ISSN: 2278-4632
Vol-9 Issue-4 No.01 April 2019

Design of Voice Recognition Autonomous Wheelchair by Using Microcontroller

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Abstract: ***Objective of this paper is to convert an ordinary powered wheelchair into voice recognition wheel chair by microcontrollers and sensors to perceive the wheelchair's surroundings, a speech interface to interpret commands, a wireless device for room-level location determination, and motor-control software to affect the wheelchair's motion. A voice controlled wheelchair makes it easy for physically disabled person who cannot control their movements of hands. The powered wheel chair depends on motors for locomotion and voice recognition for command. The voice recognition module recognizes the command by the user and provides the corresponding coded data stored in the memory to Microcontroller. Microcontroller controls the locomotion accordingly. The wheelchair also has provision for joystick for physically disabled people who can move their hand.***

Keywords: Microcontroller, Speech Recognition, Wheelchair, Handicapped

1. 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.

Background and LiteratureSurvey

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.

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ISSN: 2278-4632
Vol-9 Issue-4 No.01 April 2019

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.

2. Block Diagram

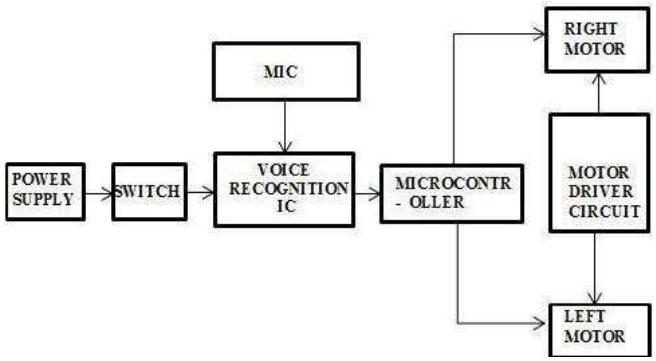

Figure 1: functioning of wheelchair

3. 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

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ISSN: 2278-4632
Vol-9 Issue-4 No.01 April 2019

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Vol-9 Issue-4 No.01 April 2019

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.

4. Prototype Model

Figure 2: Demo model

5. 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

6. 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

References

[1] Emmanuel Aubrey, “The Lost History Of The Wheelchair” http://ezinearticles.com/?The-Lost-History-Of-The-Wheelchair&id=518882 , April 8, 2007.

[2] Gene Emmer, “Custom Wheelchairs: The Trend from Functionality to Individuality ”http://www.articleset.com/Health_articles_en_Custom-Wheelchairs-The-Trend-from-Functionality-to-Individuality.htm, Feb. 15,2006.

[3] Canada Science and Technology Museum, “George J. Klein 1904-1992” http://www.sciencetech.technomuses.ca/english/about/hallf a me/u_i19_e.cfm

[4] The Wheelchair Site, “Wheelchair Price Comparisons” http://www.thewheelchairsite.com/price-comparisons.aspx

[5] Carlos Bernal-Ruiz, Francisco E. Garcia-Tapias, et al, “Microcontroller Implementation of a Voice Command Recognition System For Human-Machine Interface in Embedded System,” IEEE Conference on Emerging Technologies and Factory Automation ’05, Vol. 1, Sept. 2005.

[6] Dong Wang, et al. “Embedded Speech Recognition System On 8-Bit MCU Core,” Proc ICASSP ’04, Vol.5, pp. 301-4, May2004.

[7] Mayukh Bhaowal and Kunal Chawla, “Isolated Word Recognition for English Language Using LPC, VQ and HMM,” IFIP WCC ’04, pp. 343-352, August2004.

[8] Claudio Becchetti and Lucio Prina Ricotti, Speech Recognition: Theory and C++ Implementation, John Wiley & Sons, Inc, Chichester,1999.

[9] Geoff Bristow, Electronic Speech Recognition,

Copyright @ 2019 Authors

ISSN: 2278-4632
Vol-9 Issue-4 No.01 April 2019

Collins,London, 1986.
[10] David Gerard Reed, "Speaker-dependent Isolated Word Recognition," M.S. thesis, McMaster University, Hamilton, ON, Canada,1987.
[11] H.A. Yanco and J. Gips. Preliminary investigation of a semi-autonomous robotic wheelchair directed through electrodes. In S. Sprigle, ed, Proceedings of the Re-habilitation Engineering Society of North America 1997 Annual Conference, pages 414{416. RESNA Press, 1997.
[12] H.A. Yanco and J. Gips. Driver performance using single switch scanning with a powered wheelchair: robotic assisted control versus traditional control. In Pro- ceedings of the Rehabilitation Engineering Society of North America 1998 Annual Conference. RESNA Press, 1998.
[13] H.A. Yanco, A. Hazel, A. Peacock, S. Smith and H. Wintermute. Initial report on Wheelesley: a robotic wheelchair system. In Proceedings of the IJCAI-95 Workshop on Developing AI Applications for the Disabled, Montreal, Canada, August1995.
[14] Rajesh Kannan Megalingam, Ramesh Nammily Nair, Sai Manoj Prakhya," Automated Voice based Home Navigation System for the Elderly and the Physically Challenged"proc.ICACT2011P.603-08,Feb.2011.
[15] R.Posada Gomez, L.H.Sanchez Medel, "A Hand Gesture System Of Control For An Intelligent Wheelchair",Proc.ICEEE,P.68-71,5-7,sept.2007.
[16] http://www.analog.com/en/content/over_five_motion_sens es/fca.html,1995-2012.
[17] J.Z. Yi , Y.K. Tan Z.R. Ang, "Microcontroller Based Voice-Activated Powered Wheelchair Control", ACM publishers, 2007.
[18] C.Chandramouli and Vivek Agarwal," Speech Recognition based Computer Keyboard Replacement for the Quadriplegics, Paraplegics, Paralytics and Amputees", ACMpublishers,
[19] Munro, Jay. "Watch What You Say." PC Magazine Online. March 10, 1998. http://www.zdnet.com/pcmag/ features/speech/intro1.html (23 October1998).
[20] Rabiner L. R., "A Tutorial on Hidden Markov Models and Selected Applications in SpeechRecognition",
[21] Proc S.A. Chhabria and R.V. Dharaskar „Multimodal Interface for Disabled Persons",international Journal of Computer Science and Communication-January-June 2011,
[22] R.C. Simpson, „Smart Wheelchairs: A Literature Review", J. Rehabil. Res. Develop., 42, pp. 423-436, 2005.
[23] J.Z. Yi, Y.K. Tan, Z.R. Ang," Microcontroller Based Voice-Activated Powered Wheelchair Control" ACM 2007 ISBN:978-1-59593-852-7.
[24] L. Fehr, W. Edwin Langbein, and S.B.Skaar, „Adequacy of Power Wheelchair Control Interfaces for Persons with Severe Disabilities: A Clinical Survey", J. Rehabil. Res. Develop, 37 (3), pp. 353-360, 2000.
[25] Yasunari Obuchi, Multiple-Microphone Robust Speech Recognition Using Decoder-Based ChannelSelection, Advanced Research Laboratory, Japan, 2004
[26] Javier Hernando and Climent Nadeu, Speech Recognition In Noisy Car Enviornment Based On OsaLPC Representation And Robust Similarity Measuring Techniques, Signal Theory andcomm.. Dept., Spain, 1994

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