Project Plan

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Contents

Problem Statement

Mobile Eye-Tracking glasses are needed to be able to determine where one is looking at any given point in time. There are currently no mobile solutions that track both eyes, which would allow for 3D eye-tracking. Also, very few mobile solutions allow real-time streaming. This would allow multiple people to watch a study as it is being conducted rather than analyzing the data afterwards. There exhibits a need to stream this over WiFi networks so that this is compatible with multiple platforms and applications.

Concept Sketch

See Appendix, Figure 1: Concept Sketch.

System Block Diagram

See Appendix, Figure 2: System Block Diagram.

System Description

In order to accomplish the goal of streaming outward facing video with eye tracking data, we will be using four analog IR (Infrared) cameras -- each facing an eye -- to determine where the user is looking by calculating the convergence of the users' two eyes. The image processing and calculations required to do the algorithm will be done on-board in the user's backpack. The data from the eye tracking algorithm can then be embedded into the video feed of the point-of-view, outward facing high definition camera and streamed wirelessly to the user and also stored locally on the on-board hard drive.

Operating Environment

The solution will mainly be used in the C6 and Mirage 3D virtual environments which will be indoors and have strong WiFi connections. Ideally, our solution will be easy to adapt to a regular pair of glasses to be used outdoors or anywhere else given that there is strong WiFi for streaming.

User Interface

The device will stream video via WiFi to the client's computer. The client can connect to the device locally to run calibration and access recorded video.

The client software will display the outward facing video feed of what the wearer is seeing with a cross-hair of where the user is looking on top of the video feed, as well as the depth and accuracy rating. The client software will have the ability to provide calibration. The client software will also provide feedback about which eyes are being effectively tracked. There will also be numerous value/slider bars to fine-tune the eye tracking algorithm to the current user. If the client software loses connection to the eye tracking head gear, the client software will continually attempt to re-

establish a connection to resume streaming. The glasses will save any footage and data on a hard drive that was not streamed.

Functional Requirements

- The glasses shall track both eyes.
- The software shall track the eyes at an error no less than 1.5 degrees.
- The outward-facing video and x,y coordinates for each sensor camera shall be cached on the on-board system for a 2 hour window.
- The outward-facing video data shall be transmitted wirelessly to client machines in real-time.
- The x,y coordinates shall be transmitted wirelessly to client machines in real-time.
- The real-time streaming shall have a delay of no more than 10 seconds.
- The client application shall display the x,y coordinates as an overlay to the outward-facing video data received.
- The client application shall be able to interface with the iMotions software.

Non-Functional Requirements

General

- There shall not be a boom extending in front of the face.
- The glasses used should be Active Shutter Glasses.
- The outward-facing video shall be displayed in color.
- The battery shall last for a time no shorter than three hours.
- The glasses should not be invasive or obstructive.

Video Quality

- The outward-facing camera shall be displayed at no lower quality than 720p (resolution of 1280×720).
- The sensor cameras shall be displaying frames at no lower rate than 30 fps.
- The sensor cameras shall capture video at resolution 640×480.
- The Field of View (FOV) shall be no less than 56 degrees horizontal by 40 degrees vertical.

Size Constraints

- The glasses shall be no wider than 10 inches
- The backpack shall not weigh an amount greater than 5 pounds (2268 grams)
- The glasses shall not weigh an amount greater than 2.3 pounds (1050 grams)

Market and Literature Survey

We have talked to various companies and people who are in the field of using eye tracking data, like iMotions and researchers at Iowa State University. They both expressed that this project will be

very useful when it is made. We have also researched many different existing commercial solutions for eyetracking, and have experimented with existing products, such as the VT2, and the Mobile Eyes XG.

The following list is a review of current eyetracking solutions available in the market:

Tobii

- A very nicely packaged, small mobile unit.
- Very expensive (~$10,000 based on 2011 pricing data)
- Real-time analysis is done on the computer, not on the device.

Mobile Eyes XG

- Fairly heavy Mobile unit.
- Expensive.
- Requires a lot of calibration for each new user/session.
- Software interface is not user-friendly.
- Real-time analysis is not over Wi-Fi, only either on the handheld device itself or to the computer through Ethernet.

VT2

- Is not a mobile unit. Sits on a desk under a desktop's monitor, or under a laptop's screen.
- Requires a lot of calibration for each new session.
- Cheaper than the above solutions, but still expensive.

The following is the product that we plan to make:

Eyeris

- Inexpensive
- Un-intrusive/lightweight mobile unit.
- Will require very little calibration.
- Transmits analysis data over Wi-Fi in real-time.

Deliverables

- Eyetracking glasses prototype
- Receptive Software Interface
- Documentation and User Manual
- Demonstration of functionality

Work Plan

Work Breakdown Structure

We will be using the Agile software development methodology rather than the Waterfall methodology, so we will be using sprints, rather than a traditional Gantt-style process.

- Will and Kris - Build the hardware/ work on firmware between hardware and software.
- Tyler and Justin- Working with eye tracking algorithm and codec decoding.
- Arjay and Scott - working with intermediate between software and hardware, like codec compression and the streaming process.

Resource Requirements

This must be a relatively inexpensive project, but an exact budget is not defined.

Project Schedule

Activity	Start Date	End Date
Get a monthly meeting set up	30-Aug-2012	31-Aug-2012
Weekly reports	30-Aug-2012	7-Dec-2012
Make a template/agenda	30-Aug-2012	31-Aug-2012
Research	30-Aug-2012	12-Sep-2012
Requirements/Constraints	3-Sep-2012	13-Sep-2012
Brainstorm	12-Sep-2012	13-Sep-2012
Initial sketches	13-Sep-2012	20-Sep-2012
Initial design	20-Sep-2012	18-Oct-2012
Prototyping	18-Oct-2012	9-Nov-2012
Testing	10-Nov-2012	30-Nov-2012
Final Presentation	1-Dec-2012	7-Dec-2012

Risks

- Dangers involving eye damage when exposed to Infrared Light.
- Dangers involving Lithium Ion batteries.

Appendix

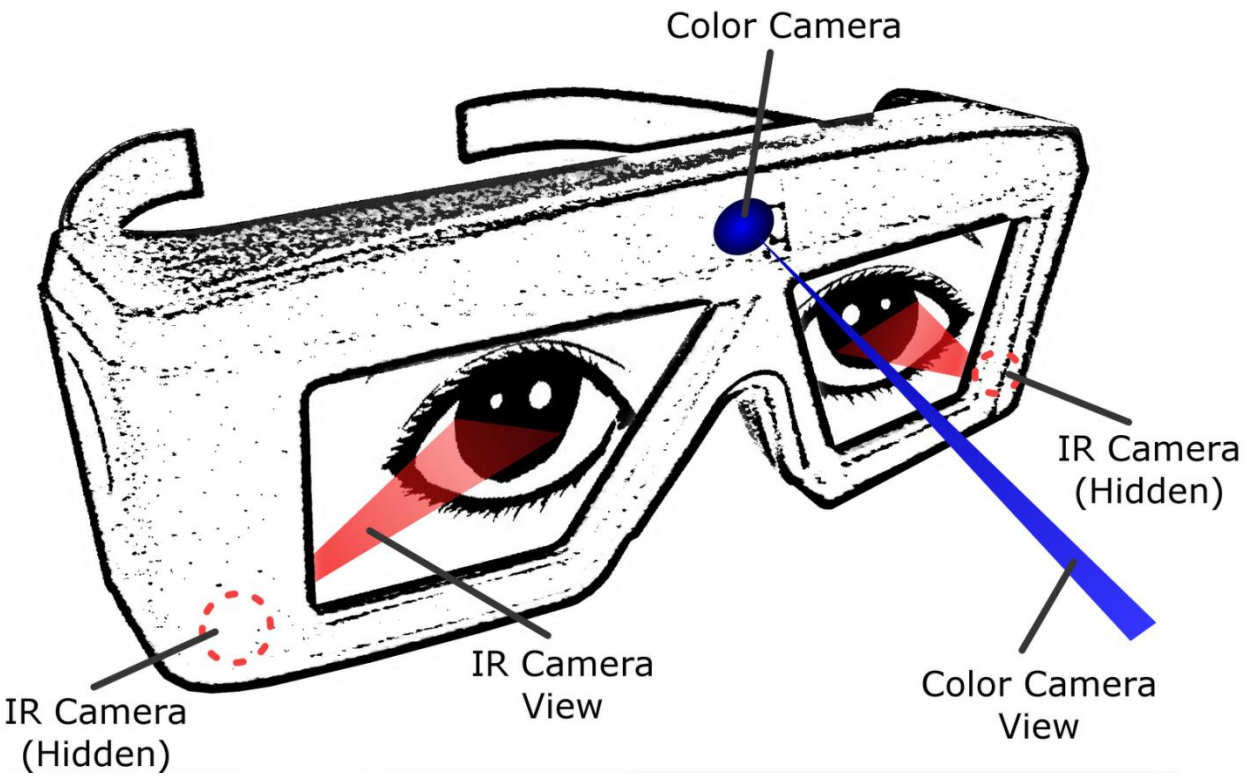

Figure 1: Concept Sketch

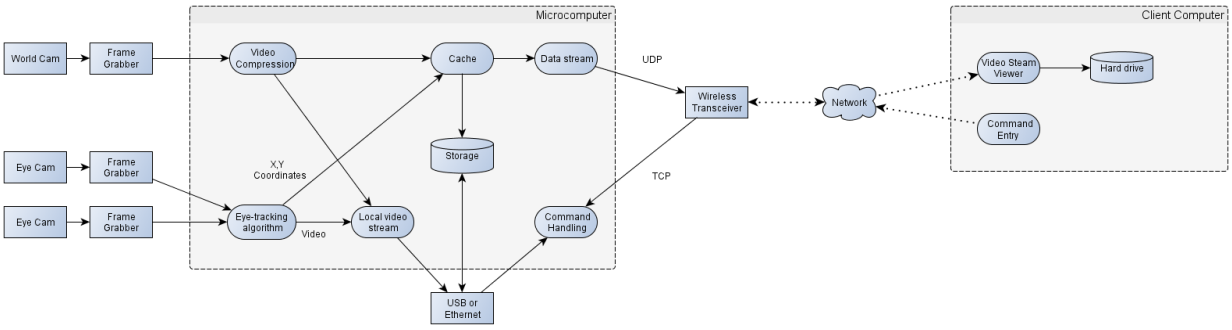

Figure 2: System Block Diagram