Gesture Controlled Wheelchair

1S. Patricia Nancy, 2S. Shanchana, 3A. Allwyn Gnanadas and 4Udhayanila
1,2,3,4Department of Biomedical Engineering
1,2,3,4K. P. R Institute of Engineering and Technology, India
1patricianancy05@gmail.com, 2shanchanasenthilnathan@gmail.com, 3allwyn@kpriet.ac.in, 4udhayanila08@gmail.com

Abstract - Wheelchairs are widely used by people who suffer from a disability, spinal cord injury, accident, or have difficulty in walking. Wheelchairs are of great use now-a-days to aged persons at home, orphanage and hospitals. This paper aims at presenting a wheelchair which can be used without external assistance. The wheelchair can be controlled by using the hand gestures of the user themselves. The hand gestures are being sensed with the help of the 3-axis accelerometer sensor. The output of this MEMS sensor is being given to the ATMEGA-328 microcontroller chip.

Keywords - Gesture, Accelerometer, atmega- 328

1. Introduction
About 10% of the global population make use of the wheelchair as of today. The increasing number of accidents, vehicle crashes, diseases has made the people lose their self-mobility. Aged persons are greatly in need of another person to maneuver to a different destination, even of a short distance.

The development of wheelchairs has increased the chances of independent survival of the people with such disabilities, but to a certain extent. The traditional wheelchairs [1] proved to be compromising to such people but to a smaller extent. Since they were unable to avoid the external assistance completely, they failed to be appropriate in flexibility and complexity. A wheelchair is said to be appropriate when the user can use these wheelchairs in a comfortable [2] way according to their usage and the living environment/workplace. Thus, the development of modern wheelchairs has laid the way to increase the maneuverability of patients and decrease the dependency.

The purpose of this paper is to demonstrate the effectiveness of accelerometers [3] in translating the gestures into signals for the wheelchair movement. For gesture recognition, the accelerometer data is filtered out. The accelerometers can measure the magnitude and direction of gravity in addition to the acceleration measurement. For the calibration purpose of the accelerometers, the device’s sensitive axis is rotated according to gravity and it makes use of the resulting signal for the complete measurement.

2. Materials and Methods
Our project is an Innovative Oddball consisting of innumerable definite components of ATMEGA-328, ADXL 345(3 – axis Accelerometer), L293D motor driver, DC motor, Slide switch, 7805-voltage regulator, 16 MHz-Crystal Oscillator, Slide switch and 2-pin RMC. Among all MEMS (Accelerometer) [4] stands unique in its participation. It works on the basics of Physics, whenever a force in a particular direction is applied, the capacitance between the plates changes resulting in the measure of acceleration force. When the gestures are given by the people, the force acts on the MEMS causing the internal assembly to move and we can infer the acceleration force acting on the body as shown in Figure 1. Gesture signals [5] sensed are delivered to ATMEGA-328 microcontroller, where the information gets processed to control the DC motor in order to move the Wheelchair. Identification and Interfacing the sensors along with the motor was compiled and the prototype was designed finally.

In our experiments, once the accelerometer is placed on the hand, the designed wheelchair moves with respect to the hand gesture movement. The wheelchair starts moving forward, when the accelerometer is tilted forward [6]. When we tilt the accelerometer in a backward direction, the wheelchair [7] moves in the reverse direction. It continues to remain in the same state until the next direction is given.

When we tilt the hand on the left side, then the wheelchair changes its movements towards the left direction as shown in Table 1. In the same way, when we tilt our hand to the right side, then the wheelchair moves towards the right with respect to the user’s hand gesture [8].

![Fig. 1: Block diagram](image)

<table>
<thead>
<tr>
<th>Gesture Movements</th>
<th>Function</th>
<th>Wheelchair Movements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up</td>
<td>Front</td>
<td>Chair moves forward</td>
</tr>
<tr>
<td>Down</td>
<td>Back</td>
<td>Chair moves backward</td>
</tr>
<tr>
<td>Left</td>
<td>Left</td>
<td>Chair moves towards left</td>
</tr>
<tr>
<td>Right</td>
<td>Right</td>
<td>Chair moves towards right</td>
</tr>
<tr>
<td>No movements</td>
<td>Rest</td>
<td>Does not move</td>
</tr>
</tbody>
</table>

Table 1: Directions of the Wheelchair

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3. Applications
This wheelchair design finds its application in Hospitals, for handicapped patients who cannot manipulate the wheelchair with the force of their arms and such people require these types of wheelchair [9]. The Wheelchair makes use of an accelerometer controlled by the hand gestures of the patient. The wheelchair is capable of moving in four directions such as front, back, left, right thus enabling the physically handicapped patient to move in a free and safe manner [10-12].

Our wheelchair design presents a new wheelchair controlled by using gestures and offers many advantages such as less complexity, easy control, low cost and great reliability relative to the conventional wheelchairs. The user can make use of either the touch pad/accelerometer for the mode selection.

4. Conclusion
The gesture control wheelchair makes it easier for the movement of the patients and reduces the strain in moving the wheel chair. The gesture-controlled wheel chair is much more useful in case of paraplegic patients who lost their movements in the lower limbs of the body. In such cases these sensors are fitted to the body parts where they have movements and therefore reduces the need for a caretaker to supervise them every time. The gesture-controlled wheel chair also reduces the mental stress of the people they undergo due to their dependency on others. Therefore, the gesture-controlled wheelchair is highly useful in all the patients’ needs and also it is like stacking up some sensors on the conventional joystick-controlled wheel chair.

Gesture controlled wheelchairs are a promising long-term invention that is reliable and of economical use. Wheelchair has been tested by tilting the MEMS transmitter which is attached to the hand. Combination of accelerometer and ATmega plays an important role, providing patients with easy access. Wheelchair moves accordingly in the directions, with the help of a DC motor. Wheelchairs can also be modified with a wireless remote and different sensor to be more effective with high output accuracy.

This kind of wheelchair design makes the user independent, thus making them psychologically strong. In order to make the user overcome physical hardship, the accelerometer comes as a boon thus enabling the user to move with slight gestures made by their hands. Our wheelchair design enables the user to control the wheelchair movements with simple hand gestures. Future scope and Improvements include controlling the wheelchair using various body gestures such as eye gaze, leg movements, or head movements.

References