Head Gesture Based Wheelchair Control and Cardiac Monitoring System

Divya Mohan¹, Archana.G², Gayathri.P³, Kavya.M⁴, Nivedha.V⁵
Assistant Professor, Department of ECE, CSI College of Engineering, Ooty, India¹
Students, IV-ECE, CSI College of Engineering, Ooty, India²,³,⁴,⁵

Abstract:
This paper implements & develops a wheel chair control for the physically challenged by employing head-gesture recognition using MEMS technology. Tremendous advances have been made in the field of wheelchair technology; however, even these significant advances haven’t been effective in helping unassisted quadriplegics to navigate the wheelchair. Here, a simple cost effective wheelchair is developed which can be controlled by simple head gestures for directions like left, right, front, and back. An MEMS sensor is used to control the wheelchair through head gestures made by the impaired person and moves accordingly. This paper monitors the heart beat rate of the person in the wheelchair also if the person’s heart beat rate goes low immediately a message will be pinged to the chief doctor through GSM. This paper also presents the experimental results on the movement responses of the developed wheel chair with patients of varying weight.

Keywords: Micro-electromechanical systems (MEMS), wheelchair, quadriplegic, gesture, heartbeat sensor, GSM.

I. INTRODUCTION

The purpose of this project is to design and develop a head gesture based wheelchair or a smart wheelchair which can be easily controlled with gesture recognition system. This project is very helpful for the movement of physically handicapped or elder people. The movement of head is detected by the tilt sensor or module. The wheelchair control system is designed with the help of MEMS sensor, PIC microcontroller, DC Motor and relay driver IC. The head gesture based wheelchair reduces the extra effort of the physically handicapped person and elder people so they can live freely and independently in today’s fast world and it is very easy to use by the needed person. This wheelchair can move in different directions forward, backward, left and right directions. This sensor recognizes the tilt and makes use of MEMS sensor to change the direction of wheel chair. With the help of this highly sensitive sensor we easily control the direction of wheelchair by the movement of the head only.

II. SYSTEM DESIGN

2.1 PIC 16F877A Microcontroller:
The 16F877A is one of the most popular PIC microcontrollers and it’s easy to see because it comes in a 40 pin DIP pin out and it has many internal peripherals. The only disadvantage that you could level at it is that it does not have an internal clock source like most of the other more modern PICs. The 16F877A is a capable microcontroller that can do many tasks because it has a large enough programming memory 8k words and 368 Bytes of RAM. This is enough to do many different projects.
2.3 Heartbeat Sensor
2.3.1 Principle of Heartbeat Sensor:
The heartbeat sensor is based on the principle of photoplethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ. In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses.

2.3.2 Working of a Heartbeat Sensor:
The basic heartbeat sensor consists of a light emitting diode and a detector like a light detecting resistor or a photodiode. The heart beat pulses causes a variation in the flow of blood to different regions of the body. When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beat rate. This signal is actually a DC signal relating to the tissues and the blood volume and the AC component synchronous with the heart beat and caused by pulsatile changes in arterial blood volume is superimposed on the DC signal. Thus the major requirement is to isolate that AC component as it is of prime importance.

To achieve the task of getting the AC signal, the output from the detector is first filtered using a 2 stage HP-LP circuit and is then converted to digital pulses using a comparator circuit or using simple ADC. The digital pulses are given to a microcontroller for calculating the heat beat rate, given by the formula-

\[ \text{BPM (Beats per minute)} = 60 \times \frac{f}{f_{\text{pulse}}} \]

Where \( f \) is the pulse frequency

2.3.3 Practical Heartbeat Sensor:
Practical heartbeat Sensor examples are Heart Rate Sensor (Product No PC-3147). It consists of an infrared led and an ldr embedded onto a clip like structure. The clip is attached to the organ (earlobe or the finger) with the detector part on the flesh.

III. TECHNOLOGY

In this work we have used the MEMS device based head gesture technology. MEMS is very important sensor in the sensor world because it can sense a wide range of motion very quickly. An accelerometer is an electromechanical device which is measure the acceleration forces in three directions with respect to the gravity. Mems compass is very useful for our project to control the direction of the wheel chair. The primary goal of the gesture control recognition research is to create a system which can be used by identify specific human gestures control and use them to convey information easily or for device control. There are different types of the gestures recognition sensors such as hand, face (emotion), body gestures etc. To going to the design of hardware module implementation we also check the programming or design with the help of the Proteus software. It is the software which helps us to design our design on this software and check the after programming build in it with the help of hex file of program it is properly work or not. We design the hardware design on it similar with the help of this software to check the design it work or not after that we implement it on hardware device. MPLAB X IDE is a software program that runs on a PC (Windows, Mac OS, and Linux) to develop applications for Microchip microcontrollers and digital signal controllers. It
is called an Integrated Development Environment (IDE), because it provides a single integrated "environment" to develop code for embedded microcontrollers. MPLAB X Integrated Development Environment brings many changes to the PIC microcontroller development tool chain. Unlike previous versions of the MPLAB IDE which were developed completely in-house, MPLAB X IDE is based on the open source NetBeans IDE from Oracle. Taking this path has allowed us to add many frequently requested features very quickly and easily, while also providing us with a much more extensible architecture to bring you even more new features in the future. MPLAB Code Configuration (MCC) is a free, graphical programming environment that generates seamless, easy-to-understand C code to be inserted into your project. Using an intuitive interface, it enables and configures a rich set of peripherals and functions specific to your application. MPLAB Code Configurator supports 8-bit, 16-bit and 32-bit PIC microcontrollers. MCC is incorporated into both the down-loadable MPLAB X IDE and the cloud based MPLAB Xpress IDE. A person’s heartbeat is the sound of the valves in his/her heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.

IV. LITERATURE REVIEW

The disadvantages of using gyroscopes are given by:

1. The Gyroscopes are really expensive, but not in the terms of camera stabilization.
2. They are noisy if you are concerned about sound.
3. Pan and tilt speed is limited.
4. They take too much time to get up the speed.
5. They require another cable, battery and an inverter to work.

Joysticks are similar to trackballs in design but use a small ‘stick’ to manipulate the mouse pointer. Push the stick up and the pointer goes up... down and the pointer goes down. The disadvantage of using this method is that it restricts mouse pointer movement to up, down, left, right and diagonals, however for some students this disadvantage is far outweighed by the advantages. Joysticks can often be used with those students who have much less developed fine motor skills. Buttons on a joystick usually mirror those on a trackball with left, right and draglock buttons being available. Both trackballs and joystick are available as wireless devices. If you are using a wireless device always ensure the batteries are fully charged.

Wheelchair control through the use of an eye tracker is possible and has been achieved. The design presented allows control of a wheelchair through a plethora of hardware and software components to create an effective system. This system included an eye tracker, a laptop, a DAQ, an inverter, a web-cam and electric wheelchair. These pieces comprised the hardware. The software included LabVIEW programs and C++ scripts used to process the data and interact with the DAQ and eye tracker. While not a perfect system the wheelchair now stands able to be controlled solely through eye movement and thus help persons with moderate/severe physical disabilities. The disadvantage of using this is the person’s eye may get damaged. 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 joysticks; however the joystick manipulation is even not practical and frequently it must be handle with the mouth. The present article presents the partial results in the development of a wheelchair controlled by an intuitive interface, where the instructions are given by hand gesture instructions. The advances are presented in the realization of the control software using a Webcam and some distances and presence sensors controlled by a PIC microcontroller that establishes the communication with a program developed in Lab view. This paper is inspired from an IEEE Research Paper Titled „A Wearable Head-Mounted Sensor-Based Apparatus for Eye Tracking Applications” that was presented in the IEEE International Conference on Virtual Environments, Human-Computer Interfaces, and Measurement Systems Istanbul, Turkey, dated 16 July 2008. The above paper approach was dealing with wheelchair control using eye ball movement with slight modification to i.e. wheel chair control which is useful to the physically disabled person with his hand movement or his hand gesture reorganization. With the help of the wheel chair physically disabled person would able to move himself to the desired location with the help of hand gestures which controls the movement of the chair. This paper aims to provide a feasible solution to those handicapped people who do not have the ability to maneuver the wheelchair by themselves. Basically, they are used for providing better usability of a computer or a system for people, including disabled people. But the main thing is Quadriplegics cannot use this controlling method.

V. APPLICATION

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 head gesture. The wheelchair moves front, back, right and left. Due to which disabled and partially paralyzed patient can freely move.

VI. CONCLUSION AND FUTURE SCOPE

From the above obtained results, we conclude that the developed head gesture based control of wheel chair is tested and works satisfactorily in an indoor environment with minimum assistance to the person suffering with Quadriplegia or Paraplegia. It has a good response with MEMS activating the motors connected to the wheels of the chair. This paper presents a new gesture controlled wheelchair with many advantages such as reduced complexity, easy controlling, low cost and great reliability compared to other conventional wheelchairs. The proposed wheelchair can be used in many applications such as hospitals, old age homes and airports etc.

VII. OUTPUT
VIII. ACKNOWLEDGEMENT

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IX. REFERENCES


