

EyeTalk: Webcam based Eye Tracking Communication Software for LIS Patients

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Opportunity

Abstract

EyeTalk is an eye-tracking software application to assist patients with LIS to communicate basic needs; using their eyes to build words and phrases as well as express how they're feeling. Once a word or phrase is completed it is played aloud to communicate to people within proximity.

Introduction

Locked In Syndrome or LIS

- is a neurological disorder with complete paralysis of muscle movement except the eyes
- leaves the patient conscious but without any ability to communicate.
- has 50,000 cases in the US alone.

Current solutions are expensive, usually include invasive hardware or caretaker assistance and can take a long time to receive.

Approach

Eye Tracking

- Utilizes a laptop's integrated webcam
- Locate facial and eye features
 - OpenCV and dlib
- Calculate pupil center
 - Tim-Barth Algorithm
- Calibrate with screen locations and train machine learning algorithm

User Interface

The EyeTalk interface is setup with an 8 button layout to:

- maximize the amount of options
- minimizing the error mapping gaze to a specific button

EyeTalk interface provides the following features:

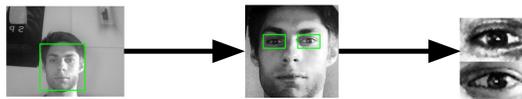
- Yes/No
- Feelings
- Movement
- Attention Bell
- Greetings
- Entertainment
- Adapted Keyboard w/ word completion

Results

Gaze Detection

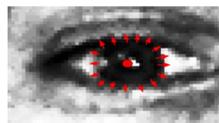
Step 1: Locate the face and eyes

- Read image from webcam and preprocess
- Identify facial features and use it to find each eye using trained facial classifiers



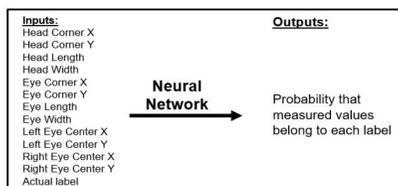
Step 2: Find the center of the pupils

- Calculate x and y location for each eye
- Timm-Barth algorithm uses eye gradients to accurately estimate center of pupil

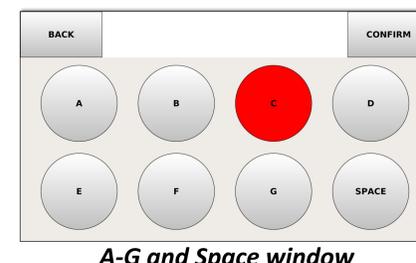
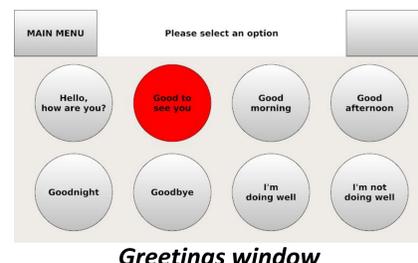
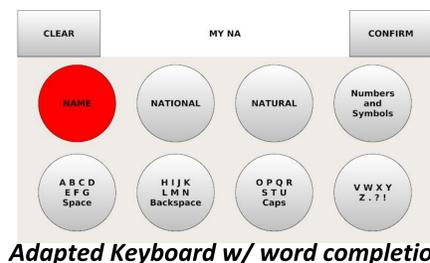
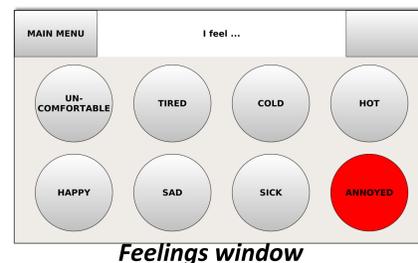
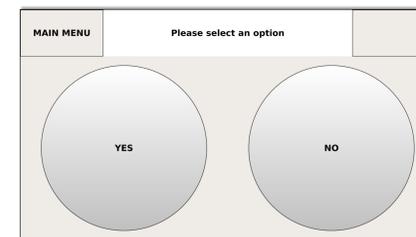
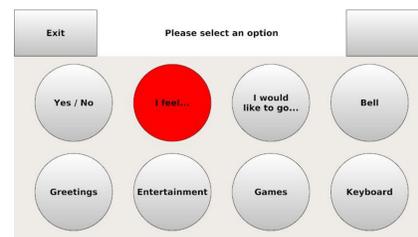


Step 3: Calculate on screen location

- Gather hundreds of data points during short calibration program
- Use known gaze targets with the data to train machine learning algorithm
- Correlate pixel locations to on screen buttons using probabilities
- ~80% accurate with training data (as of 3/15)



User Interface



Impact

Need for EyeTalk

LIS patients need the ability to communicate with the world around them.

Current solutions are expensive

- EyeGaze: \$2500+
- MindScribe: \$1500+

require proprietary hardware

- EyeGaze: IR cameras, mounted monitor
- Mind Scribe: BCI headcap

and can be very difficult to learn how to use.

Value Proposition

The unique features of EyeTalk are:

- Cross platform compatibility
 - Windows, Linux, Mac
 - Any machine with a webcam
- Affordability
 - No expensive hardware to buy
 - Downloadable software package
- Ease of use
 - Download and install software
 - Quick calibration and it's ready to use



References

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4. Jacob, R.J.K. (1995) Eye Tracking in Advanced Interface Design. Oxford University Press, Inc., NY, USA.