Gesture Control of Wheel Chair and Electrical Devices by Physically Challenged Using 3D MEMS Accelerometers and Health Monitoring

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Abstract – Wheelchairs are used by the people who cannot walk due to physiological or physical illness, injury or any disability. Recent development promises a wide scope in developing smart wheelchairs. The present article presents a gesture based wheelchair which controls the wheelchair and electrical devices using hand movements. The system is divided into three main units: MEMS Sensor and wheelchair control and electrical device control. The MEMS sensor, which is connected to hand, is an 3-axis accelerometer with digital output that provides hand gesture detection, converts it into the 4-bit digital values and gives it to the Arduino mega controller. The wheelchair control unit is a wireless unit. The electrical device control unit is controlled using Arduino UNO.

Index Terms – Accelerometer, Hand gesture recognition, Wheelchair control, Wireless.

I. INTRODUCTION

In today’s time, an estimated 1% of the world’s population needs a wheelchair. An increased percentage of elderly and disabled people who want to enhance their personal mobility, for them wheelchair is the best assistive device. A disabled individual (usually the disability of the lower part of the body) can find it convenient to move around using the help of a chair constructed on wheels which can either be pushed by another individual or propelled either by physical force or electronically. Such a chair is called as a Wheelchair.

Traditional wheelchairs have some limitations in context to flexibility, bulkiness and limited functions. Our approach allows the users to use human gestures of movement like hands and synchronize them with the movement of the wheelchair and control of electrical devices so that they can use it with comfort and ease on all kinds of terrains without the hurdle or cardiovascular problems or fatigue. Some existing wheelchairs are fitted with pc for the gesture recognition [2]. But making use of the pc along with the chair makes it bulkier and increases complexity. This complexity is reduced by making use of the MEMS accelerometer [3-4], the size of which is very compact and can be placed on the fingertip of the patients.

Other existing systems, which make use of the similar kind of sensors are wired, which again increases the complexity of the system. They also limit the long range communication. This complexity is removed by using the RF transmission. Signals through RF travel larger distances. Irrespective of line of sight communication, signals through RF travel even when there is obstruction between the transmitter and receiver.

In addition to this In this system the health of physically handicapped person is monitored and if any abnormalities occur either in Heart beat or body temperature an automated alert SMS is sent to the family members / doctor mobile. Family members / doctor can any time give a missed call to the GSM Modem installed in the wheelchair and get the status of the physically handicapped.

II. BLOCK DIAGRAM

The system comprises of three main parts: Transmitter part, wheelchair controller part and electrical device control. In transmitter part the hand gesture is recognized by the sensor, digital output is transmitted to the controller and then transmitted to receiver side by the rf transmitter. Fig. 1 shows the block diagram of the transmitter unit. The same data is received at receiver side by the rf receiver. DC Motors which are interfaced to the controller by the motor driver controls the direction of the wheelchair. Fig. 2 shows the block diagram of the wheelchair unit. Electrical equipment controller is fitted in the Home to which 4 electrical Home appliances can be connected.Fig.3 shows block diagram of electrical device control.
III. SYSTEM – HARDWARE

A. HAND GESTURE MODULE

The hand gesture module has been prepared by using a triple axis accelerometer sensor (ADXL 335) as shown in fig.4. The relatively low cost sensor provides the data for the orientation of the hand and therefore helps in recognizing the gestures. The accelerometer sensor senses the accelerating force (acceleration due to gravity or g) and thus gives a particular voltage for the x, y coordinate orientation.

The accelerometer sensor has specific values which are read as analog inputs by the controller. The data obtained from the accelerometer for the various orientations of the hand give us the readings to decide the threshold value for each x, y coordinates.

B. RF TRANSMITTER & RECEIVER MODULE

The RF transmitter module has been used as per the purpose of making the gesture module completely wireless. We are using a 433 MHz module for the transmitting purpose. For a specific orientation of the hand the microcontroller unit on the hand decides the condition and a particular character are sent to the receiver module. For the receiver we are using a 433 MHZ module which is a low cost receiver module. The receiver upon receiving the string sends the data to the controller on the wheelchair which in turn decides the case of the locomotion for the wheelchair.

C. LOCOMOTION

For the locomotion of the wheelchair we have used geared DC motors as part of the model for the project. The motors are controlled by the bi-directional motor driver IC – L293D. The motor driver is connected through the controller on the wheel chair which sends the signal to the driver for the various conditions.

D. HEALTH MONITORING MODULE

Heart beat monitoring device is fitted to the finger to measure the heart beat and body temperature is measured by LM35, if any abnormalities occur either in Heart beat or body temperature an automated alert SMS is sent to the family members / doctor mobile. Family members / doctor can any time give a missed call to the SIM900 GSM Modem installed and get the status of the physically handicapped.

IV. RESULTS AND DISCUSSIONS

The various gestures were tested and the outputs were studied to check if the right codes were transmitted. The model is also able to transmit SMS when there is an abnormality in the health. Therefore the project is seen to be working successfully with an artificial human-machine interaction system.

V. CONCLUSION

With the development of the project it can be successfully implemented on a larger scale for the handicapped people. The low cost of the assembly makes it really a bonus for the general public. The wireless system will be a boost to the confidence and will power of physically challenged people as it will help them to be self reliable.

As a part of further development the project can be developed with addition of object avoiding and careful navigation principle can be implemented. There can also be the application of intelligent home navigation for
handicapped people to go through the entire house and get help from technological interface for the navigation.

REFERENCE


