



Project Management and System Development

Real-time Gaze Estimation

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The project

- Using a simple camera, estimate the point of gaze of a subject in real time
 - Medical application static/dynamic
- Camera Intel RealSense D435
 - RGB + stereo depth resolution
- Find eye regions
- Recognition of some points of interest in the eye region
 - Eye corner
 - Iris center
- Use linear algebra to predict gaze
 - Calibration
 - Polynomial regression or RBF Kernel for non parametric regression

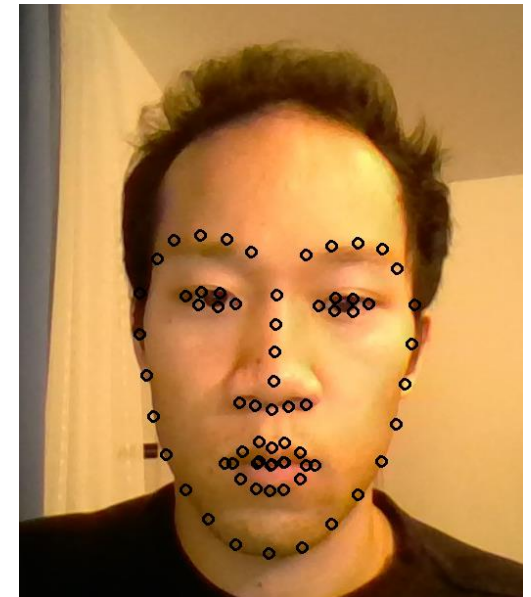
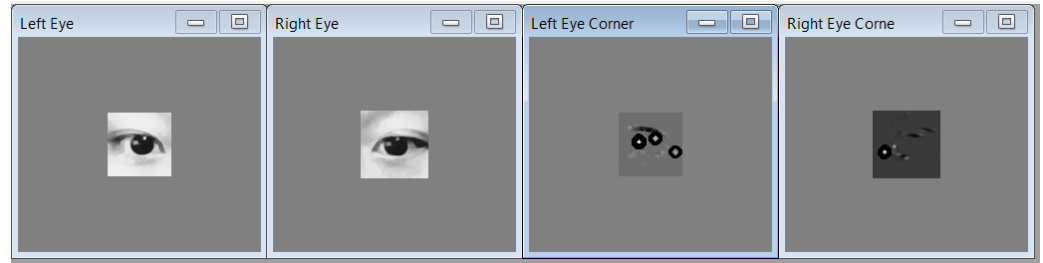


- G. Anjith & R. Aurobind (2016). *Fast and Accurate Algorithm for Eye Localization for Gaze Tracking in Low Resolution Images*, IET CV 2016



Eye corner detection

- Low quality image detection
 - Need to find adapted algorithms
- Harris corner methods
 - Works well in some cases but parameters vary too much depending on light/type of eyes
- Regression trees
 - Library implementing 68 facial landmarks detection with regression trees
 - Usage really fast: < 10ms for both eye corners



- G. Santos & H. Proenc (2011). *A Robust Eye-Corner Detection Method for Real-World Data*, IEEE Biometrics Compendium
- V. Kazemi & J. Sullivan (2014). *One Millisecond Face Alignment with an Ensemble of Regression Trees*, IEEE Conference on Computer Vision and Pattern Recognition



Estimating the gaze

- Calibration on a 3 x 3 square
- Could not make iris center detection work, need to reimplement it
 - Detection of iris by hand
- Polynomial regression to predict point of gaze

$$\text{screen}X_i = a_0x_i + a_1y_i + a_2x_iy_i + a_3x_i^2 + a_4y_i^2 + a_5$$

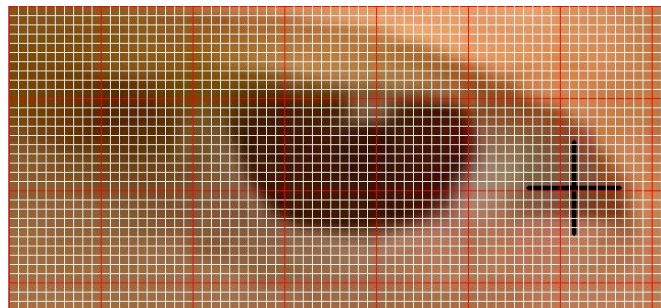
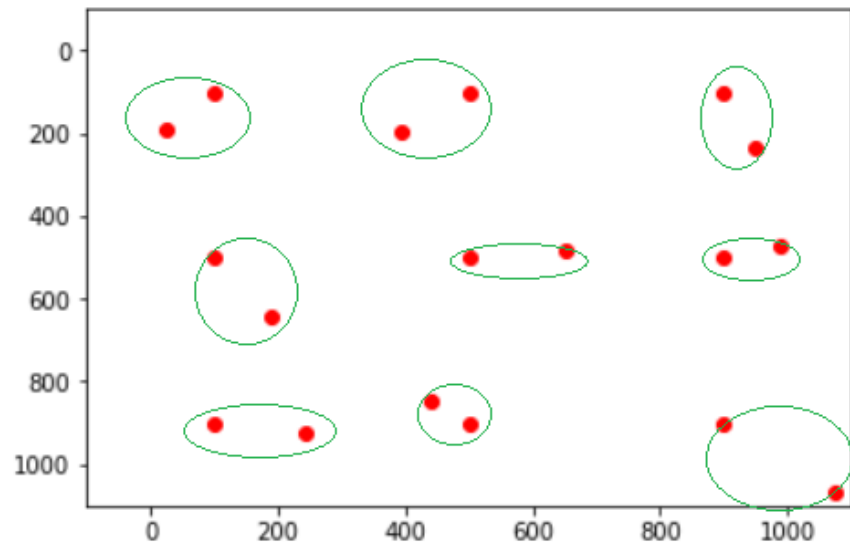
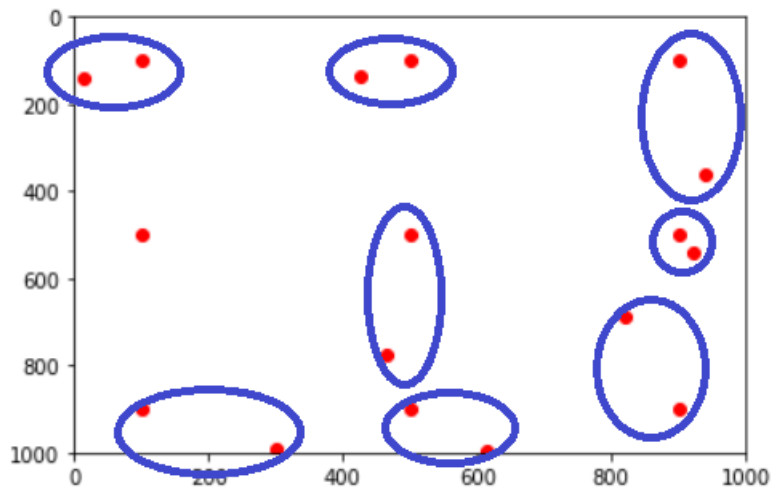
$$\text{screen}Y_i = b_0x_i + b_1y_i + b_2x_iy_i + b_3x_i^2 + b_4y_i^2 + b_5$$

- (x_i, y_i) coordinates of EC – IC
- screenX and screenY coordinates of the point of gaze



Improving precision

- More precision in the grid used to determine iris center coordinates
- On the left, without precision grid, on the right with





Real-time gaze estimation — Matthieu Zhang

Questions ?

