Home Automation and Laptop Control for Quadriplegics

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Abstract: The person affected with paraplegia normally has malfunctioning of limbs. Some of these patients can only move their head. Establishing a new channel without speaking and hand/arm motions makes life easier for patients and therefore improves their life quality. The objective of our project is to present the design and application of an accelerometer based efficient human computer interface (HCI). A head mounted accelerometer device is used to detect acceleration caused by head movements of the user in three axes and the provided data are collected by software on the target computer. The movement of the eye is detected by an eye blink sensor. Through this facility, the disabled person is able to control laptop, fan, lamps and other house hold equipment's in his room. Our main aim is to make computer easily accessible by everyone including disabled people.

Keywords: Accelerometer, eye blink sensor, software, HCI, mouse cursor.

I. INTRODUCTION

This document aims to provide an alternative way of interaction with a computer, for those who do not prefer or unable to use the traditional human computer interfaces, namely mouse and keyboard, and this goal is achieved by utilizing an untraditional hardware instead, the accelerometer. A head mounted and wireless accelerometer device is used to detect acceleration caused by head movements of the user in three axes and the provided data are collected by software on the target computer. Software, then, estimates the pitch and roll tilt in degrees by analysing the collected acceleration data. These tilt data are then used to simulate mouse cursor movement and clicking on target computer. Also, to simulate keyboard input, software provides an on screen keyboard interface to user where, the cursor movements are used to navigate through keys. Software, also, has a calibration process that, determines the system's current conditions and user's movement characteristics. The objective of this document is to present the design and application of an accelerometer based efficient human computer interface (HCI).

The movement of the eye is detected by an eye blink sensor. Wireless device control is an additional feature of this project. Through this facility, the disabled person is able to control fan, lamps and other house hold equipment's in his room. This report presents the overall design decisions and implementation methods and phases, as well as a through explanation of all layers of the system.

II. SYSTEM ARCHITECTURE

The heart of this system is an AVR architecture based microcontroller which controls and coordinates all the operations. The system can be controlled by using a Visual basic GUI application installed on the computer. This GUI application provides various features like controlling the movement right click and left click of the mouse and controlling the home appliances. The interaction between GUI application and robot is achieved wirelessly by using Bluetooth module. The Bluetooth module is connected to the UART channel of AVR microcontroller.
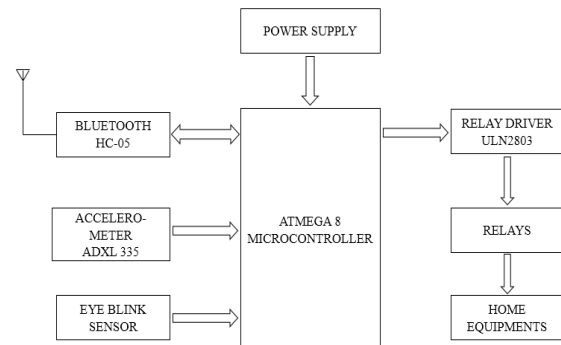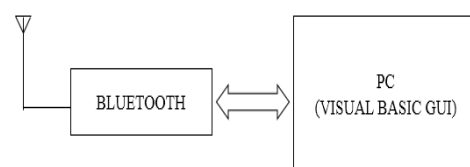

Fig 1: Control Section

Fig 2: PC Section

In power supply, we provide 220V A.C power supply to the step-down transformer which converts 220V A.C into 12V A.C. Now this 12V A.C is converted into D.C with the help of "Full Wave Bridge Rectifier" which consists of bridge diode and a filter capacitor (1000µF). A 7805 based voltage regulator is employed in this circuit to provide regulated +5V to microcontroller and associated sensors. The maximum input voltage that can be given to 7805 regulator is +25V and it effectively provides regulated

output of +5V. The maximum current that can be sourced by 7805 regulator is 1A. A 7803 regulator is also used for providing +3.3V.

A. Working of Overall System

AVR microcontroller is used for controlling all the operations of the system. Which receive analog input from accelerometer mounted on the head and eye blink sensor and process the data according to the program stored in its flash program memory. The system is equipped with a 3 axes accelerometer with analog output to control the movement of the mouse, and an eye blink sensor for click mouse. When the head of the user is tilted left/right or up/down the accelerometer output voltage along x, y and z axes are changed. These values are read by the built in ADC in the Atmega8 microcontroller. According to the received analog voltages corresponding to x, y and z axes, the movement of the head is detected, and corresponding characters are sent to the PC through Bluetooth module. The mouse pointer is moved to the corresponding location on screen based on the received characters. Mouse click is achieved by using an eye blink sensor. A photo sensor is used to detect the eye blink. When the eye is closed a logic high signal is obtained at the output of the eye blink sensor. Additionally, this system can control all home appliances connected to this system. The home appliances can be controlled by clicking corresponding buttons in a GUI application. When a button is pressed, corresponding characters are sent to the microcontroller through Bluetooth. Based on the received data corresponding relay is closed.

III. CONCLUSION

The project was aimed to develop a device to provide assistance to the injured that cannot use their limbs to move around. It explains the importance of a multipurpose device which can be successfully used by a quadriplegic and gives the related design aspects. The laptop and home automation by the head movement of the user using an accelerometer is developed to eliminate the use of limbs to move around. To reduce the dependency a wireless home automation system controlled by tilt of accelerometer is successfully developed. This system effectively provides the control like switching on/off basic electrical appliances (lights, fans) thereby providing a degree of freedom to the user which eliminates the use of external help to operate such devices.

A Human mouse interface was successfully developed which doesn't require much of extra hardware as the same accelerometer is used to help the user use his head as a mouse pointer. The tilt of the head provides motion to the mouse pointer in required direction and an eye blink sensor acts to provide the click of the mouse. This field is open to a great amount of further research and development. The system can be extended to include much more complex home appliances apart from basic electrical appliances such as bulbs, fans etc. to provide for a much more effective home automation control.

IV. FUTURE SCOPE

As future development, more sophisticated head movement mappings for simulating mouse click events can be designed and implemented, which would benefit the system hugely. And adding a more creative keyboard control layout would also increase the overall system usability. The same control unit can be used for the automation of car for quadriplegics Also, more flexible analysis algorithms and interfaces can be used provide an alternative computer control interface not only to disabled people but, to non-disabled people too. To present the alternative computer controlling idea as a commercial product, a special cap or hat can be designed with multiple built in accelerometers located perfectly, which would make the system more appealing to all user types and provide better input signal to the system at the same time.

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