Gaze Estimation with Pupil Tracking in Real-Time

Final Presentation

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Recap

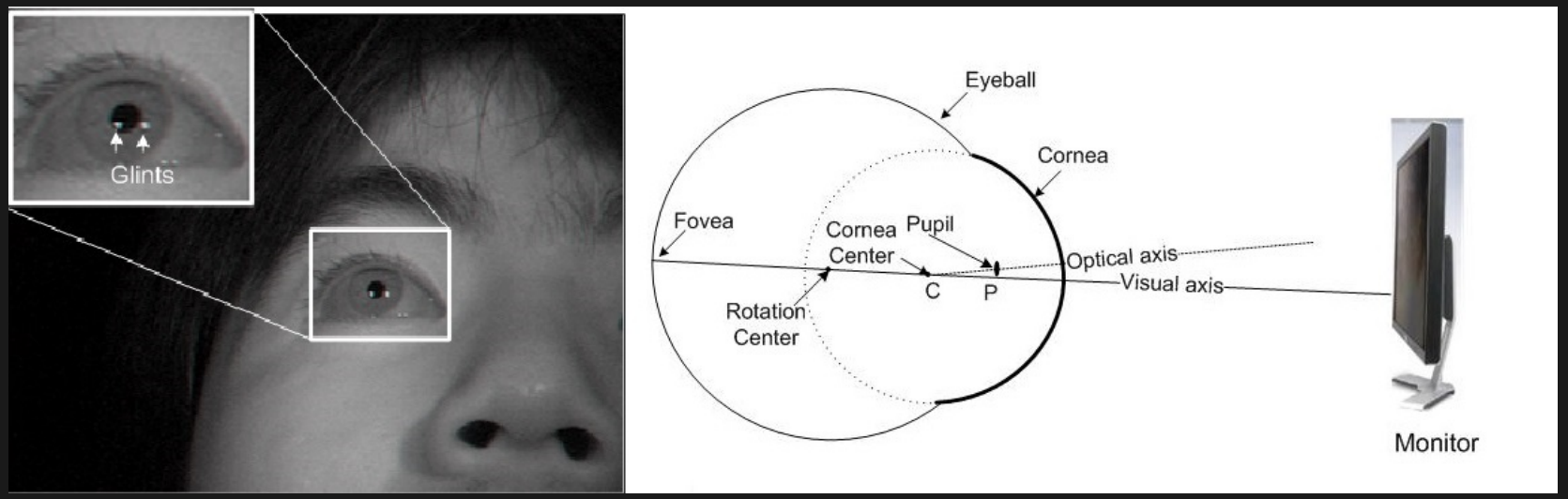

Figure: NIR light reflection and eye schematic

Source:
Real-Time Eye Gaze Tracking Under Natural Head Movements
`https://www.ecse.rpi.edu/~cvrl/zhiwei/gazetracking/gazetracking.html`
Accessed: 9/11/17

Recap hardware

Figure: Hardware in use

The steps to get there

1. Locate eye region (Haar)
2. Locate iris center (Snakuscule)
3. Locate glint (Ellipse fitting)
4. Calculate gaze from iris-glint vector and eye position (Linear regression)

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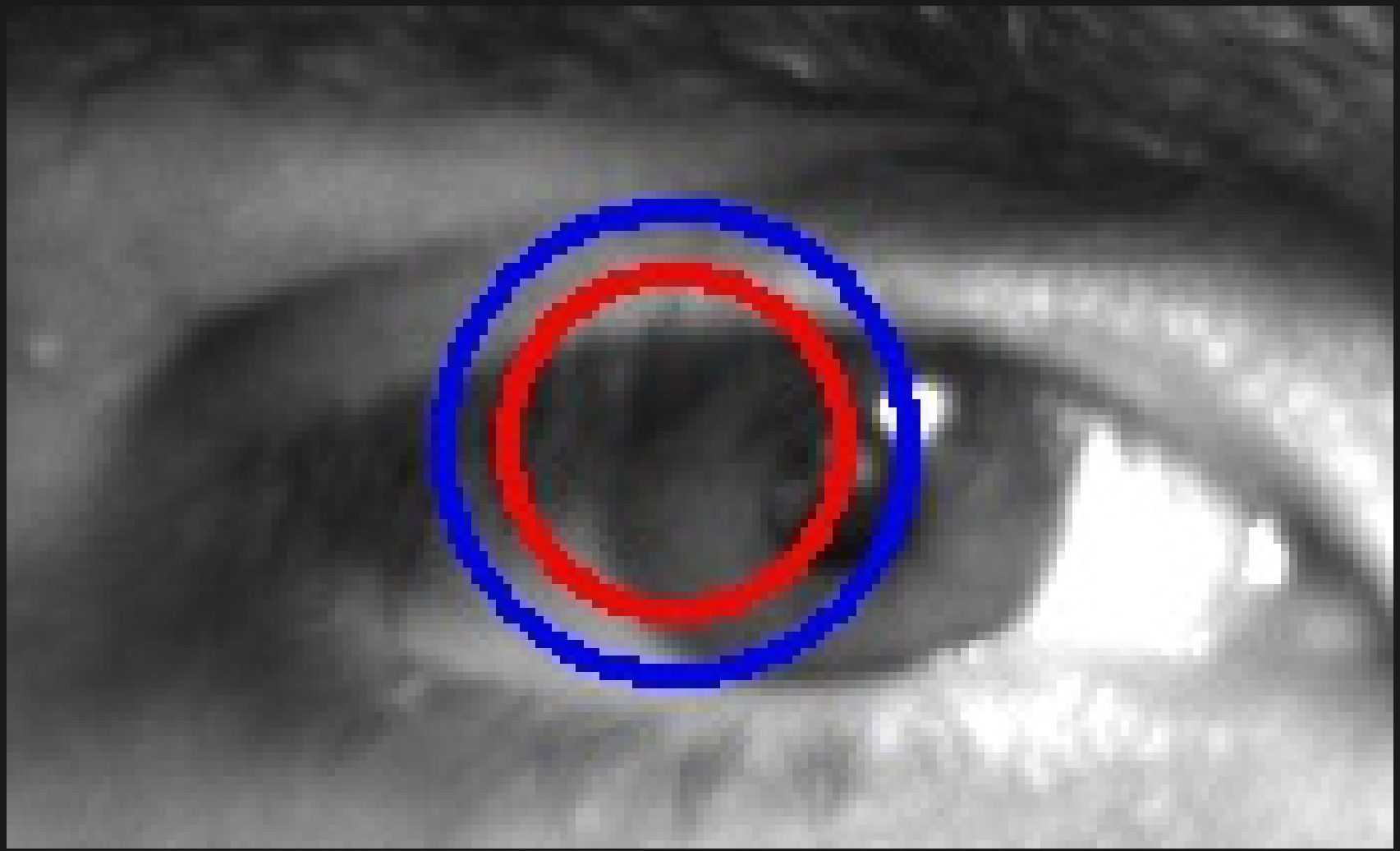
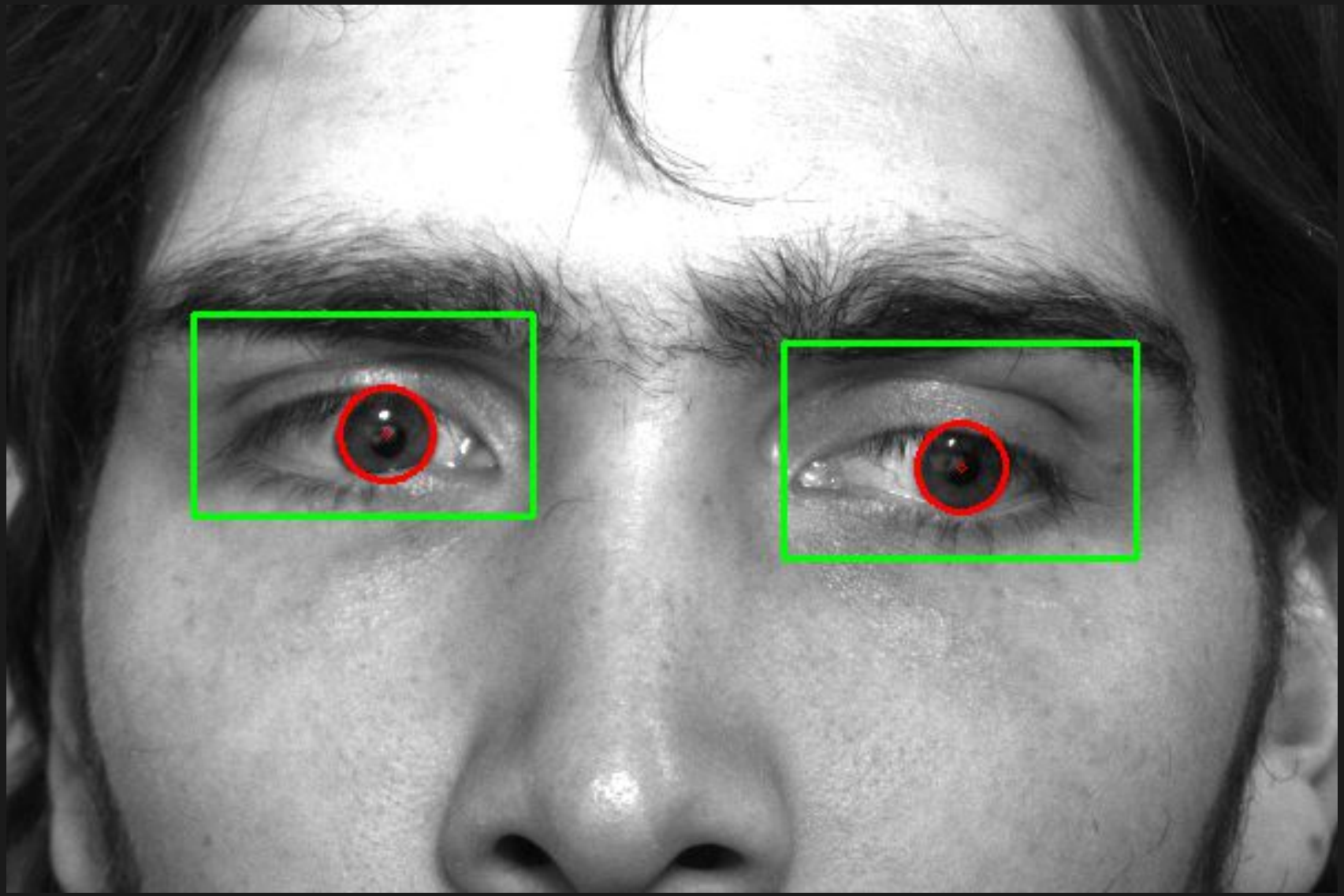
Snakuscule



Example Pass



Glint detection

1. Locate the brightest pixels in cornea region
2. Find a contour
3. Fit an ellipse
    - Get a proper light! Until then, just use a point.

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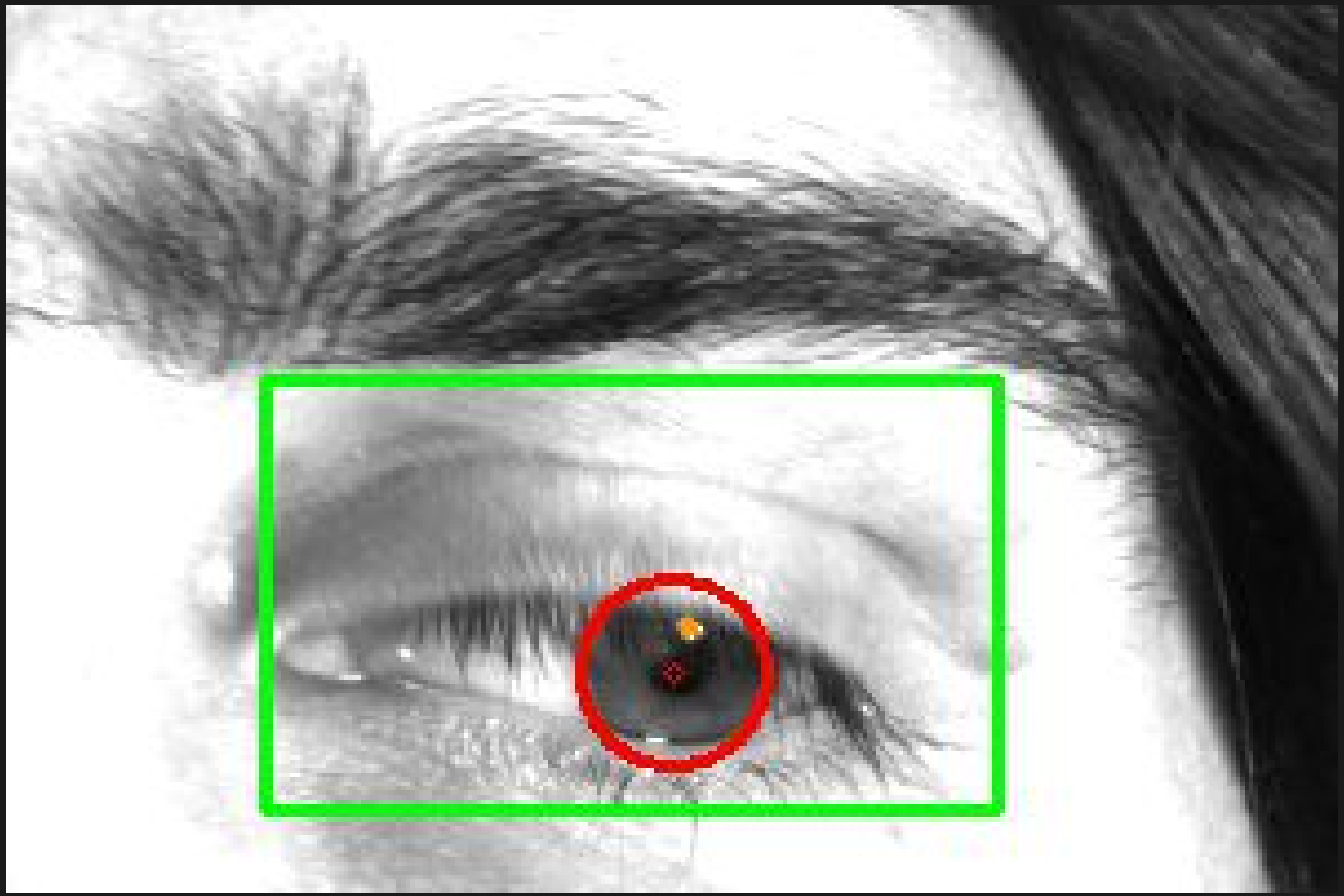
Glint fit



Last step - Linear regression

1. Create a polynomial transformation function
2. Input(variables) = eye center position, glint parameters
3. Output = screen coordinates
4. In callibration phase, let user look at many (15-30) points and calculate polynomial coefficients that minimize squared error
5. In action phase, plug the actual values into the polynomial

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Linear regression is simple, but hard to do right!

```
// TODO 2 separate polynomials for left/right?
VectorXf xPolynomial = m_parameterMatrix.jacobiSvd(ComputeThinU | ComputeThinV).solve(m_xRhs);
VectorXf yPolynomial = m_parameterMatrix.jacobiSvd(ComputeThinU | ComputeThinV).solve(m_yRhs);
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1. Needs many callibration points
2. Coefficients need to have the same order of magnitude.
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4. Better to use non-realtime methods in callibration phase

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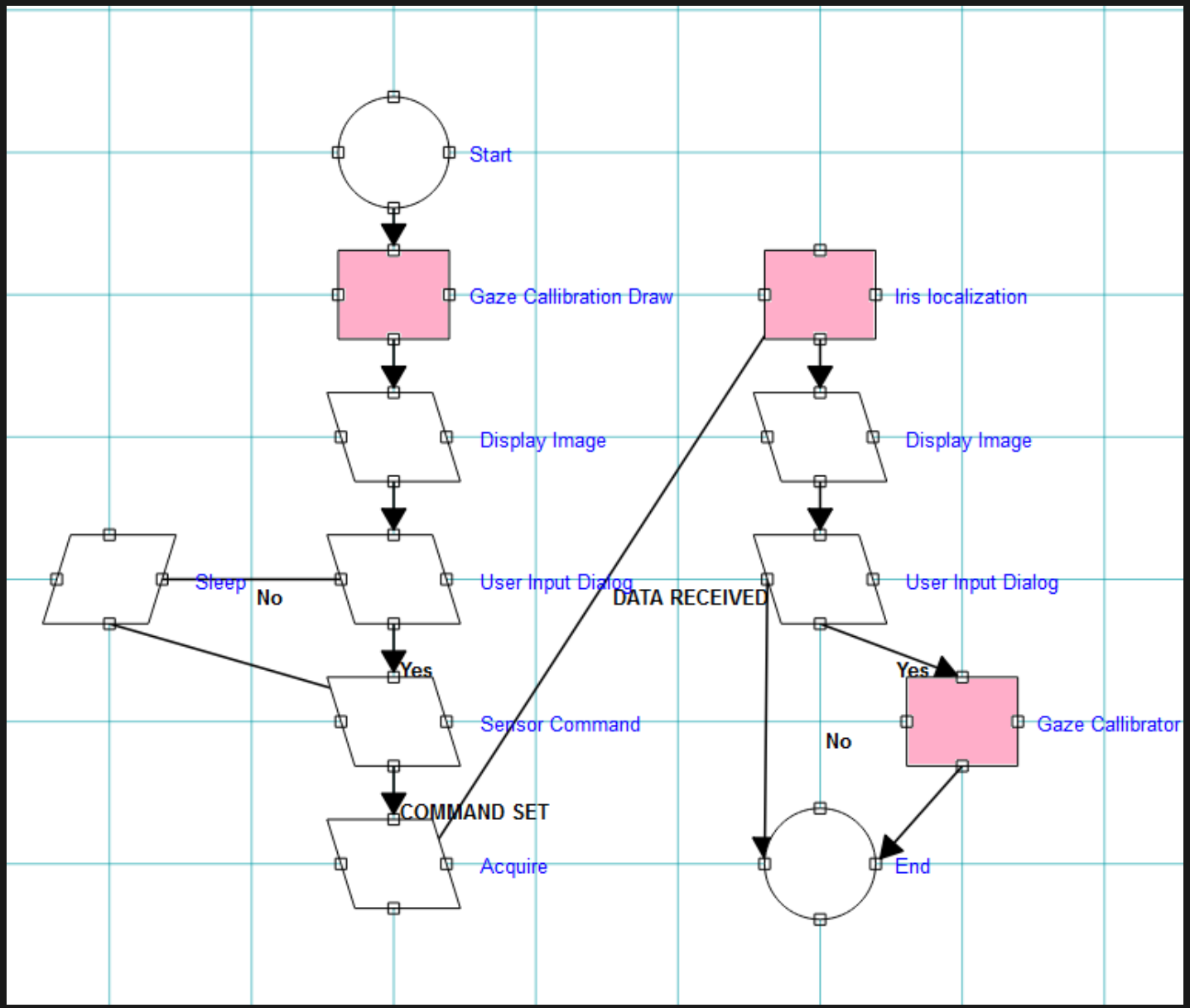
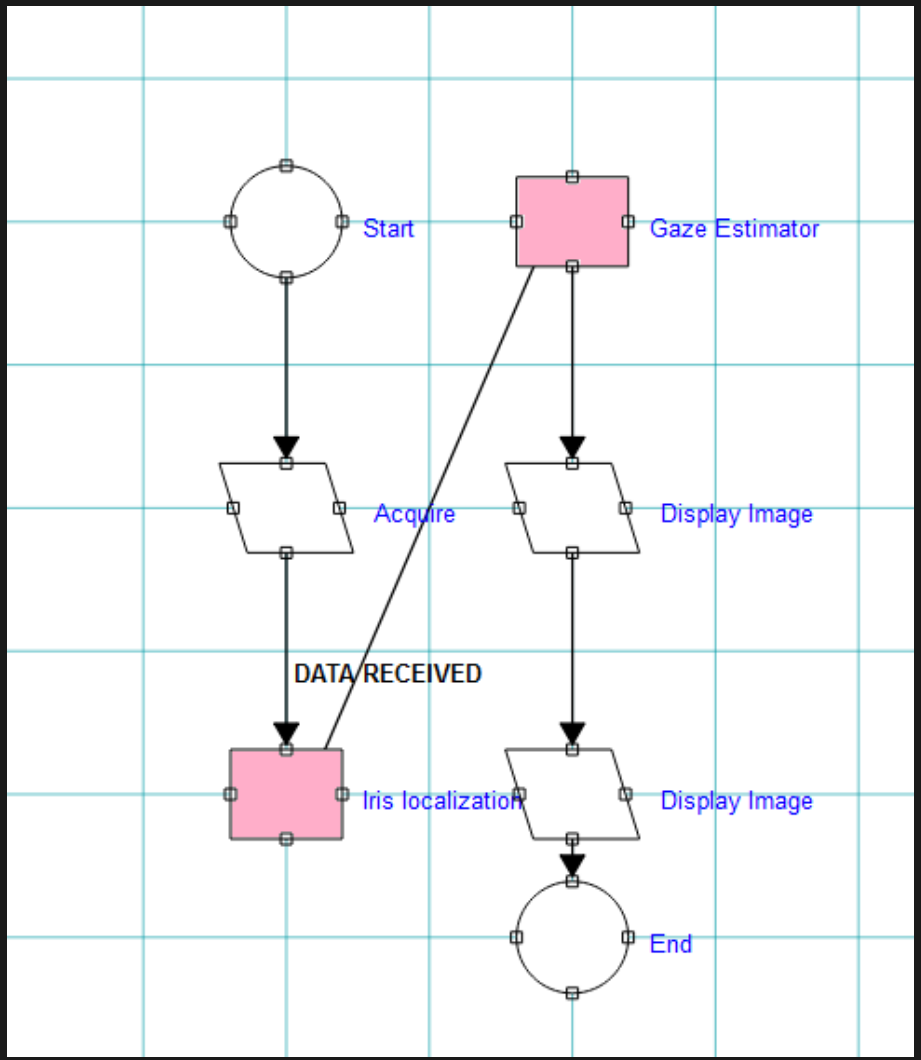
Callibration Phase



Running Phase



Status report

- Eye center localization - done!
  - Could be more stable...
- Glint fitting - done!
  - Needs bigger lights to be actual ellipse fitting.
- Callibration data acquisition - done!
  - Works fine.
- Linear regression - (kind of) done!
  - Can't get it right! :(

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- Have to use more lights.
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That's all, folks!

Questions?

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