Hand Gesture Controlled Wheelchair with Emergency Alert System and Obstacle Detection

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Abstract - *This paper introduces a simple but effective method for implementing hand gesture recognition that provides a platform for people with physical disabilities. Using these gestures, the wheelchair can be operated in an efficient manner that is normal and convenient unlike a machine. The wheelchair consists of an accelerometer sensor that senses the hand movements and sends the output to the microcontroller. Depending on the gestures recognized by the accelerometer, the wheelchair will move in forward, backward, right and left directions. Obstacles can be detected using ultrasonic sensor, saving the user from risk. In case of any emergency the user can just press the button provided which sends the alert messages to the doctors/relatives with the help of GSM module.*

*Key Words***: Gesture, wheelchair, accelerometer sensor, obstacle detector, GSM modem.**

1. INTRODUCTION

This has been primarily proposed for physically disabled people who are dependent on wheelchairs and for those who cannot use their hand to drag their wheelchair efficiently. The motive is to help such people to live an independent life without much dependence on others. Disabled people find it difficult when they need to move from one place to another as they have to depend on others. The traditional wheelchairs have some limitations in terms of flexibility, bulkiness and limited functions. Wheelchairs with in-build joysticks are very expensive and also sometimes have a steep learning curve for people of various ages or backgrounds & also to people who are not even strong enough to push the controls here and there. In such cases, a smart wheelchair can be an assistant for them. The wheelchair is automatically controlled by giving commands using hand gestures. The wheelchair can be moved using accelerometer sensor in different directions just by tilting hands in forward, backward, right and left direction. This wheelchair has ultrasonic sensor which are also helpful in avoiding obstacles. In addition, the GSM module sends alert messages in emergency. Basically, this wheelchair will add on to the comfort and make the life of people bit easier.

2. RELATED WORK

Depending on the direction of the Acceleration, ARM7 controller controls the wheelchair ways like LEFT, RIGHT, FORWARD, & BACKWARD. The purpose of this system is to implement wheelchair direction control with hand gesture reorganization [1].

Handicapped person which is physically ill or partially paralysis should communicate with normal humans in natural way. Also many handicapped persons suffering from various difficulties, like they are not able to do work individually, therefore it is essential to overcome this situation [2].

A wheelchair is an electric wheelchair fitted with acceleration sensors, obstacle sensor and computer to help less able drivers achieve some independent mobility. By just tilting acceleration sensor wheelchair can be moved in four directions. The obstacle sensor can help the rider control the wheelchair by taking over some of the responsibility for steering and avoiding objects until he or she is able to handle the job. The amount of work that the rider chooses to do and how much control is taken by the chair is decided by the rider and his or her care [3].

In Hospitals for handicapped patients: Some patients that cannot manipulate the wheelchair with their arms due to a lack of force or psychomotor problems in the superior members require electric wheelchair. The wheelchair is operated with the help of accelerometer, which in turn controls the wheelchair with the help of hand gesture. The wheelchair moves front, back, right and left. Due to which disabled and partially paralyzed patient can freely move [4]. This device is portable and this system operation is entirely driven by wireless technology. User can wear it to his wrist like a watch and can operate it by tilting the MEMS ACCELEROMETER SENSOR Accelerometer sensor. This project makes use of a micro controller, which is programmed, with the help of embedded C instructions. This microcontroller is capable of communicating with transmitter and receiver modules. The MEMS ACCELEROMETER SENSOR based sensor detects the tilt and provides the information to the microcontroller (on board computer) and the controller judges whether the instruction is right movement or left movement instruction and controls the direction respectively. The controller is interfaced with two dc motors to control the direction of the wheel chair [5]. Health monitoring system can be implemented on wheelchair which is very useful for handicapped person. This system checks health of handicapped persons daily. [6]

The paralyzed person can operated wheelchair using eyes sensor they can move the wheelchair left or right by just

looking to the required direction, they can also start and stop the wheel chair, with other gestures or else another sensor such as voice recognition system, his project can be implanted [7].

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. 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 [8].

3. SYSTEM DESIGN

3.1 Aim and Objectives

The aim of this paper is to introduce a hand gesture controlled wheelchair using accelerometer as a sensor to help the physically disabled people in moving from one place to another just by giving directions using hands. In earlier systems, driving and controlling of traditional wheelchair were much harder task. This paper aims to build a low cost and powerful wheelchair which helps the handicapped people to travel without depending on others. Hence, a prototype of cost effective electronic gesture based wheel chair is designed which is easy to operate.

Also, to provide benefits to the people who are:

• Paralytic person.
• Those who walk with the help of aid.
• Those who have lost sense of sensation in lower part of the body due to paralysis or other problems.

3.2 Scope

The proposed model is a wheelchair prototype built around 8- bit microcontroller platforms. The microcontroller takes the input from acceleration sensor installed on the wheelchair covering all the directions and provides corresponding outputs that helps user to take decision and make judgments for the safe movement and control of the wheelchair. A wheelchair is an electric wheelchair fitted with acceleration sensors, obstacle sensor and computer to help less able drivers achieve some independent mobility. By just tilting acceleration sensor wheelchair can be moved in four directions. The obstacle sensor can help the rider control the wheelchair by taking over some of the responsibility for steering and avoiding objects until he or she is able to handle

the job. The amount of work that the rider chooses to do and how much control is taken by the chair is decided by the rider and his or her care.

3.3 Features

• It can detect the obstacles using obstacle sensor.
• It functions using hand gestures given by users.
• Alert message will be sent to the stored number by pressing a push button in case of emergency.

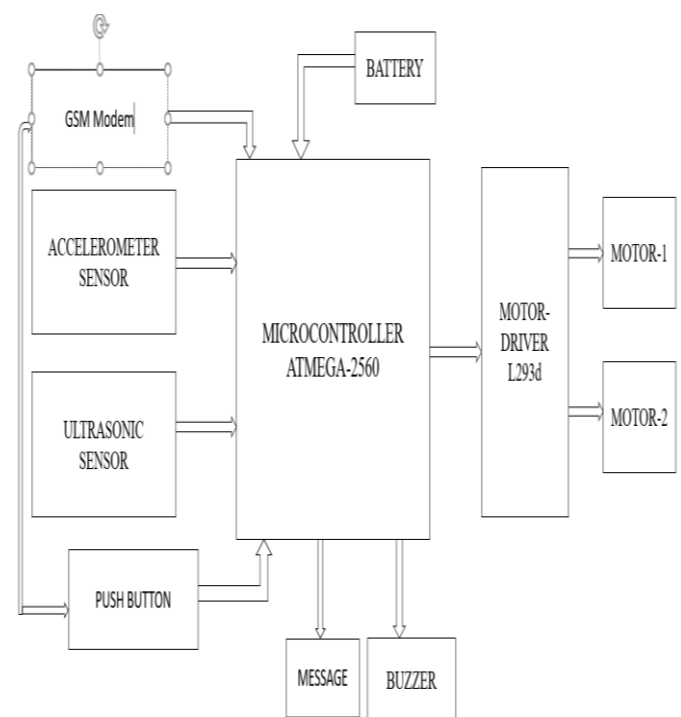## 4. IMPLEMENTATION METHODOLOGY

4.1 Design

Fig -1: Block Diagram of Hand Gesture Controlled Wheel Chair.

Fig.1 shows the block diagram of Hand Gesture Controlled Wheel Chair.

4.2 Hardware and Software Required

Table -1: The Hardware and Software Requirements

| Hardware Components	Software Components
• Arduino Mega 2560	• Arduino IDE
• Accelerometer Sensor (Adxl335)	
• Ultrasonic Sensor	
• DC Motor	
• GSM Modem	
• Motor Driver IC	

(L293D)	
• Push Button	
• 12 V Battery	
• Buzzer	

4.3 Working of Model

4.3.1 Ultrasonic Sensor

An Ultrasonic Sensor is a device that measures distance to an object using Sound Waves. The ultrasonic sensor is used as obstacle detector which can automatically sense the obstacle in front of it and if obstacle is detected it stops. This design allows the wheelchair to navigate in unknown environment by detecting collisions, which is a primary requirement for any autonomous mobile wheelchair. Here buzzer is taking input from ultrasonic sensor and using the distance value coming from ultrasonic sensor, we will turn the buzzer on or off. The ultrasonic sensor emits an ultrasonic wave from the trigger which comes back after hitting the object and it is received by the echo. We will get the distance value and after that, we will set a value which will help us make the buzzer high or low.

4.3.2 Accelerometer
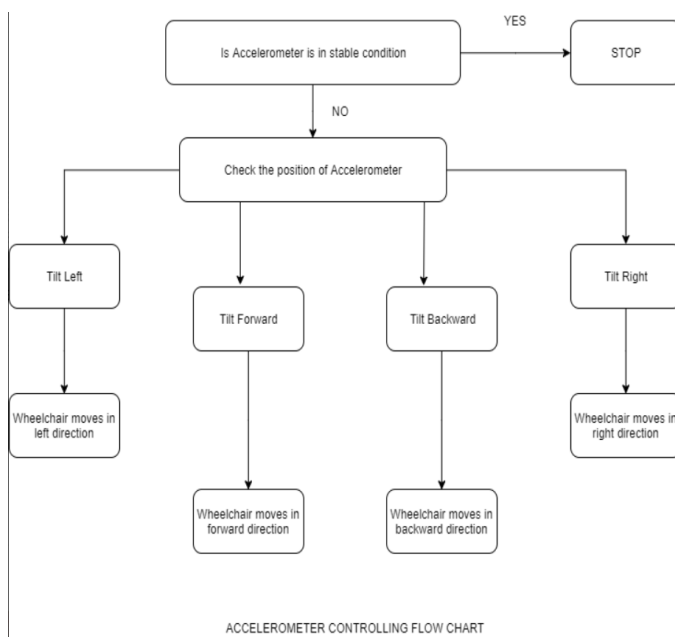
Fig -2: Accelerometer Controlling Flow Chart

Fig.2 shows Accelerometer Controlling Flow Chart. Accelerometer is used to recognize the hand gestures and with the help of this information it converts into valuable data. This is accomplished with two major components which are Arduino microcontroller and an accelerometer. Accelerometer transmitting the hand gesture measurements to the Arduino microcontroller which processes it and tells the wheelchair to move in the desired direction. The Adxl335 is 3-axis accelerometer where analog input is given to X,Y,Z axis.

The sensor attached on the hand gives the movement commands by detecting the orientation of the hand.
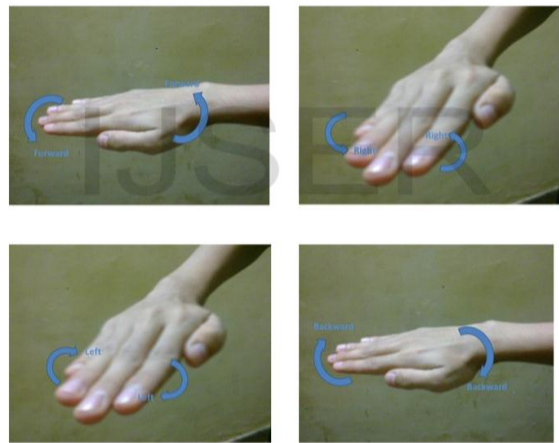
Fig -3: Hand Gesture Movement Diagram

Fig.3 chows Hand Gesture Movement Diagram. Change in sensor values whenever it is tilted in the (X-direction) vehicle has to move forward and when it is tilted in inverse of that direction vehicle runs backward. Similarly if sensor is tilted in (Y-direction) vehicle turns either left or right simultaneously inverse to each other so that it can turn easily. When sensor is in flat position (straight) wheelchair stops.

4.3.3 GSM Modem

For GSM Modem, we just have to connect the RX of Arduino Mega to TX of GSM modem and TX of Arduino mega to RX of GSM modem. Also connect the ground of GSM modem to ground of Arduino Mega. OR We need to select two PWM enabled pins of Arduino for this method. So I choose pins 9 and 10 (which are PWM enabled pins). This method is made possible with the SoftwareSerialLibrary of Arduino. SoftwareSerial is a library of Arduino which enables serial data communication through other digital pins of Arduino.

When the button is pressed, the GSM will send the message. This system is implemented on wheelchair which is used in case of emergency.

Fig -4: Final Prototype for Hand Gesture Controlled Wheelchair (1)

Fig -5: Final Prototype for Hand Gesture Controlled Wheelchair (2)

Fig.4 and Fig.5 show the final prototype model for Hand Gesture Controlled Wheelchair.

5. CONCLUSIONS

This paper proposes a model for Hand Gesture Controlled Wheelchair, which is able to control some of the overall disadvantages of the other strategies commonly used by providing a gesture controlled wheel chair.

This gives the user independence and a psychological advantage of being independent.

To avoid physical hardship, a user can use the accelerometer to the rescue as with the slight twist of the hand the user gets the ability and freedom to turn the wheelchair into the desired direction. Also, the obstacle sensor detects the obstacle, turns on the buzzer and stops the wheelchair because change of direction may be dangerous.

The user can then give another alternate direction to move. During an emergency, the user presses the button placed on the wheelchair and the GSM module sends the recorded alert message to the relative/doctor.

6. FUTURE SCOPE

• Range of communication can be increased to100m with the powerful wireless devices.
• Health monitoring system can be implemented on wheelchair which is very useful for handicapped person. This system checks health of handicapped persons daily.
• 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.
• GPS system can also be implemented to know the exact location of the person who is in wheelchair.

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