A Portable Wireless Human Computer Interface For Physically Challenged People

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Abstract— In recent years the development of Human-Computer Interface (HCI), methods have been developed to help these people for communication. Unlike traditional HCIs (a keyboard, or a mouse, etc.), modern HCIs have played an important role in the area of rehabilitation. However, the disabled with severe paralysis have only few ways to control and work with the applications. For these people, methods based on eye movement or blinking and voice can be selected. In this project, we focus on implementing an IR Sensors for EOG based HCI and voice to text processor which is cheap, portable and non-invasive.

Index Terms— HCI, IR Sensor, MEMS Sensors, Microswitch, EOG Sensors.

1 INTRODUCTION

In the Eye Ball Control section IR sensors will be placed closer to the eye and when it sense the Eye ball movement then it will automatically transmit the value to the Comparator to compare the voltage received from the Sensors. If the voltage is about 0.5 volt then automatically signal will be passed to the Remote section and control few applications in PC connected to it. This voltage will be gained only if the eye ball movement is sensed. In the Receiver section we have microcontroller section interfaced to the zigbee module and PC. Zigbee receiver will receive the value and controller will calculate the sensed movement and control the application in PC.

In the tooth click application sensor is placed in tooth and while the user clicks the teeth, Micro switch sensor will sense the data and mouse click operation is performed for particular application.

In the last phase of the project MEMS sensor is used for head nodding application. MEMS can be tilted in three positions like our head, so far each head position a particular application can be controlled.

1.1 Literature survey

Inference from Literature Review

- A newly designed adjustable head mounted EOG acquisition device with the permanent surface electrodes is proposed.
- Pattern recognition is the scientific discipline whose goal is the classification of objects into a number of categories or classes.
- Electrooculography (EOG/E.O.G.) is a technique for measuring the resting potential of the retina.
- Many approaches have been made using cameras and computer vision algorithms to interpret sign language.
- Including analogue connections, codec's, packet loss and variable delay.

1.2 Electronic Eye Gesture

Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field include emotion recognition from the face and hand gesture recognition. Many approaches have been made using cameras and computer vision algorithms to interpret sign language. However, the identification and recognition of posture, gait, proxemics, and human behaviors is also the subject of gesture recognition techniques. Based on the fact that there are many challenging cases of infirm persons, who are able to control only their eye muscles, a low-cost mobile device for electronic eye gesture recognition has been designed as a human-machine interface, which enables the control of different applications and home appliances by user's eye gestures by the IR and Bluetooth wireless

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technology. In this paper the embedded system design of the device is presented in detail, including hardware and software design, modes of operation, and used methods for the eye gesture recognition. Beside these, measurements of the used differential amplifier and the achieved eye gesture recognition efficiency are presented within the test results. Furthermore, a newly designed adjustable head mounted EOG acquisition device with the permanent surface electrodes is proposed.

1.3 Pattern Recognition

Pattern recognition is the scientific discipline whose goal is the classification of objects into a number of categories or classes. In machine learning, pattern recognition is the assignment of some sort of output value (or label) to a given input value (or instance), according to some specific algorithm. An example of pattern recognition is classification, which attempts to assign each input value to one of a given set of classes (for example, determine whether a given email is "spam" or "non-spam"). However, pattern recognition is a more general problem that encompasses other types of output as well. Other examples are regression, which assigns a real-valued output to each input; sequence labeling, which assigns a class to each member of a sequence of values (for example, part of speech tagging, which assigns a part of speech to each word in an input sentence); and parsing, which assigns a parse tree to an input sentence, describing the syntactic structure of the sentence.

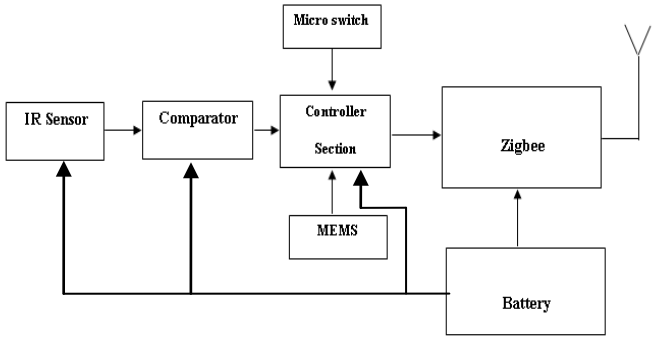
1.4 EOG

By Brandon Peters, M.D., A measurement of the electrical activity associated with eye movements as recorded with the placement of small metal discs called electrodes applied to the skin near the eyes. It is useful for monitoring eyeball movement in REM and non-REM sleep. Electrooculography (EOG/E.O.G.) is a technique for measuring the resting potential of the retina. The resulting signal is called the electrooculogram. The main applications are in ophthalmological diagnosis and in recording eye movements. Unlike the electroretinogram, the EOG does not represent the response to individual visual stimuli. Principle of electrooculography. The eye acts as a dipole in which the anterior pole is positive and the posterior pole is negative.1.Left gaze; the cornea approaches the electrode near the outer canthus resulting in a positive-going change in the potential difference recorded from it. 2.Right gaze; the cornea approaches the electrode near the inner canthus resulting in a positive-going change in the potential difference recorded from it (A, an AC/DC amplifier). Below each diagram is a typical tracing displayed by a pen recorder. Electrooculography was used by Robert Zemeckis and Jerome Chen, the visual effects supervisor in the movie Beowulf during the enhanced performance capture to correctly capture and animate the eye movements of the actors. It was an improvement from The Polar Express.

2. MODULE EXPLANATION

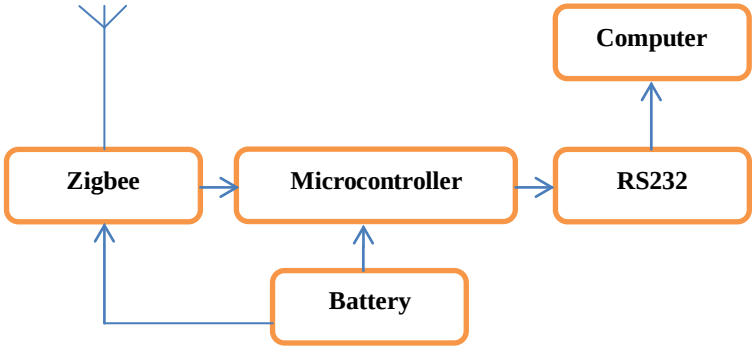
2.1 Block Diagram

Transmitter Section.



Transmitter part consists of Sensing unit, Controller section, Comparator circuit, Zigbee Transceiver module and charging unit. Battery source is given as power supply as the nodes will be in remote place. IR Sensor with Transmitter and Receiver are placed closer to the eye ball and signal received from the sensor are compared in the comparator circuit and transmitted to the remote location for mobile device controlling through Zigbee Transceiver module. Next values of Microswitch sensor which is fixed in the tooth is transmitted to the Receiver via same medium for mouse clicking action. At last MEMS values(X,Y,Z) are acquired for head motion control for controlling the scrolling action while reading the document.

Receiver Section



Receiver part consists of Zigbee Transceiver module, Microcontroller Module, PC. The signal from the transmitter is received by Zigbee Transreceiver, processed by Microcontroller and interface with the computer via RS232 port. Here, as a user end module an Pop-up window is designed by DOT-Net frame work in the computer, which will tend the mouse pointer to move over the desktop with users eye ball movement. A clicking action is also introduced when the user clicks the microchip in the transmitter side. An linking with voice controlled process in windows platform is done through microphone in-order to open an application by user's command.

So, as an end module the disabled person can sit in front of the computer and can use his eye ball movement for the movement of mouse pointer and press the microchip which is placed in the tooth to perform the clicking action, which in-turn provides a full access to operate the computer as the normal person do.

3. PERIPHERAL DEVICES

3.1 Zigbee Module – Zigbee Physical Layer

ZigBee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless M2M networks. The ZigBee standard operates on the IEEE 802.15.4 physical radio specification and operates in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz.

The 802.15.4 specification upon which the ZigBee stack operates gained ratification by the Institute of Electrical and Electronics Engineers (IEEE) in 2003. The specification is a packet-based radio protocol intended for low-cost, battery-operated devices. The protocol allows devices to communicate in a variety of network topologies and can have battery life lasting several years.

3.2 Zigbee Protocol

The ZigBee protocol has been created and ratified by member companies of the ZigBee Alliance. Over 300 leading semiconductor manufacturers, technology firms, OEMs and service companies comprise the ZigBee Alliance membership. The ZigBee protocol was designed to provide an easy-to-use wireless data solution characterized by secure, reliable wireless network architectures.

3.3 ZigBee Advantage

- Support for multiple network topologies such as point-to-point, point-to-multipoint and mesh networks
- Low duty cycle – provides long battery life
- Low latency
- Direct Sequence Spread Spectrum (DSSS)
- Up to 65,000 nodes per network
- 128-bit AES encryption for secure data connections

3.4 ZigBee Applications

ZigBee enables broad-based deployment of wireless networks with low-cost, low-power solutions. It provides the ability to run for years on inexpensive batteries for a host of monitoring and control applications. Smart energy/smart grid, AMR (Automatic Meter Reading), lighting controls, building automation systems, tank monitoring, HVAC control, medical devices and fleet applications are just some of the many spaces where ZigBee technology is making significant advancements.

3.5 IR sensor

The IR sensor is a very simple device that works by reflecting infrared light off of an object and detecting the reflecting with a photo-transistor that is tuned to the same frequency of light. The LED is mounted next to the photo-transistor; however, the emitted light from the LED does not directly shine into the photo-transistor. Appropriate values for resistance are in series with both the LED to limit current and the photo-transistor in order to show a voltage drop based on distance to the object in front of the sensor. The effective range of the sensor is a few centimeters. Object detection can be enhanced by placing a reflective surface between the object and the sensor. When the object passes between the sensor and reflective surface, a large drop will be observed in the output signal.

4. CONCLUSION

The main advantage of this paper is to eliminate the disability for the handicapped people so that they can enjoy this world as a normal human being are enjoying. Those people can control or operate all the computer application by the gesture of their eye movement and the interactive application are done by their tooth click and also gaming, swapping, page scrolling, etc. are also done using their head movement by placing a MEMS

- The complete replacement of wired communication
- It finds the solution to the disabled person to operate the computer fully with the enabled mode.
- Typing of the word document is also possible via virtual keyboard which is available in windows platform.

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