CPSC 1490 – Project Proposal

Nayon: An Accessible Human Computer Interaction System

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Group Members

- Aswin Sai Subramanian
- Ayrton Itiro Kobo Yoshii
- Bhumika Arora
- Joshua Maharaj
- Lisa Hochhausen

Abstract

People who are paralyzed can have trouble communicating. Depending on the severity of their paralysis, this can make them unable to write or type information on a computer. While we cannot provide the opportunity for these people to write by hand, we can allow communication with a computer, controlled by the eyes, as they are typically the last parts of the body to lose motion. Using a camera and software to track eye movements, we can allow someone to use a computer and type with their eyes.

Introduction

Motor neuron diseases lead to progressive full body paralysis. People lose the ability to communicate with others and interact with the environment as a result. The eyes are among the last parts to lose motion, making it an apt choice to expand such a person's ability to interact with others and their environment. Specifically, a human-computer interface through eye-tracking can fulfill this need.

Approaches to using eye-tracking as a human-computer interface use electro-oculography (EOG), or infrared oculography for gaze tracking. Mapping the user's gaze on a coordinate system, and calibrating the coordinate system to the area of a computer screen allows the user to control the cursor via eye movement. Now, developments aim to improve affordability and improve the accuracy of the interface (Poole and Ball, 2006). One such development is the EyeWriter 2.0, which inspired this project, allows users to write by tracing their desired cursor path with their gaze (The EyeWriter 2.0, 2017).

Infrared oculography uses strategically placed arrays of infrared lights are shone on the eye, with a camera recording infrared reflections from the eye. The two main infrared reflections on the eye are from the retina, through the pupil, and from the cornea, the transparent outer covering of the eye. These two reflections, in relation to each other allow the the computer interface driver to calculate and map where on the screen the eye is pointed (Poole and Ball, 2006).

Our project follows in the footsteps of EyeWriter (The EyeWriter 2.0, 2017), using infrared oculography as a human-computer interface input, with the hopes of improving accuracy and adding features. Since electro-oculography involves sensing signals smaller than one milli-volt, EOG signals need to be separated from noise, and then amplified (Cruz, 2012). Therefore, we chose to use infrared oculography, which does not pose the challenges of EOG. We will be using openFrameworks, a C++ based tool to develop an interface on Windows 10, and the PlayStation Eye driver to connect our eye-tracking system to openFrameworks.

Milestones

Week	Feb 3 - 9	Feb 10 - 16	Feb 17 - 23	Feb 24-Mar 2	Mar 3 - Mar 9	Mar 10 - 16	Mar 17 - 23	Mar 24 - 30
Design								
Collect parts								
Rig camera with IR Lens								
Creating Interface								
Coding (Camera)								
Prototype assembly								
Test & debug								
Improvements								
Final report and presentation								

Table 1. Gantt chart – Milestones

Work Division

Project and Budget Manager: Lisa
Research Managers: Bhumika and Itiro
Progress Manager (reports and timeline): Joshua

Sub teams:
Software
Arduino Coding

- Bhumika
- Itiro

User Interface Development

- Lisa

Hardware
Soldering

- Joshua

Rig System

- Aswin
- Joshua

Camera Alteration (physical)

- Aswin
- Lisa

Camera Alteration (software)

- Bhumika
- Itiro

Key Management Points:

- Weekly meetings with the entire team and sub team meetings according to need
- Internal Deadlines
- Decisions made as a team; by vote if necessary
- Preferred internal conflict resolution. Chain of command leads to Pooya when in the case of an unsolvable issue

Budget and resources

Equipment	**Approximate Price ($)**
Webcam	20.00
M12 Lens	18.00
Lens Holder	6.00
IR LEDs	25.00
Mosfet Transistor	3.00
Regulator	0.70
Power Adaptor	15.00
Arduino Male/Female Pins	2.50
Visible LEDs	0.40
Wires	4.00
Resistors	-
Potentiometer	-
Arduino	-
Breadboard	-
Round PCB Kit	10.00
Solder	-

Table 2. Resources cost

Any items we already have any don't need to purchase have "-" for the price. The estimated cost for the remaining items it is $104.60. However, the price may be lower as some items can be borrowed from the computer science department. The rest of the items will be bought at Lee's electronics or online.

Although we have not worked with some of the equipment before, we have many resources to help if we are in need. The computer science department has been very helpful in the past with any questions regarding projects, and the staff at Lee's Electronics were also very helpful with questions about the equipment.

Optional Work

There is a scenario in which we would encounter a problem that may greatly delay and affect the delivery time of the project. In a case where the software fails, a simple alternative would be to use the infrared camera as a heat-based motion sensor camera and implement it long with an app that would allow the user to control and visualize the camera. Although, in a case where the hardware fails, we would have to drastically change the project. A similar approach that involves eye tracking would be the usage of electrooculography to track the eyes movement instead of using an infrared camera and LEDs. A project using this feature has already been done, and the author shared his tutorial on how to implement it. The alternative would be to refer to his guide and implement a software that would allow the user to control its operating system with eye movements and gestures.

It is predictable that our tracking accuracy might not be as accurate as we expect. Therefore, in case the projects develop faster than we expect we could further improve the eye tracking accuracy and precision.

Conclusion

The goal of this project is to create an eye tracking human computer interface. To do this, we will use infrared oculography to track eye movements with a camera, then use software to transmit information to the computer. We aim to be able to make this with less expensive parts and have a more affordable system. We also hope to improve the smoothness in operating this system in order to fix the problems that would inconvenience the user. Future implications can hopefully make a system like this more accessible to people.

References

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Poole, A & Ball, Linden. (2006). Eye tracking in human-computer interaction and usability research: Current status and future prospects. *Encyclopedia of Human Computer Interaction*. (pp.211-219). Idea Group Reference.