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Improving Computer Accessibility for Specially Abled People through Zigbee

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Abstract

From the findings of our research studies we observed that motor impairment and visually impaired people face a lot of difficulties in accessing computer input/output devices. In our paper we design economical wireless mouse and keyboard that emulates it functions. So users will not have any physical connection while interacting with their computer system. Our model uses tilt sensors to detect the user's head movement in order to direct mouse position on the monitor. Also clicking events are generated by detecting complete eye blinking as a selection mechanism. The system has been demonstrated to perform mouse movements and clicking events successfully. These results are presented in this paper.

1. Introduction

In the evolution of computer user interfaces, the mouse and the keyboard have withstood challenges from other input devices such as joystick, light pen, track ball and many more devices. But still in most of the computer application we are using mouse and keyboard as standard devices. This is not same for the people who with severe disabilities. However as computers become more compact and powerful, e.g., PDAs, notebooks, wearable computers…etc., traditional designs for the mouse and keyboard may not be suitable for interfacing with the small computing systems. But all these devices need physical connection with computer system. We believe that by combining the advent in sensors and wireless technologies, it is possible to develop a novel computer input system that could enable multi-functional input tasks and allow the overall shrinkage in size of the graphical and text interface devices. Our experimental results could be performed using MEMS based motion detection sensors.

From our literature analysis, although there are many computer input devices available are not wearable multifunctional devices. Prince has developed finger mounted device [1] using pressure sensors, but no hardware has been realized so far. B Thomas [2] has done analysis on virtual keyboard, but it needs mouse as an alternative to give an input an individual character. Again users need physical kind of interaction with computer system. J. K. Perng has developed a model that uses sensors for input text through gestures [3]. Mascaro [4] [5] has investigated a fingernail sensor to measure the finger posture and forces, which could be used to develop a virtual mouse, but its limited in sensing the pressure between finger and table surface and hence cannot be used in mid-air for 3D emulation. Samsung [6] and Senseboard [7] have introduced a novel virtual keyboard, which allows mini computer users to type efficiently without physical connection. But both has disadvantage of sensing the speed and velocity of fingertip and latter one may not be used as a mouse or a light pen. Our proposed model could perform mouse and keyboard like functions.

2. System Description

Our model consisting of four main subsystems: 1) the MEMS multi-axes acceleration sensors, 2) wireless transmission interface board for PC, 3) wireless transmission spectacle, and 4) the interface program. The illustration in figure 1 shows the interface section how human and computer interacts with each other. We use eye blink sensor and MEMS accelerometer, both are interfaced with circuit. Wireless transmitter is used in microcontroller unit, which transmit encoded information to another end of the machine circuit.

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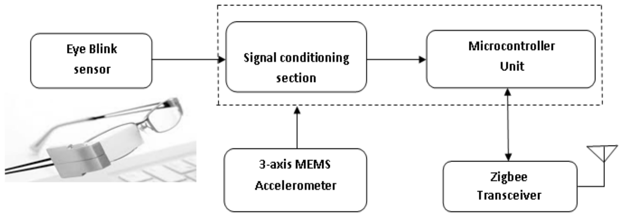


Fig.1. Human Interface section

The illustration in figure 2 shows the computer interface section that received encoded information and decodes it, send those to computer. Wireless receiver receives encoded data and sends decoded data to microcontroller unit.

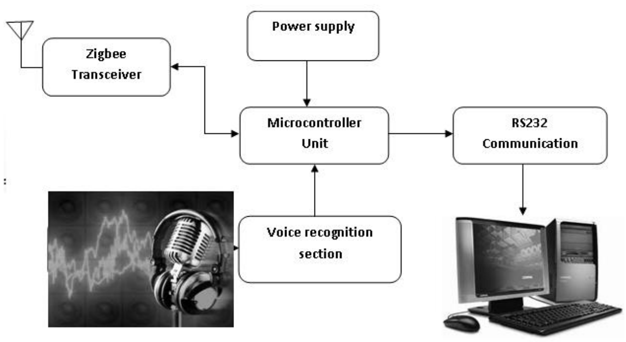


Fig.2. Computer Interface section

A. Hardware tools used

1) *PIC16F877A Microcontroller:* PIC16F877A microcontroller is used for this project. It is 8-bit Microcontroller System and uses RISC Architecture. It has Small set of Instruction set. It has 35-Instructions only. Compatibility: avail 28/40 Pin ICs

2) *Analog to Digital Converter:* ADC module is a 10-bit analog-to-digital converter.

3) *Zigbee:* ZIGBEE is a wireless technology developed as an open global standard to address the unique needs of low- cost, low-power, wireless sensor networks. This technology is used in our system to transmit and receive data collected through accelerometer and eye blink sensors.

4) *Eye blink Sensor:* The eye blink sensor is an Infrared sensor that detects the blink of the eye and is mounted on a dummy frame.

B. Software tools used

1) *MPLAB IDE:* MPLAB IDE is a free, integrated toolset for the development of embedded applications employing Microchip's PIC® and dsPIC® microcontrollers. MPLAB IDE runs as a 32-bit application on MS Windows. Both Assembly and C programming languages can be used with MPLAB IDE.

2) *PICKIT 2 Programmer:* PIC KIT 2 PROGRAMMER is software that is used to dump the hex file into the pic controller

3) *OrCAD Design:* ORCAD really consists of tools. Capture is used for design entry in schematic form. You will probably be already familiar with looking at circuits in this form from working with other tools in your university courses.

4) *KEIL C*

Keil software makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, and evaluation boards for 8051, 251, ARM and XC16x/C16x/ST10 microcontroller families.

5) *FLASH MAGIC*

Flash magic can control the entry into ISP mode of some microcontroller devices by using the COM port handshaking signals to control the device. Typically the handshaking signals are used to control such pins as Reset, PSEN and VCC. The exact pins used depend on the specific device.

3. Working Architecture and Components Design

Zigbee component: The XBee and XBee-PRO OEM RF Modules were engineered to meet IEEE 802.15.4 standards. Here Zigbee is used for transmission and receiving information. This is interfaced with circuit at both ends.

ADC component: The analog circuits of this converter, referred to as the core in this document, include the front-end analog multiplexers (MUXs), sample-and-hold (S/H) circuits, the conversion registers. It includes programmable conversion sequencer and result registers.

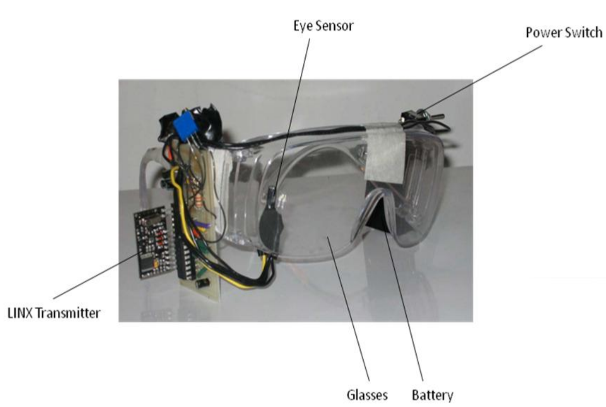
PC component: The signals received by the zigbee receiver are decoded by decoder and the information is transmitted to the microcontroller. Based on the condition received from the microcontroller the mouse pointer will move over a visual basic screen. The mouse control program in PC is mpcom written using mplab software tool.

Microcontroller component: The microcontroller is programmed to send control to the PC based on the head movement of the user. We use PIC16F877A microcontroller for interfacing the circuit.

Cursor can be moved with the help of head movements. 3-Axis Accelerometer will send the movement direction to Microcontroller. Microcontroller then passes the actual information to encoder. Information encoded then sends using Zigbee receiver will decode the received information. Microcontroller sends to PC through RS232 cable. It will perform the operation. Same operation for selecting any documents with the help of eye blink.

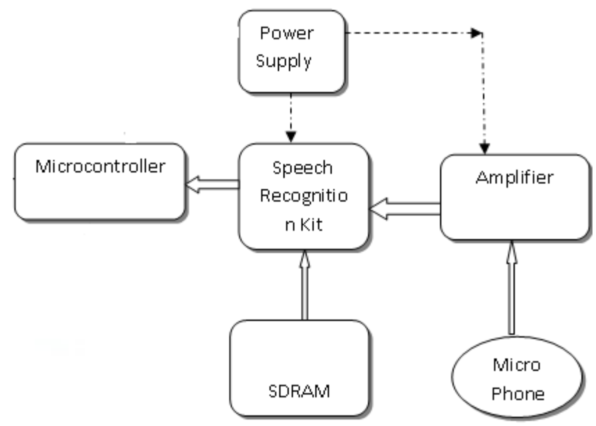
A. Spectacle Prototype

This switch is activated when the user blinks their eye. It allows individuals to operate electronic equipment like communication aids and environmental controls hands-free. Each blink of the eye is detected by an infrared sensor, which is mounted on dummy spectacle frames. The eye blink switch can be set up to operate on either eye and may be worn over normal glasses. The sensitivity of the switch can be adjusted to the users needs and involuntary blinks are ignored. The sensor is connected to a hand-held control unit with a rechargeable battery



B. Voice Recognition Kit

Voice recognition kit processes voice analysis, recognition process and system control functions. 40 isolated voice word voice recognition systems can be composed of external micro-phone, Keyboard, 64K SRAM and some other components. Here we are using HM2007 IC for voice recognition.



4. Experimental Results

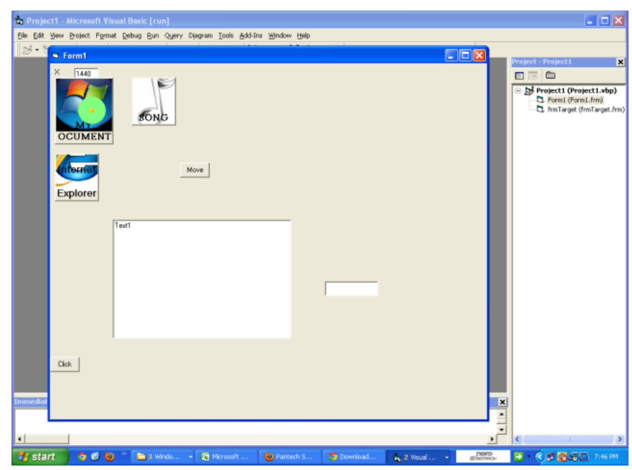


Fig.1. VB Interface with menus

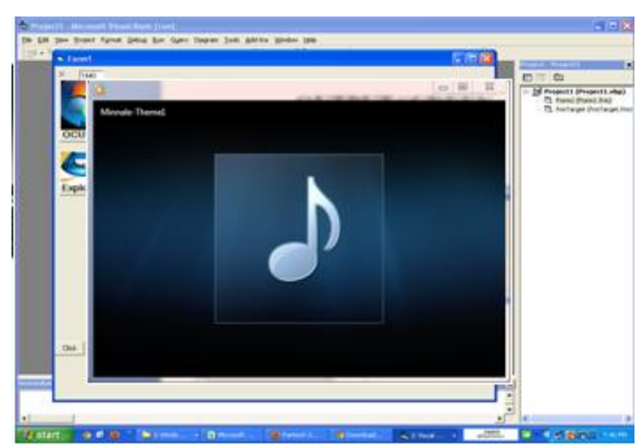


Fig.2. Through a complete eye blink user can able to open windows media player.

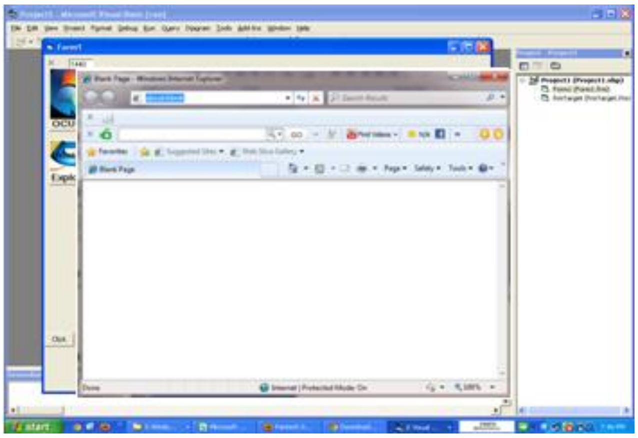


Fig.3. Through a complete eye blink user can able to open IE.

V. CONCLUSION

A novel multi-functional wearable micro-input-devices system has been proposed and a working prototype of this system has been demonstrated. The prototype uses MEMS-based acceleration sensor to detect motions. The prototype system was demonstrated to perform the basic functions necessary for a virtual keyboard, a virtual mouse, and a virtual light pen. In addition, a self-calibration method was described to eliminate angular offset errors that may cause ambiguities in the sensed motion. In the short future, we will demonstrate a more advanced input system to emulate commercially available functions of a virtual mouse, a virtual keyboard and a virtual light pen. We will also explore the possibility of using our prototype to control robotic grasping hands.

5. References

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