Voice Recognition Electric Wheelchair

V.Hiroshaan, R.M.T.C.B. Ekanayake

Abstract— Wheel chairs are the evaded partner for most of disabled people lives to support their day to day activities. Manual and powered wheelchairs fail to meet the needs of the quadruple amputees. The objective of this study is to produce wheelchair to meet the needs of quadruple amputees by adjustable seat and control the wheelchair movement by means of voice commands. Aluminium frames were used to make the body of the wheelchair and modified wheel and caster wheels were used as wheels. Jack was connected with the motor to make the seats adjustable to various heights. Wheelchair was designed to work with two modes, which were human voice control and switch control. In voice control mode, commands were given through microphone which was connected to the voice recognition module. Access port 137 software was used to access the voice recognition module via computer. This software recognizes and records the voice. Voice recognition module was initially trained to identify our voice commands. It was attached with USB TTL to connect with the computer. Given voice command was identified by voice recognition module, converted as serial signal and was input to Arduino programming board (Uno) which was programmed to control the wheelchair. Five essential actions which were "forward", "backward", "left side turning", "right side turning" and "stop" were implemented in this project. Based on the serial signal input generated by Voice recognition module, commands were identified in Arduino and required signals were sent to motor control circuit to control the viper motor in order to get the desired motion for the command. In Switch mode command signals from switch were directly connected to Arduino and were identified. 94% of the voice commands were successfully identified and desired actions resulted.

Index Terms— Voice recognition, Wheelchair, Arduino, Quadruple amputees, Voice and Voice control

1 Introduction

WHEELCHAIRS are the most important, evaded partner for most of disabled people lives to support their day to day activities. Wheelchairs can be manual or powered. Manual wheelchairs need to propel the wheels to move. With the advancement of technology, electric wheel chairs also introduced to the market in order to make the disabled people's movement easy. Manual wheelchairs and powered wheelchairs are failed to meet the needs of the quadruple amputees. Manual wheelchair which needs to propel the wheel is cannot handle by them. Even the electric wheel chairs also cannot handle by them as it needs to press the button or use joysticks for movements. Researchers are concerned on producing a wheelchair which is cost effective and facilitate all their needs of quadruple amputees to carry their day to day activities independently. The main objective of the research was to implement a voice recognition wheel chair for quadruple amputees for their independent movement and seat adjustment facility to adjust seat height to various positions according to their needs.

2 Methodology

Wheelchair was designed to work with two modes, which were human voice control and switch control. In voice control mode, commands were given through microphone which was connected to the voice recognition module(VR2). Voice recognition module was initially trained to identify our voice commands. This module can store up to fifteen pieces of voice instruction divided into three groups. Module can be trained with voice instructions group by group. Five voice instructions were trained and imported. Access port 137 software was used to access the data from voice recognition module via computer. This software recognizes and records the voice. Voice recognition module was attached with USB TTL to connect with the computer. Given voice commands were identified by trained voice recognition module, converted as serial signal and was input to Arduino programming board (Arduino – Uno) which was programmed to control the wheelchair. Necessary code was programmed inside the module to send signal to two motor control circuits. Direction of the wheelchair movement was controlled by the motor control circuit by giving signal to their connected motors individually. PCB Wizard-professional edition software was used for the motor control circuit PCB design. Along with the voice control mechanism, manual switch control also provided in this wheelchair as an alternative way. Switch box was designed with one switch and seven push buttons. One switch was there to select the mode of operation, which were voice control and switch control, and other seven buttons were to control the movement of the wheelchair. Two of seven buttons were used to control the seat adjustment. Block diagram of the wheelchair is shown in below Fig 1.

In Mechanical design, Wiper motor was selected for the movement of wheelchair. Wheelchair body was made by aluminium frame as it is low weight and high strength. Two types of wheels were used for the movement, one was modified bicycle wheel and other one was universal caster wheel. Modified wheels were connected with axel without directly connect with motor. Because weight of the wheelchair cannot carry by motor axle. Whole weight of the wheelchair was carried by the two modified wheels and rotation of the modified wheels were depending on the speed of the wiper motor. Modified wheels were attached with pre-wheel and using chain mechanism it was connected with wiper motor,

- *V.Hiroshaan, Lecturer at University College of Jaffna, Sri Lanka, PH-+94771965123. E-mail: hiroshaanv@gmail.com*
- *R.M.T.C.B. Ekanayake, Lecturer at Uva Wellassa University, Sri Lanka.*

which was also attached with pre wheel. Caster wheels were used as the rear wheels as it can operate well on smooth and flat surfaces. They were designed to be mounted to the bottom of a larger object so as to enable that object to be easily moved. Caster wheel movement was depending on the backside modified wheel. Scissor car jacks were used to adjust the seat height. Seat was directly joined with the jack. Jack was connected with the motor to control its movement. Prismatic joint was used for this connection. Power supply with 12v, 10A current was used to test the system.

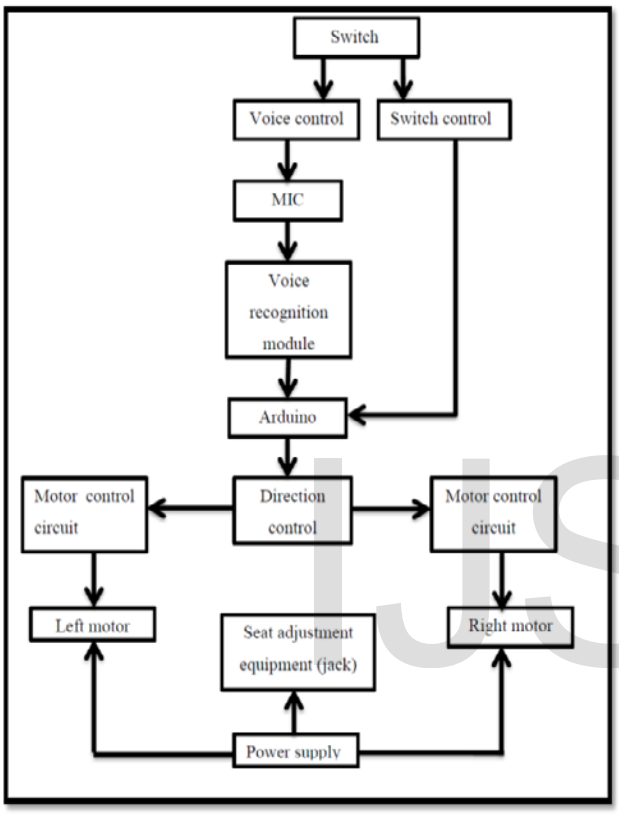

Fig. 1. Block diagram of the wheelchair

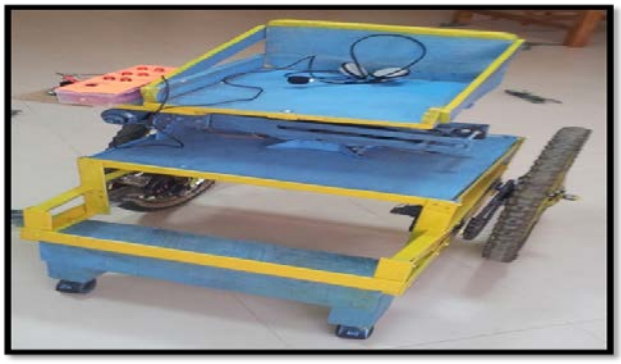

Fig. 2. Voice recognition electric wheelchair

3 Results and Discussion

After the completion of this research, system was tested under two environmental conditions which were normal environment and noisy environment. Fifty voice commands were given using headphones in both conditions. In normal environment 94% of commands were identified and in noisy environment 80% of commands were identified. According to the gained results, this system is perfectly working in normal environment. In order to increase the accuracy in noisy environment commands should be given louder and use effective headphones. Only five commands can work at the time in Voice recognition module (VR2) which is used in this research. Because of this limitation possible voice commands were analysed and most needed five voice commands were selected. Forward, backward, left side turning, right side turning and stop actions were implemented using voice commands. HM 2007 module can detect about 40 voice commands. Because of its high cost it was avoided. The overall prototype wheelchair designed in this work is shown in figure 2. Total cost taken to develop this prototype is nearly twenty thousand rupees.

TABLE 1
RESULTS OBTAINED

Type of Environment	No of Given Commands	No of Recognized Commands	Success Percentage
Normal Environment	50	47	94%
Noisy Environment	50	40	80%

4 Conclusion

Main objectives were accomplished by providing developed voice controlled electric wheel chair along with the seat adjustment facility to quadruple amputees. Five essential commands were successfully implemented. This speech recognition system is speaker dependant. That means the voice that trained the system has the highest recognition accuracy.

References

[1] Borenstein, J. and Koren, Y. 1985. A Mobile Platform for Nursing Robots. IEEE Transactions on Industrial Electronics, 32(2):158–165.

[2] Voice recognition module manual. [Online] Available from: http://www.elechouse.com/elechouse/images/product/Voice%20Recognition%20Module/Manual.pdf [Accessed: 17thAugust 2014]

[3] Borenstein, J. and Koren, Y. 1991. The vector field histogram—fast obstacle avoidance for mobile robots, IEEE Transactions on Robotics and Automation, 7(3):278–288.