REAL-TIME GAZE-CONTROLLED DIGITAL PAGE TURNING SYSTEM

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Data

Music Score Data

Device Set Up

Obtain RAW Video

Video resolution: 320 x 240 pixels
Video frame rate: 60 Hz

Example Raw Frame

Pipeline Overview

Message Routing through Web Sockets

Video Stream → Pupil detection algorithm → Gaze detection algorithm →msg→

"Detected gaze to the left"

"Detected gaze to the right"

→ HTML update request → Page turns
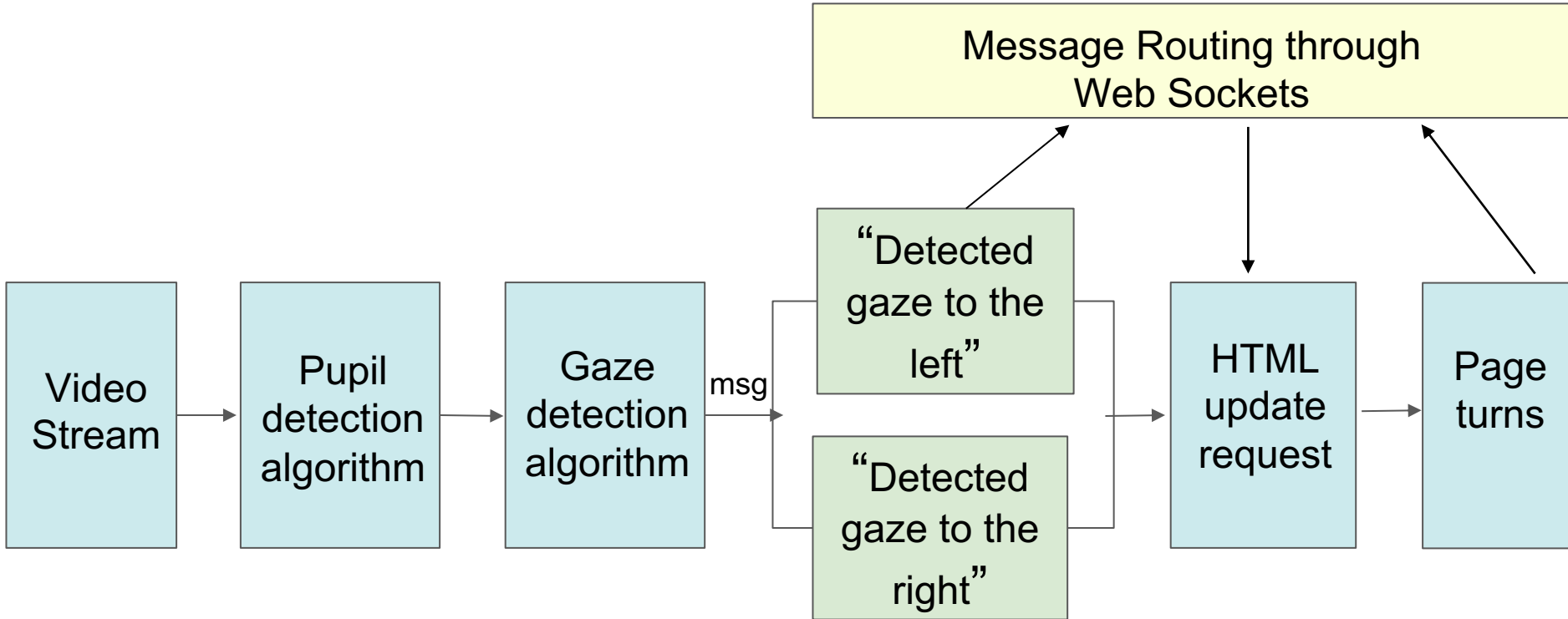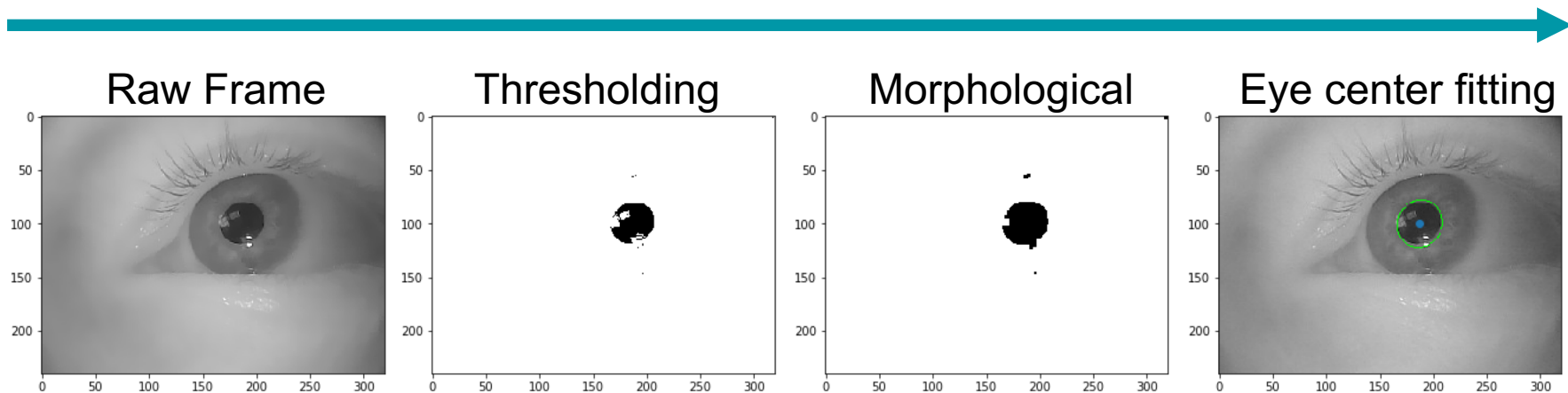
Pupil detection

- Pre-process the raw video frame with bilateral filter
- Apply thresholding to segment out the pupil region
- Morphological processing to recover the pupil shape (dilation and erosion)
- Obtain pupil center coordinates from contour central moment
- Apply elliptical fitting to the pupil

Raw Frame   Thresholding   Morphological   Eye center fitting

Gaze detection

1. Morphological Edge Detector to get the eye contour
2. Apply Harris Corner Detector the find all corners
3. Find the eye corners of both end, and obtain the geometrical center of eye
4. Calculate the shift between pupil center and geometrical center of eye to determine gaze direction

Raw Frame   Edge Detection   Corner Detection   Gaze Direction
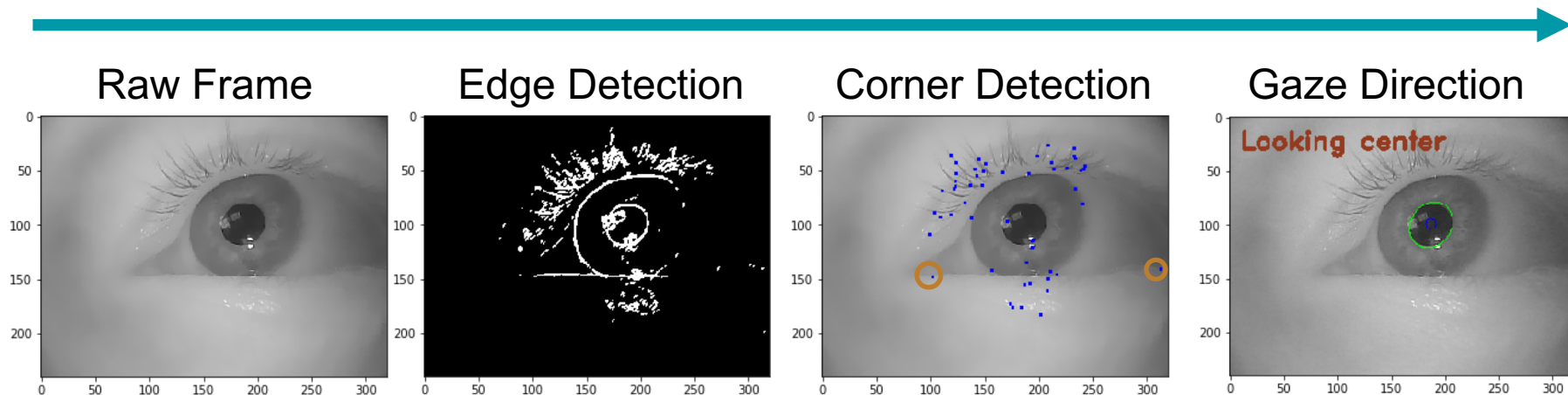
Page Turning System Design

- Web Socket Server receives live requests while the video is running

- Treat central gaze as neutral

- Trigger Page Flip when detecting corner gaze

- Flip page only when current gaze is different from last preserved gaze state (prevent duplicate triggering)

Real Scene Simulation
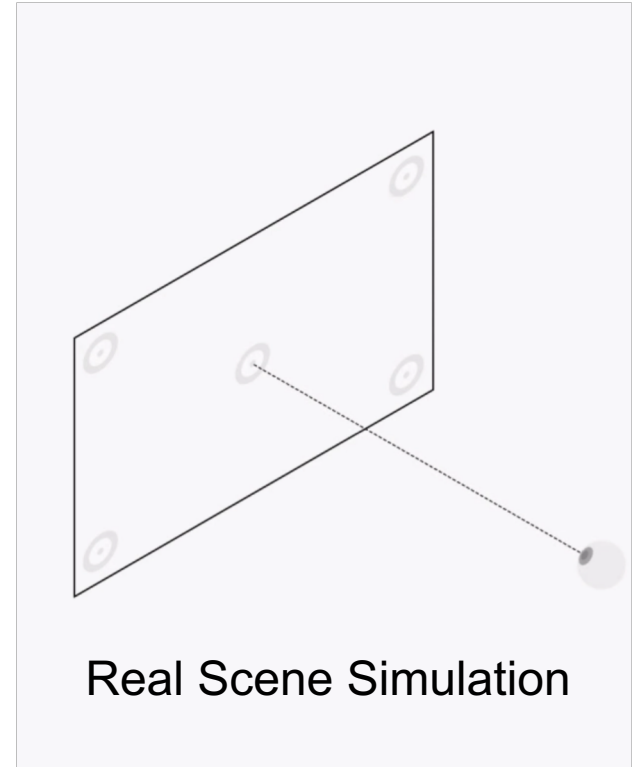
Proof of concept

Run time Per frame: 0.0176s
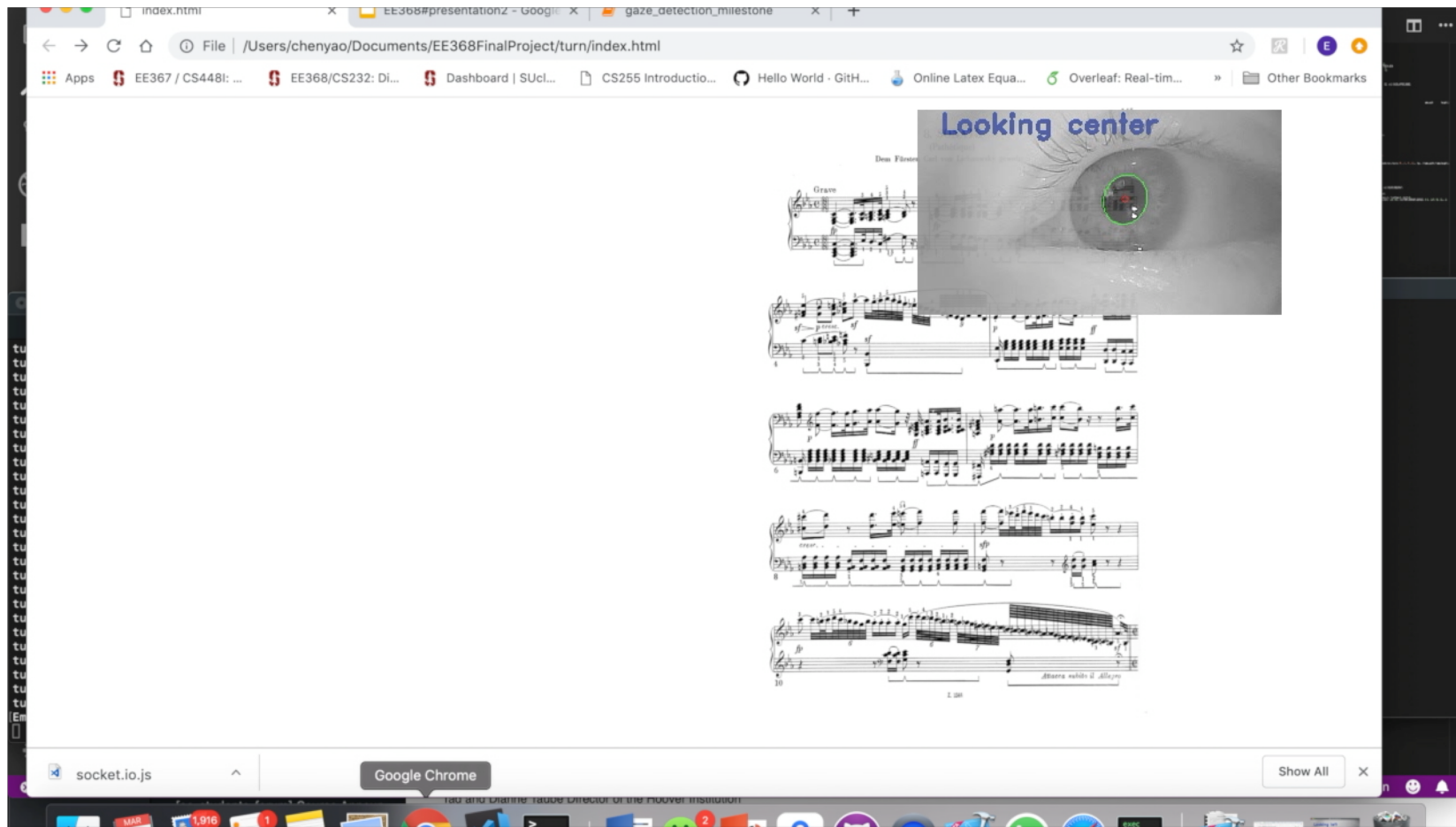
Current Problems

- Algorithm NOT ROBUST:
- Apply Dynamic threshold for pupil segmentation
- Require more precise eye corner detection

Next Step

- Support Pupil Labs real-time Video Streaming
- Real-time Scenario HCI Design
- Add blink detection method (more robust)
- Evaluation of the eye tracking system

Potential Extensions

- Support users who wear glasses
- Support Webcam to increase accessibility