Eye Tracking for Reading Assistance

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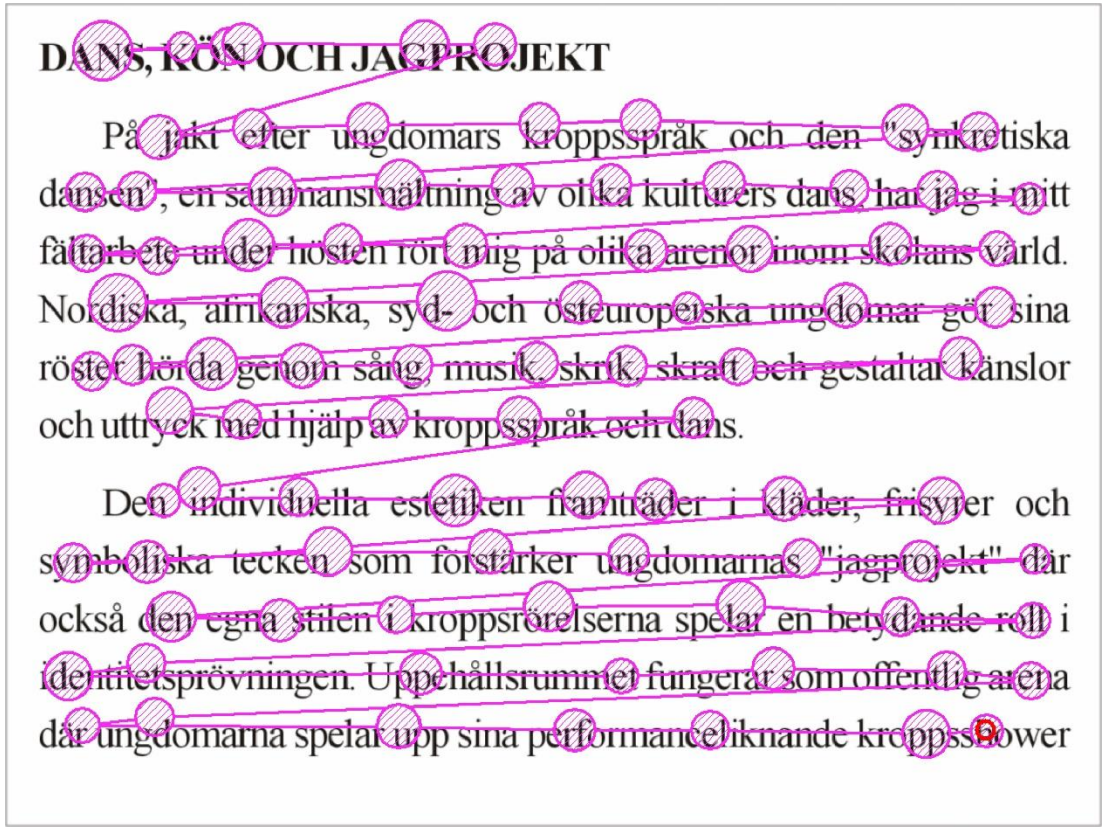
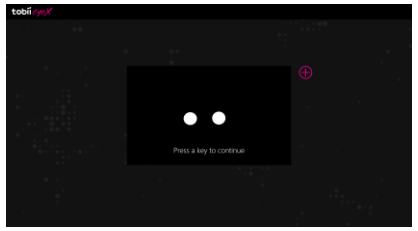
Problem Formulation

- Create a story environment to allow reading support
- Develop techniques to determine how to convert eye tracking into the precision needed for reading
- Create prediction techniques to allow for smooth transitions to between words

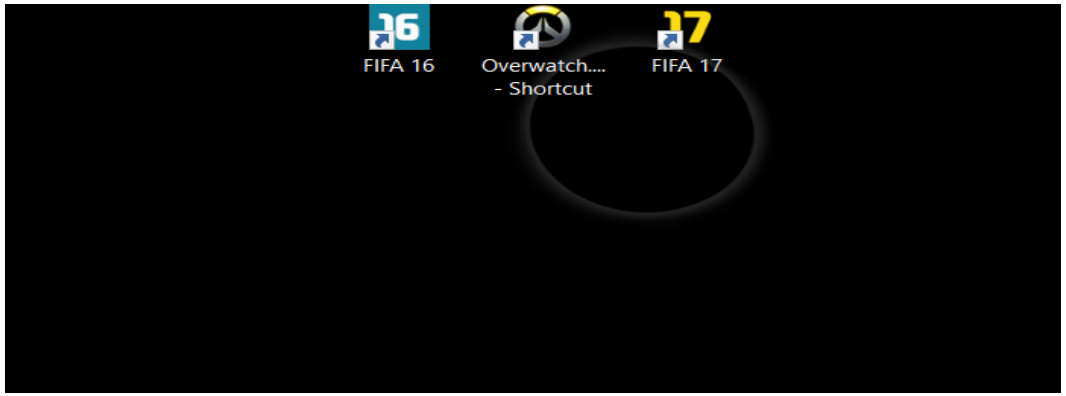


Problem Formulation



Detecting eyes during setup

Aim - Render Voice



Detection of eyes during Gaze Trace

Pros

- Accuracy – OK
- Speed
- Gaze Trace options
  - Touch at gaze
  - Scroll at gaze
  - Mouse wrap on move
  - Application switching

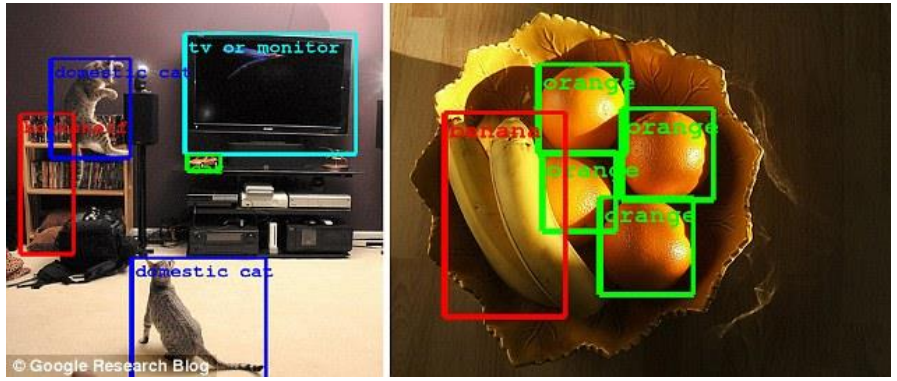
Cons

- Detail Accuracy
- Miss
- Eyes Pain
- Mounted

Tobii eye X Tracker

Technical Challenges

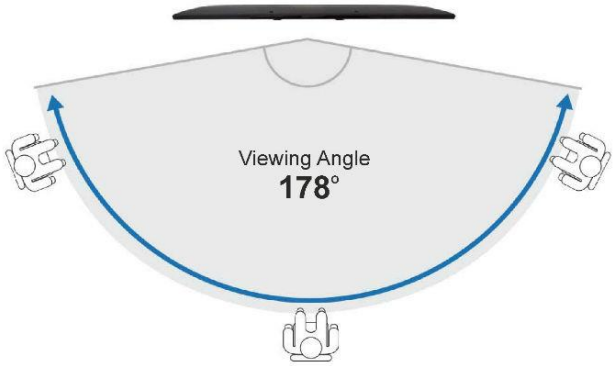
- Accuracy



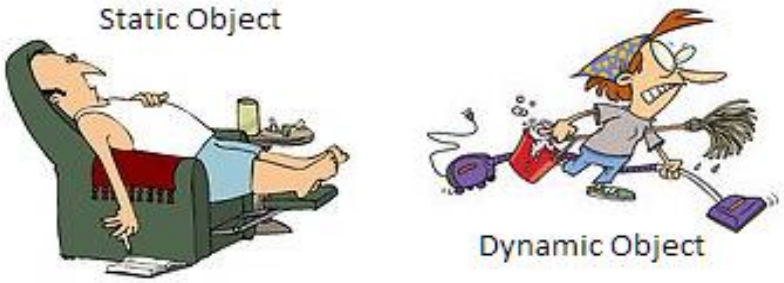
- Individual differences between eyes and conditions
  - What works for one set does not always transfer
  - Account for rapid, random eye movements

Technical Challenges

- Degree of coverage



- Constant connection between eye and sensors
  - Dealing with dynamic positioning of user



Technical Challenges

- Ease of setup / portability
  - Hidden mounting requirement

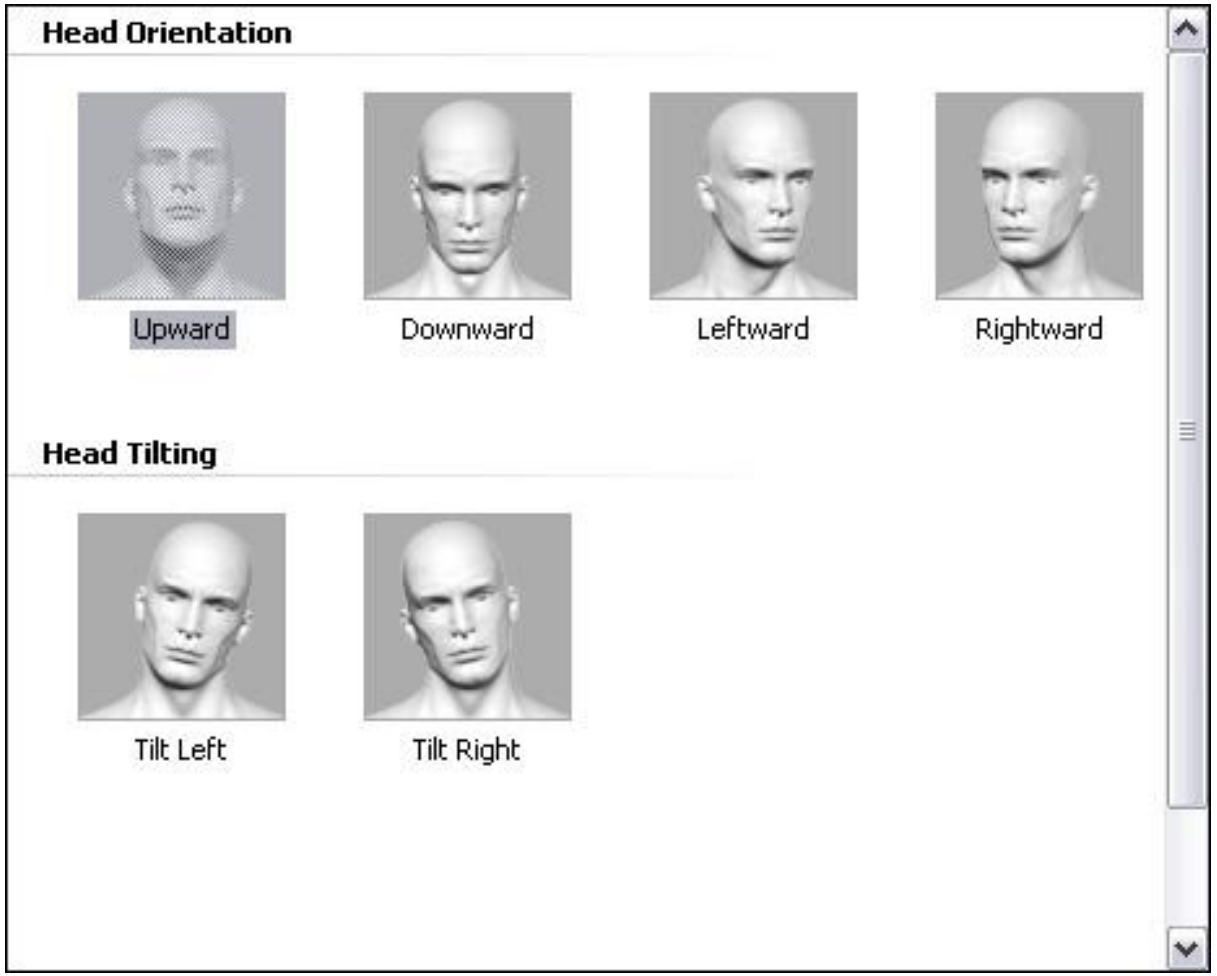
- Write our own program to obtain data from eye tracker and detect text and object

Approach

- EyeLink Headband
  - Mounted to head
  - Cameras hang below eyes
  - Overhead camera tracking head position
  - Only track dominate eye position
  - Calibration period difficult (unclear of what changes to calibration allowed for greate success)
- Currently minimal exploration of text
- Capture infrared light reflections on both cornea and retina
- Saccades and fixations
- Develop a grid based on calibration
- Change stimulus based on where eye is looking
- Create boundaries to compensate for over/undershooting targets

Experiment 1

- Configuration time and reconfiguration requirement
- Assumption: user sit still and laptop at a fixed position
- Record configuration time
- Move head to different position



Experiment 2

- Whether or not user are look at screen
- Assumption: head keep still just eye movement
- Look at 8 position outside the screen:
  - Up
  - Down
  - Left
  - Right
  - Up right corner
  - Up left corner
  - Down left corner
  - Down right corner
- Utilize results to help set up grid for tracking fixation

Experiment 3

- Test of various granularity expectations from eye movement data
- Assumption: User looks at screen during experiment
- Divide screen into 2 by 2, 3 by 3, and so on doing experiment until the accuracy is better than random guessing
- User looks at one shape and eye tracker give the one they think user is looking at

Experiment 4

- Does tracking the flow of user's actual reading
- Highly depends on the result of experiment 3
- Assumption: User reads the article during experiment and does not get distract
- Highlight words which software thinks user is reading
- Design a questionnaire to collect user's feedback

Demo

- Eye Tracker is mounted to a laptop and a person is made to sit in front of laptop.
- Person is made to see a sentence.
- Eye movements are tracked accurately.
- Render the voice of the words as the person scans the sentence.

Milestones

Tasks	October	November	December
Programming to get correct output from Eye tracking sensor			
Programming for object detection			
Writing first draft of report			
Combining two programs and writing final report			
Writing final report			

References

- Alghowinem, S., AlShehri, M., Goecke, R., & Wagner, M. (2014). Exploring eye activity as an indication of emotional states using an eye-tracking sensor. In *Intelligent systems for science and information* (pp. 261-276). Springer International Publishing.
- Evans, M. A., & Saint-Aubin, J. (2005). What children are looking at during shared storybook reading evidence from eye movement monitoring.*Psychological Science*, *16*(11), 913-920.
- Gary Feng (2011) Eye Tracking: A Brief Guide for Developmental Researchers, Journal of Cognition and Development, 12:1, 1-11, DOI: 10.1080/15248372.2011.547447
- Jacob, R. J., & Karn, K. S. (2003). Eye tracking in human-computer interaction and usability research: Ready to deliver the promises. *Mind*, *2*(3), 4.