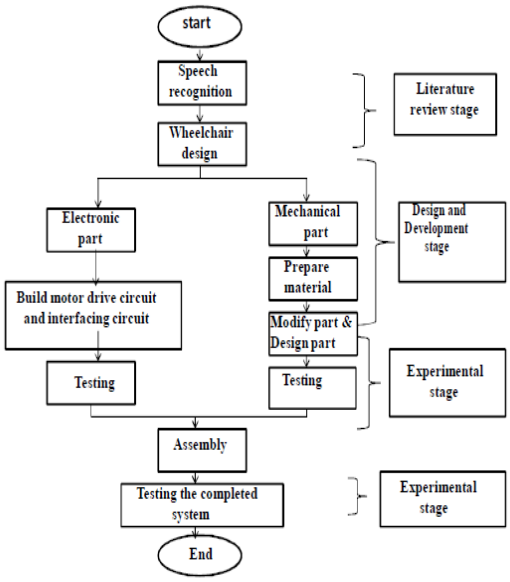


Figure 3. Flow chart of system design

4. Accuracy of Wheelchair

Chair this experiment was conducted in a room which is in silent condition to observe the result of the experiment. The goal of the experiment is to find the correctness of the wheel chair in response to the speech (voice) in various situations [2]. This study demonstrates the importance of better understanding the potential mismatch between the anticipated and actual patterns of wheelchair use. The findings suggest that users can be relied upon to accurately predict their basic wheelchair-related needs in the short term.

Table 1. Accuracy Of Wheelchair In Noisy And Silent Area

	Result in Silent Area						Result in Noisy Area					
Voice Command	Experiment Trails					Total Response	Experiment Trails					Total Response
	1	2	3	4	5		1	2	3	4	5	
Reverse	1	1	1	1	1	5	1	1	1	1	0	4
Forward	1	0	1	1	1	4	1	1	1	0	0	3
Right	1	1	0	1	1	4	1	1	0	0	0	2
Left	1	1	1	1	1	5	1	1	0	1	0	3
Stop	1	0	1	1	1	4	0	1	1	0	1	3

5.1. 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 [3]. 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.

4.1. Wheel Chair Design

Wheelchairs should be designed to enable their users to participate in as many activities as possible. As a minimum, a wheelchair should enable the user to lead a more active life without having a negative effect on their health or safety. Comfort and safety are two important factors affecting the quality of life of long-term users. A cushion is to be considered an integral part of a wheelchair, and is therefore to be included with all wheelchairs, in particular for wheelchair users with sensory issues to prevent the development of life-threatening pressure sores [9]. The functional performance of a wheelchair is determined by its unique design and features. There are many compromises to consider when designing or selecting for different uses but overall the manual wheelchair should be configured to optimize stability and maneuverability for everyday function. Stability is necessary to ensure client safety and security in chair use. Maneuverability affects access to tight spaces and the ease of propulsion. The estimated weight of the entire wheelchair is given as an example.

(a)

(b)

(a) Marsden M-210 Chair

Professional, Easy To Use Chair Scale with BMI
Capacity: 250kg
Graduations: 50g<150kg>100g

(b) Marsden M-200 High Capacity

High Capacity Bariatric Chair
Scale With Large Seat
Capacity: 250kg or 300kg
Graduations: 50g<150kg>100g

Figure 4. Estimated Weight Calculation

4.2. User's Health and Safety

Although it may seem that any wheelchair is better than no wheelchair, this is not true when the wheelchair causes or contributes to injury or other health risks. The health and safety of users should never be compromised in order to reduce costs. A wheelchair should be designed to ensure the user's safety and health [8]. There are many ways in which users can be injured by their own wheelchairs, as illustrated by the following examples:

- A wheelchair with an inadequate cushion or no cushion can cause pressure sores;
- Unstable wheelchairs can tip either forward or backwards, leading to users falling out and potentially injuring themselves;
- Shoulder injuries, either through overuse or increased loading can result from a wheelchair that is too wide, too heavy or set up incorrectly for the wheelchair user;
- Sharp edges on surfaces can cause a break in the skin, which in turn can lead to infection.
- Poor design can result in places on the wheelchair where the user can get their fingers or skin pinched.
- Wheelchairs that cannot endure daily use in the user's environment may fail prematurely and can injure the user.

5. Result and Discussion

After the design and development of the wheel chair with respective interfacing circuits, the technology was examined for the movement of the wheelchair using trained voice. This design is experimented found on two important aspects, firstly, on the correctness of the system and secondly, wheelchair velocity control by means of on & off control commands [10]. This proposed design was implemented with the help of normal people. This would be implemented for handicapped people after having the smoothly enhance design of the wheel chair.

Figure 5. Wheel Chair that can be used on the Staircase

6.1. Why is it important to use trolley in the staircase system?

Just like a wheel chair for a physically disabled person, people who can't climb on the stairs and people who can't carry a lot of things to remote areas, for such people it is necessary to use a staircase trolley. The design not only reduce the manufacture cost compared with present market but also will give great competitive with other types of electrical wheelchair. This project has many advantages like safety, comfort, energy saving, full automation etc. This circuit would to be kept isolated from human reach as it is delicate and light. Hence it is mounted below the seat of wheelchair to keep it safe. Vibrations of a certain frequency and also load impacts would be felt while a patient is moving on normal plane as well as on stairs hence the circuits needs proper mounting so that the connections and arrangements are not harmed.

6. Conclusion

Voice Recognition processor HM2007 as well as switch control for acquiring and distinguishing the command for controlling the motion of a wheelchair & home appliances is shown. With the implementation of low cost and flexibility in design, this project can reduce the mechanical force required by physically impaired. By improving this system, we directly enhance the life style of the disabled people in the community. 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. 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.

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