WIRELESS HAND GESTURE CONTROLLED WHEELCHAIR

MRS.SURABHI TANKKAR-SAWANT[1], MISS.SAYALI KAJARE[2],MR.ASHFAQUE ANSARI[3], MR.MUJAMMILALI KAZI[4],MR.PRANAV RANE[5]

[1]Assistant Professor, Dept of Electronics & Telecommunication, Alamuri Ratnamala Institute of Engineering & Technology , Asangaon, Maharashtra, India,

[2,3,4,5]UG students, Dept of of Electronics & Telecommunication, Alamuri Ratnamala Institute of Engineering & Technology, Asangaon, Maharashtra, India

Abstract: A 'hand gesture' based easy to operate navigation mechanism using the wireless technology in the form of wheelchair control system is presented in this work. This work proposes an integrated approach for detection, tracking and recognition of hand gestures in real time. The approach uses acceleration technology to establish a reliable medium of human-machine interaction for the movement control of an intelligent wheelchair. The remote-control facility up to 60 meters and obstacle avoidance technology provided for additional comfort during navigation task for elderly or disabled people. The wheelchair motion is controlled by employing Arduino microcontroller interfaces with accelerometer sensor, motor driver unit, and edge detection sensors. The designed system was tested with five experiments by two subjects independently.

Index Terms: Arduino,MEMS,RF encoder,crystal oscillator

I. INTRODUCTION

Elderly people or persons with physical disabilities & partial paralysis always find it difficult to navigate through their habitat without the assistance. Wheelchair is the most common mean of locomotion after paralysis or physical disability. Driving a wheelchair in domestic environments is a difficult task even for a normal person and becomes even more difficult for people with impairment. The use of powered wheelchairs with high navigational intelligence is one of the important step towards the service of these people. Tetra pelagic people are completely unable to operate a joystick unless they use the tongue, which is obviously a very tedious task. Someone's needs for navigation often causes feeling of dependency and demoralization. With the present development in the robotics, assistive technology, embedded system and rehabilitation engineering, it is possible to address this problem. For that, a working model demonstrating the successful use of hand gesture for controlling a wheelchair has been developed and that too at a very low cost. The wheelchair in context can be controlled wirelessly without muscular forces and also without help of attendee. The chair can be controlled by simple hand gestures in required directions. Previous developments on this topic include the presence of a laptop or CPU on the wheelchair for the purpose of processing. Some other studies employed voice recognition system for robot control. These systems are suffering from drawbacks of their bulky nature as it required processing computer system. This limits the navigation flexibility and autonomy of system. Further speech impaired users cannot operate this system. The ability to understand hand gestures will improve the naturalness and efficiency of human interaction with robot .Literature review reveals that the gestures control robots are employed to achieve human non-verbal communication. In a study conducted by Luetal the accelerations of a hand in motion in three perpendicular directions are detected by a MEMS accelerometer and transmitted to a PC via Bluetooth wireless protocol.

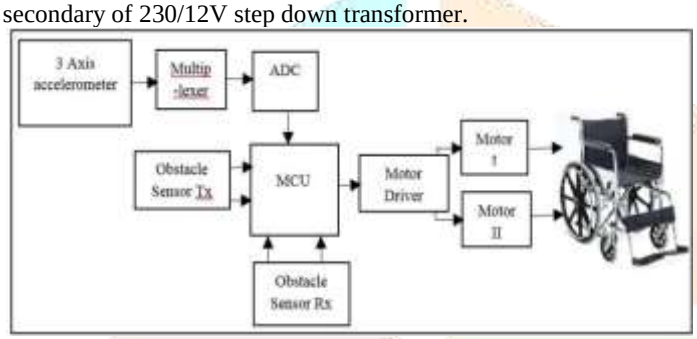
In another study, hand gesture recognition using convexity hull defects to control 6 axis industrial robot is demonstrated, the image is acquired by means of a web cam system and undergoes several processing stages before a meaningful recognition can be achieved. Finger gesture and pattern recognition-based device security system presented. In this study an image database for matching of image pairs to trigger unlocking of mobile devices. Though remarkable progress has been made, still systems suffers from limitations of need of processing computer, heavy architecture, necessity of lot of training, signal processing, image processing, and many more. The proposed model makes the wheel chair a lot easier to assemble and simple in the use, in addition the cost of manufacturing also reduced to large extent. Also, with the use of RF technology the wheel chair can be controlled remotely from near about 10 to 20 meters of a distance. So, a person laying on a bed can move the wheelchair near or away from him just by simple hand movements. It can also help people during the night without the need for a third person, for the person to get on the wheelchair and move inside or outside the habitat. Wheelchair will autonomously detect the obstacles in its path and will avoid by changing the path. Thus, people can control the chair in narrow spaces without collision.

II.SYSTEM ARCHITECTURE

The percentage of disabled people has increased in both rural and urban part of India. The disability could be by birth or due to some medical or accidental reason. The aim of this paper is to make a hand gesture-controlled wheel chair using accelerometer as sensor to help the physically disabled people in moving from one place to another just by giving direction from the hand. Today in India many people are suffering from disability, there are people whose lower half of the body is paralyzed. This Wheelchair will add on to the comfort and make the life of people bit easier. Around huge numbers people are affected from movement disability.

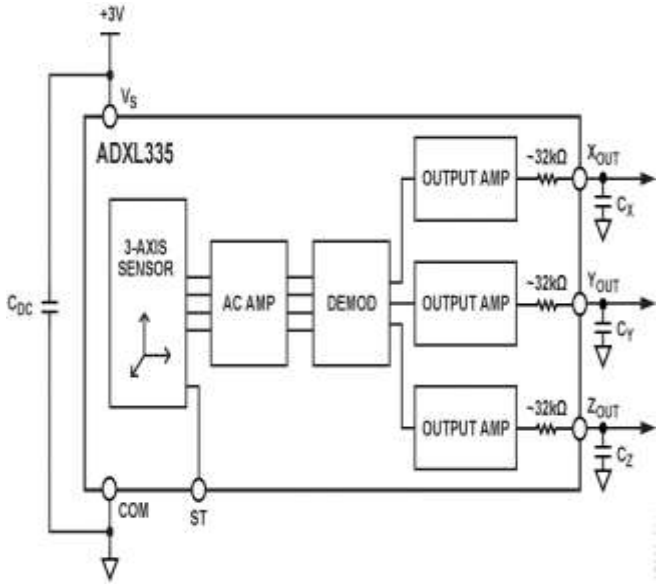
Architecture for wireless motion control of an intelligent wheelchair using hand gesture recognition technology is shown in Fig. 1. MEMS accelerometer sensor is used to control the wheelchair as per the movement of the hand. The accelerometer sensor senses the accelerating force and converts the hand position into 3-Dimensional Output in the form of a particular voltage for the x, y

and z coordinate orientation. Crystal oscillator is used here to generate the clock pulse & to support the RF module with its frequency. It is provided in both the transmitter and the receiver section. RF transmitter transmits the data signals with its carrier wave which can be accepted only by the receiver of the same frequency. The signals from accelerometer sensors that are received in analog form has to be converted in to digital form. This is done by employing AD converter and the digital values are fed to Arduino microcontroller. On receipt of these digital values, programmed controller controls the direction of motors through motor control unit. Depending on the direction of the MEMS, wheelchair directions like front, right, left and back are controlled. Arduino also receives input from proximity sensor and edge detection sensor. A working model is implemented with a wheelchair and DC motors operating on 12V rechargeable battery. In this system we are implementing it with Arduino Atmega 328 microcontroller at transmitter and receiver sections. This system uses regulated 5V, 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.



III.SYSTEM IMPLEMENTATION

Hand gesture module: The hand gesture module has been designed by using a triple axis ADXL 335 accelerometer sensor. An accelerometer measures acceleration (change in speed)of anything that it's mounted on. The relatively low-cost sensor provides the data for the orientation of the hand and therefore helps in recognizing the gestures. This is a very handy device for measuring the orientation of an object relative to the earth. Sensor senses the accelerating force and thus gives a particular voltage for the x, y and z coordinate orientation. The basic working block diagram of the accelerometer sensor is as shown below:



Transmitter and receiver modules: In transmitter part, hand gesture recognized by the MEMS sensor in digital output is transmitted to the controller by RF transmitter after encoding. Fig.3a and 3b shows the block diagram of the transmitter and receiver unit. The transmitted data signals are received by RF receiver which operates in the same frequency as the receiver. The encoded data signals are separated by the decoder.

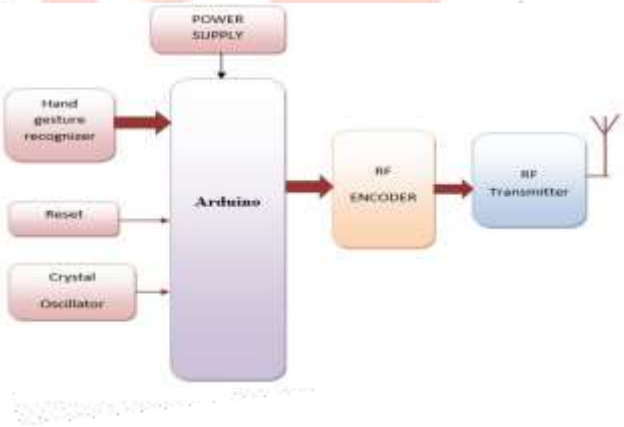


Fig.3a. Transmitter Block Diagram

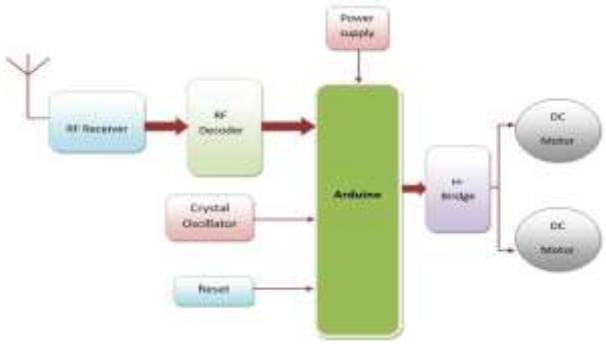


Fig.3b.Receiver Block Diagram

Edge detection module: The edge detection sensors have been used on the backside of the wheelchair. The sensors are at a constant digital low state on the straight surface. But if there is a sharp increase of height during any backward motion of the wheelchair then it automatically sends a digital high signal to the microcontroller on board.

IV : CONCLUSION

The wheelchair is fully capable of carrying the load up to 110Kgand moving in accordance to the gesture given by the person who is using the wheel chair. Certain improvisation and improvement can be done to make the wheelchair more reachable to those whose whole body is paralyzed. Certain eyes gesture or brain signals reader can be imparted on the wheelchair system so as to make it better.

V.FUTURE SCOPE:

The hand gesture wheelchair has the ability to bridge the gap between man and machine. Further this hand gesture can be changed to speech and brain signal recognition which will be a battle winning factor for all those people whose whole body is paralyzed. We can further improve wheelchairs by making it with low cost and high accuracy which are operating by a wireless remote with various different sensors. An array of sensors can be used and integrating the inputs of multiple sensors and then processing them. Further safety features can be added into the wheelchair like implementation of ultrasonic sensor for the object detection. GPS system can also be implemented to know the exact location of the person who is in wheelchair and by using GSM module an SMS can be sent to pre-defined number in case of emergency.

VI.REFERENCES

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