Introduction

- Currently, 12 million people within the U.S require assistance for ordinary tasks. While computer technology can help individuals with upper body movement disabilities independently handle a wide range of activities, they cannot provide computer inputs with a standard keyboard or mouse. The purpose of this project was to provide these people with a cost-effective control system for home computers.

- Electrooculography (EOG) is a technique that measures steady state corneal-retinal potential of the eye balls. EOG signals are collected by two pairs of surface electrodes placed around the eyes. Compared with other biological signals, they have larger amplitude and distinguishable patterns for different types of eye movements. Furthermore, the signals linearly change as eyes rotate away from the center.

- Taking advantages of EOG signals, this project developed a low-cost and power-efficient device, “Eye-Mouse”, which used eye movements to control joystick-like movements of the computer cursor in the four cardinal directions.

Implementation

Using 3D printer, a set of adjustable goggles were designed and fabricated to house the EOG electrodes. Afterwards, a circuit was designed to provide a differential EOG signals on the needed range by the ADC (Analog to Digital Converter) on the microcontroller unit. The circuit was prototyped on breadboard, Vector board and PCB.

Following signals were fed to the ADC on the vertical and horizontal channels.

![Vertical and Horizontal Channels](image)

Digitized signals then are processed on the microcontroller to determine the eye movements. An algorithm was setup for blinks, horizontal, and vertical eye movements to associate them with joystick-like movement of the mouser cursor on the screen.

Since Eye-mouse is detected as a generic USB mouse, it is multi-platform compatible.

System Architecture

Top Level Architecture

- User wears EOG goggles.
- A single cable from goggles connects to The EOG HCI.
- USB cable from EOG HCI connects to PC.
- Mouse cursor movement is visible on PC Monitor screen.
- Cross-platform compatibility.

Level-2 Architecture

Results

Horizontal Movement

A testing application was designed based on Fitts’s Law. Performance was compared to two other conventional mice:

- Logitech Laser
- Microsoft Opticle
- Eye-Mouse EOG

![Comparison of Rotation](image)

Vertical Movement

Movement time was compared against two other conventional mice and averages of consecutive movement between the same distance were recorded:

- Logitech Laser vs Microsoft Optical vs Eye-Mouse EOG
- Logitech Laser vs Vertical Laser vs Eye-Mouse EOG

![Comparison of Average Time for 13 Trials](image)

<table>
<thead>
<tr>
<th>Movement</th>
<th>Result</th>
<th>Comparison to Conventional Mice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td>0.264 linear correlation co-efficient</td>
<td>41.1% less performance</td>
</tr>
<tr>
<td>Vertical</td>
<td>12096 ms average movement time</td>
<td>77.5% slower movement</td>
</tr>
</tbody>
</table>

![Graph](image)