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Wheelchair Control by Head Motion Using Accelerometer

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Abstract: **The challenging problem faced by the paralyzed people is their independent mobility. They need an external help to perform their daily activities. Electric wheelchairs are designed to aid paraplegics. Unfortunately, these can not be used by persons with higher degree of impairment, such as quadriplegics, i.e. persons that, due to age or illness, can not move any of the body parts, except of the head. The main objective of this project is to provide an automated system for disabled people. The wheel chair will work based on the head movement of the user. The recognized gestures are used to generate motion control commands to the controller so that it can control the motion of the wheel chair according to the user intention. Design and development of Head motion controlled wheelchair has been achieved using accelerometer sensors and PIC microcontroller. The system is implemented practically and works well. The ACCELEROMETER senses the change in direction of head and accordingly the signal is given to microcontroller. Depending on the direction of the Acceleration, microcontroller controls the wheel chair directions like LEFT, RIGHT, FRONT, and BACK with the aid of DC motors.**

Keywords: **accelerometer, pic microcontroller, DC motor, wheelchair, gesture.**

1. INTRODUCTION

Quadriplegics are persons who are not able to use any of the extremities. The reasons for such decreased motion possibilities can be different: stroke, arthritis, high blood pressure, degenerative diseases of bones and joints and cases of paralysis and birth defects. Also, quadriplegia appears as a consequence of accidents or age. The patients with such severe disabilities are not able to perform their everyday actions, such as: feeding, toilette usage and movement through space. Depending on the severity of the disability, a patient can retain freedom of movement to a certain level by using different medical devices [1]. Mobility has become very important for a good quality of life. Designing a system with independent mobility for such disabled people is our aim in this project.

This system is an automatic head tilt movement controlled wheelchair that could operate in any direction using head movements, i.e. Forward, Backward, Left and Right. It stops when the person does not tilt his head in any direction. In this paper, a microcontroller system that enables standard electric wheelchair control by head motion is developed. The project describes a wheelchair for physically disabled people developed using head motion and accelerometer sensor which is interfaced with DC motors. The prototype of the wheelchair is built using a PIC micro-Controller, chosen for its low cost, in addition to its features of easy erasing and programming. ACCELEROMETER SENSOR is a Micro Electro Mechanical Sensor can be used to effectively translate head movement into computer interpreted signals. For motion recognition the accelerometer data is calibrated and filtered. The accelerometers can measure the magnitude and direction of gravity in addition to movement induced acceleration. This project utilizes two DC Motors. The DC motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary permanent magnets, and rotating electrical magnets, battery. The Microcontroller is programmed with the help of embedded C instructions.

2. LITERATURE VIEW

When an unfortunate event affects the motor capacity of a person, it is necessary to use devices like wheelchairs that offer a means of displacement for patients with motors problems of the lower limbs. Tremendous leaps have been made in the field of wheelchair technology. However, even these significant advances haven't been able to help quadriplegics navigate wheelchair unassisted. Some patients that cannot manipulate the wheelchair with their arms due to a lack of force

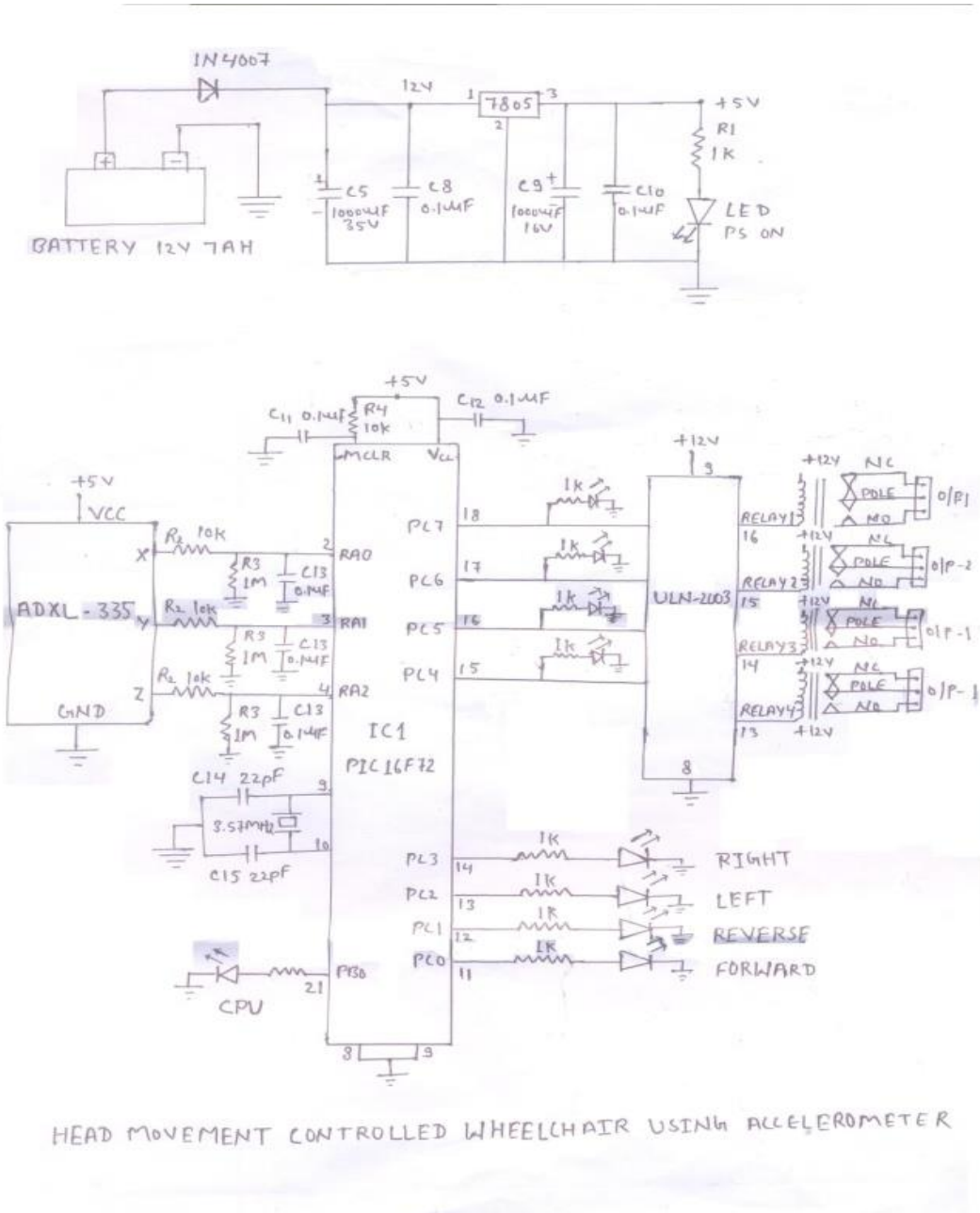
or psychomotor problems in the superior members, request electric wheelchairs, frequently manipulated with head motion. The present article presents the partial results in the development of a wheelchair controlled by head motion, where the instructions are given by head motion. The advances are presented in the realization of the control software using an accelerometer and some distances and actuator sensors controlled by a PIC microcontroller that establishes the communication with a program developed in Lab view.

Smart wheelchairs will remain fertile ground for technological research for many years to come. Smart wheelchairs are excellent test beds for sensor research, particularly machine vision. Smart wheelchairs also provide an opportunity to study human-robot interaction, adaptive or shared control, and novel input methods, such as voice control, EOG, and eye-tracking. Furthermore, smart wheelchairs will continue to serve as test beds for robot control architectures.

3. BLOCK AND CIRCUIT DIAGRAM

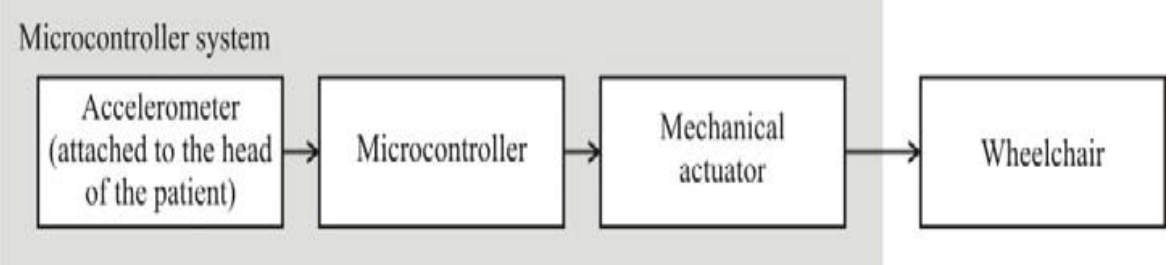
The system consists of major components like PIC Microcontroller 16F72 with 8K Flash memory, accelerometer Sensor, four DC Motors and 12V DC supply, Driver L293D, ADC, Crystal oscillator, LED circuitry etc

CIRCUIT DIAGRAM:



HEAD MOVEMENT CONTROLLED WHEELCHAIR USING ACCELEROMETER

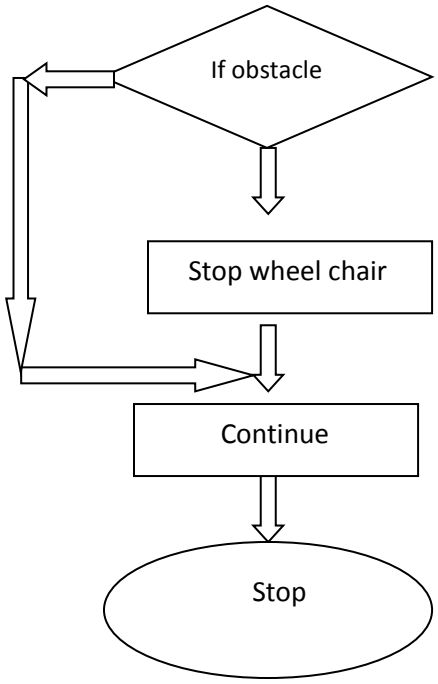
BLOCK DIAGRAM:



ACCELEROMETER:

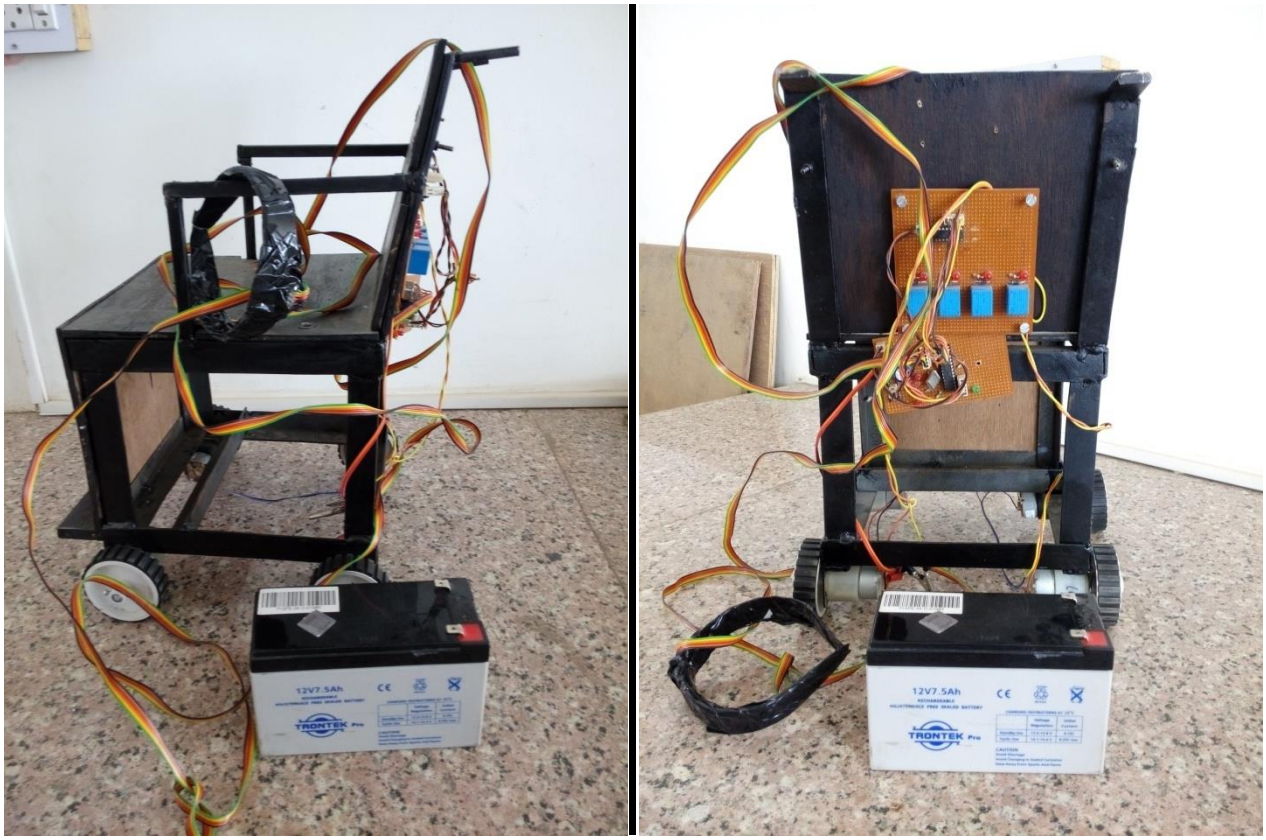
An accelerometer is an integrated device that measures proper acceleration, the acceleration experienced relative to freefall. Single- and multiaxis models are available to detect magnitude and direction of the acceleration as a vector quantity, and can be used to sense orientation, acceleration, vibration shock, and falling. Micro machined accelerometers are increasingly present in portable electronic devices and video game controllers, to detect the position of the device or provide for game input. It is a capable of measuring how fast the speed of object is changing. It generates analog voltage as the output which is used as an input to the control system. The accelerometer used in this automated system is ADXL335. It is a three axis accelerometer, which senses the tilt in two directions only. The supply voltage ranges from 2 to 3.6v [2].

HEADMOTION-RECOGNIGATION ALGORITHAM:



Since a set of possible motions in this case is very small, the number of available commands is also very limited. Thus, the control system that we propose allows the user to give only four different commands: “forward”, “backward”, “left” and “right”. This means that the set of motions to be recognized has only four members. The implemented algorithm relies greatly onthis fact. The meaning of each of the commands is relative and depends on the present wheelchair state, Fig. 2. Namely, we define six different wheelchair states: “state of still”, “moving forward – 1st gear”, “moving forward – 2nd gear”, “moving backward”, “rotating left” and “rotating right”. If the wheelchair is in the “state of still”, the command “forward” will put it in the state “moving forward – 1st gear”, and the command “backward” will put it in the state “moving backward”. On the other hand, if the wheelchair is in the state “moving forward – 1st gear”, the command “forward” will put it in the state “moving forward – 2nd gear”, and the command “backward” will put it in the state “state of still”, i.e. stop the wheelchair. Analogously, if the wheelchair are in the state “moving backward”, the command “forward” will stop it [3].

4. WORKING MODEL



ADVANTAGES

a. User Friendly

b. Helpful for the paralysis stroke people who don,,t have much stamina in the hands.

c. Reduces the human activity.

d. Reduces the physical strain.

e. Spontaneous output

5. CONCLUSION

In the race of man versus machine head motion controlled system comes as an example of companionship of man and machine. In this paper a technique of head motion recognition is used to enable wheelchair control for quadriplegics.

To avoid physical hardship an accelerometer is used due to which the slight movement of head turns the wheelchair into the desired direction. It is designed to be characterized by low price and higher reliability

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