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"Wheelchair cum Stretcher with Head Gesture Recognition System"

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Abstract: The Wheelchair chair is an assistive device used by the physically challenged people to move from one place to another. But there is some sort of difficulties in manual operation of the wheelchair by the physically challenged people. The main objective of this paper is to develop a wheelchair cum stretcher operated by the Head gestured recognition system. This provides mobility assistance and posture stability for bed ridden people and physically challenged people. The wheelchair can be converted to stretcher with the help of two-way electric actuator attached along with linkage mechanism provided in the back rest, seat, and leg rest portion of the wheelchair. The mobility is provided using the Head gestured recognition system operated with the help of the Arduino microcontroller and accelerometer sensor which is a 3 axes sensor used to sense the gesture of the user and manipulates the signal to the driving unit i.e. To the motor driver which transmits the signal to the DC geared motion to move the wheelchair forward, backward, left or right respectively.

Keywords: Arduino microcontroller, Accelerometer sensor, Two-way electric actuator, DC geared motor.

I. INTRODUCTION

In these modern days, everyone has a mindset that they must be independent in all forms of life rather depending on other people and asking help from others. Even physically challenged people think about it that they should not depend on others to help them in propelling the manual wheelchair from one place to another. Now a days, many physically challenged and elderly people need wheelchair to make them easily assist in mobility from one place to another. So, they require an automated wheelchair to help in their mobility rather using the manual wheelchair which required someone to propel it. These disadvantages of manual wheelchair can be overcome by using automated wheelchair which is the electric wheelchair controlled using the joystick. Generally, these automated wheelchairs cost ranges from 60000 and more [1]. So, I have developed a wheelchair cum stretcher with head gestured recognition system which provides an advantage of mobility assistance and posture stability to physically challenged people at low cost than conventional wheelchair available in the market.

In this wheelchair, we have incorporated a linkage mechanism to convert the wheelchair to stretcher along with the help of two-way electric actuator. This can provide the posture stability to the physically challenged people than the conventional wheelchair. The electric actuator works based on the electrical switch attached to the hand rest portion of the wheelchair and can be operated whenever required by the user. The head gestured motion is incorporated to provide mobility assistance to physically challenged people who are affected by spinal cord injury, Paraplegic, Quadriplegic and muscular dystrophy. They cannot use the joystick controlled because of the non-functioning of the limbs or people who are paralyzed. This paper investigates the research work of Wheelchair cum stretcher with Head gestured recognition for the user interaction. Gesture type, interface, technology used, user types, issues, problems, advantages, and final result have been listed and described to give background of Wheelchair based technology development.

The mobility of the wheelchair is controlled with the user defined head gesture which is basically sensed with the help of accelerometer sensor MPU6050 we have incorporated in this technology. This is a 3 axes sensor detects the head gesture defined by the user. This is connected to the Arduino microcontroller. The Arduino is connected to the transmitter side of the Radio frequency module which uses a 355 MHz frequency to communicate with the receiver side of the system which relates to the DC geared motor. This provides the motion to the wheelchair according to the gesture defined by the user. In this wheelchair, the accelerometer sensor MPU6050 is placed in the form of head set of the user which senses the gesture of the head of the user along the three axes i.e. x, y and z axes which defines the pitching, yawing and rolling motion. So, based on the motion i.e. forward, backward, left or right the accelerometer sensor changes its axis from its reference point and senses the direction of the gesture according to the axes and transmits the signal to the Arduino microcontroller ATMEGA328p. Then the signal is transmitted from the transmitter side of RF module to the receiving side of the module. In the receiving side of the RF module it receives the signal from the transmitter side and the receiving module is connected to the Arduino microcontroller. The signal is sent to the Arduino microcontroller. The Arduino microcontroller relates to L293d 2A based H- Bridge Dual Motor Driver. The Arduino

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microcontroller sends the signal to the motor driver which is the signal sent by the Radio frequency module of the receiver side and process the signals in the pins of the motor driver and the motion of the wheelchair is provided with the DC geared motor according to the motion sensed.

II. LITERATURE REVIEW

- According to research paper, "HAND GESTURE RECOGNITION: A LITERATURE REVIEW" [2], it focuses on human computer interaction. It is a survey of recent hand gesture recognition systems. Key issues of hand gesture recognition system are presented with challenges of gesture system. Review methods of recent postures and gestures recognition system presented as well.

Orientation histogram method applied in this have some problems which are similar gestures might have different orientation histograms and different gestures could have similar orientation histograms, besides that, the proposed method achieved well for any objects that dominate the image even if it is not the hand gesture.

- According to research paper, Titled Sensor-Based Gesture Control Wheelchair" [3] published in IEEE, it works on the principle of gesture recognition by using Infrared Sensors. In this method, IR sensors are used for identifying the simple gestures to control the powered wheelchair to move in any direction. In the proposed prototype system, a gesture pad that includes IR sensors, MCU and power management circuit is designed for gesture recognition and identification and a controller for driving motors is implemented.

The main problem that comes with IR is during daylight, its sensitivity is reduced, and hence causing problem for processing the further programs. And it is difficult to recognize exact gestures using IR sensors.

- In research paper published, entitled, "Electric Powered Wheelchairs",[4] its aim was to review the concepts and previous work on velocity control, traction control, suspension control, stability control, stair-climbing wheelchairs, and wheelchair navigation. The information gathered in this study is intended to promote awareness of the status of contemporary powered wheelchair control technology and increase the functional mobility of people who use EPWs.

But it has a major disadvantage of cost efficiency. It's quite expensive as compared to normal wheelchair.

- In an article [5], from Int. Journal of Engineering Research and Applications, aims at gesture control wheelchair using hand movements. According to this article, with hand movements, wheelchair's direction can be changed. But it has disadvantage over paralyzed patients, who cannot move their hands.

- We are using accelerometer, mounted to the head of the user in the form of head set, so that with movement in head, or say, by moving your head, slightly in different direction, we can change the direction of wheel-chair.

III. METHODOLOGY

The main concept for this Wheelchair cum stretcher using Head gestured recognition is using gesture recognition system with the help accelerometer sensor, but the accelerometer is mounted in the head of the user in the form of head set to detect the motion of head in all axis. The wheelchair is converted into stretcher using the electric actuator and linkage mechanism. The circuit system of the wheelchair consists of two sides. One is transmitter side and other one is receiver. The transmitter side sends the accelerometer data to receiver through Radio frequency. The transmitter side mainly consist of three parts Arduino microcontroller ATMEGA328p, Accelerometer MPU6050 and RF transmitter.

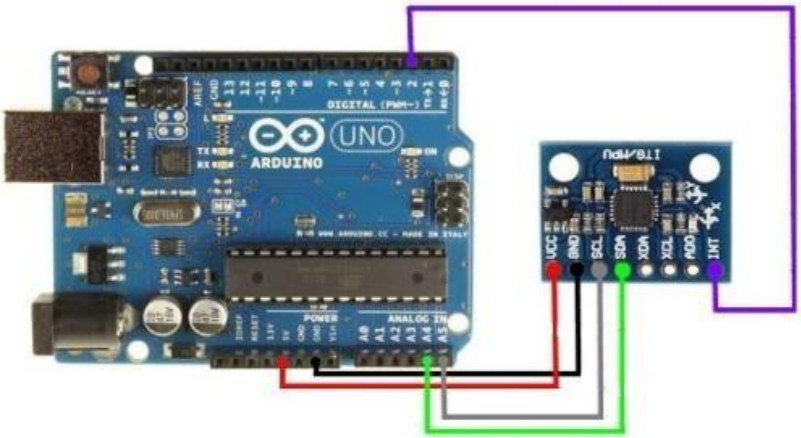

Fig 3.1: *Accelerometer MPU6050 Module*

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The accelerometer used in this wheelchair MPU6050 is a 3 axes sensor which is used to detect the gesture defined by the user for controlling the directions of the wheelchair i.e. forward, backward, left or right. The accelerometer reads the signals and sends it to the microcontroller which then processes the signal and sends it to the receiver side module from the transmitter side through the radio frequency signals.

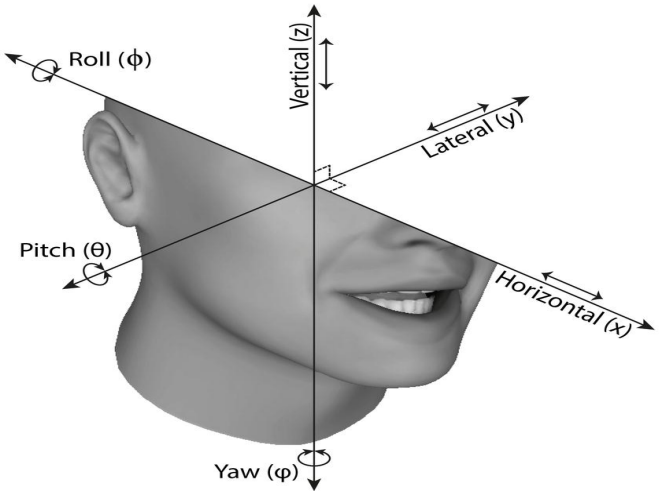

Fig 3.2: *Accelerometer sensor axes*

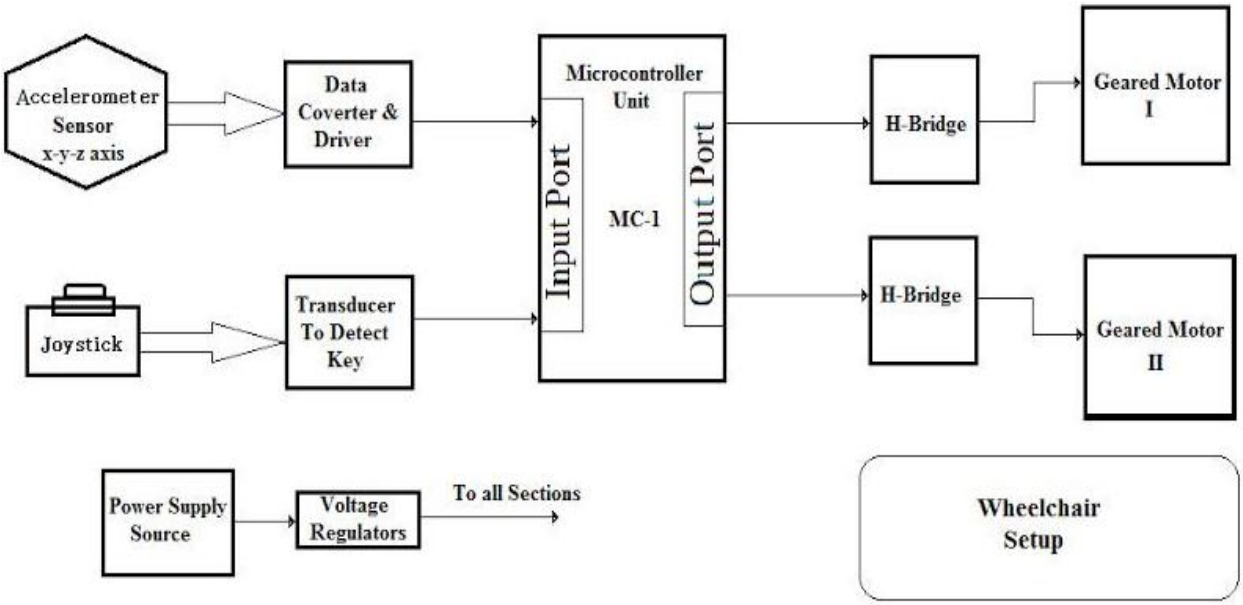

Fig 3.3: *Block diagram of Head gesture recognition system circuit*

The input signal received from accelerometer sensor is processed through Arduino micro controller and the micro controller encodes the signal through HT12E encoder Integrated circuit. The coded signal is then transferred to the Transmitter Module. With the help of antenna, Transmitter side of Radio Frequency module uses 355 MHz frequency and sends the code. This is sent to the receiver side of the circuit. This Receives the 355 MHz signals transmitted from Transmitter side. The received signal is then decoded using the HT12D decoder Integrated circuit. Then the decoded signal is fed to the Arduino microcontroller.

The major part of this Wheelchair is in the Receiver side. It contains DC geared Motors and motor driver for operating the Wheelchair. The signals from RF transmitter is decoded to RF receiver through HT12D decoder Integrated circuit. This RF receiver sends the data to Arduino. The Arduino trips the motor driver accordingly, which propels the Motors forward, backward, left or right direction respectively. The Motor driver uses L293d Integrated circuit to generate the supply by giving interrupt signal to the motor driver module. In such a way Arduino is programmed to switch the interrupt signals on the motor driver module. By giving Interrupt signal, we can change the polarity of motor and hence change the direction of motor.

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Fig 3.4: *Wheelchair design model*

Fig 3.5: *Stretcher design model*

The Motor used in this Wheelchair is High torque DC geared motor of 300 rpm, which has a torque of 25 kg/cm. These motors are operated by L293d H- Bridge Dual Motor driver which operates the motor in desired direction based on the user defined gestures. This L293d motor driver is based on dual H bridge Motor driver IC, with the help of the motor driver it is easier to transmit the signals to the motors and easy control of the direction of the wheelchair can be obtained.

IV. APPLICATION

- **In Hospitals for Physically challenged patients:** People who are physically disabled cannot manipulate their wheelchair because they may have non functioning or limbs or may have lack of muscle mass and don't have power to propel the manual wheelchair and in such cases it provides easier way of operation to provide mobility assistance for challenged people. It also provides posture stability for bed ridden people which improves their forms of life and benefits physical health. It reduces common problems such as pressure sores, progression of deformities and improve digestion and respiration.
- Also used in Institution and Offices, Industries and Homes etc.

V. RESULT

COMPONENTS	SUPPLIED VOLTAGE
Electric actuator	12V DC, Stroke length – 200 mm, Load capacity – 1200 N
Motors (DC geared 300 RPM, 25 kg/cm Torque)	11.86V DC
RF Module (Transmitter and Receiver)	4.56V DC
MPU6050	4.56V DC
Arduino	9V DC
Motor Driver (L298N)	11.86V

VI. CONCLUSION

This survey is the accomplishment of the task where Wheelchair cum stretcher with head gestured recognition system user interface for physically challenged people has been. From this survey it has been identified that physically challenged people require more technology support using their nature behavior, considering their limitations. We can use affordable technology for daily activities that supports human life and improves their quality of life.

The wheelchair is fully capable of carrying the load up to 120Kg, and motion is provided in accordance with the head gesture given by the user who is using the wheelchair. The wheelchair can be improvised and developed in certain way to be used for people who are paralyzed whole body. Certain eyes gesture or brain signals reader can be imparted on the wheelchair system to make it better. For now, it works for all kinds of physically challenged people, and even for those patients whose whole body is paralyzed but still head movement is possible.

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VII. FUTURE SCOPES

As the world is growing fast in technologies such as machine learning, Artificial intelligence we can incorporate it to the future of the development of the wheelchair fully as an automated device and the controls can be incorporated based on the open vision system which basically senses the signals based on the camera setup arrangement and functions accordingly to the program that has been installed through the programming languages such as Python, C programming and even MATLAB can be used as an image processing system and the controls given by the user can be monitored by the camera and can be functioned accordingly. Voice based and Brain controlled based recognition system can be incorporated in the future development of this project.

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