

Eye Detection and Tracking: A Platform For Novel Computer Interfaces

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Our long-term goal for this project is to develop a robust eye-detection and tracking platform that would allow unique interfaces for a computer equipped with a webcam.

For our EE368 end of quarter project, however, we plan to develop a MATLAB application that can perform the following tasks on a fixed high-resolution image with controlled lighting conditions:

1. Accurately recognize locations of important facial features, namely pupils/irises, nose, lips.
2. Estimate gaze angle based on the relative positions and shapes of the above facial features. Our aim is to detect gaze with sufficient accuracy to be able to control a computer interface.
3. Recognize whether each eye is open.

Once the core functionality above is accomplished, we would attempt to make improvements that will allow for a more robust and performant platform, including:

- Low resolution images
- Uneven or low lighting
- Motion and Gaussian blur
- Obstructions, such as glasses
- Extracting information about user intent from gestures and blinking
- Operation on low-power computing platforms (which could enable this to run quickly on a mobile device's interface)

Prior work (much of which is described in the below references) includes techniques such as:

- Determining eye position relative to other facial features, thus estimating gaze. This could be a promising technique for us. [1]
- Inspect the shape of the iris to estimate gaze angle based on the assumption that the iris underwent a rotational transform. This technique requires high resolution images that a webcam might not be able to provide. [2]
- Use of the Hough transform to detect circular irises. [3]
- Use of a neural network to localize eyes, followed by a mean-shift algorithm to detect gaze changes. [4]

Android Device?

No; we think the applications for our software are better-suited to large displays with webcam-style cameras.

References

- [1] A. C. Varchmin, R. Rae, and H. Ritter: "Image Based Recognition of Gaze Direction Using Adaptive Methods." In *AG Neuroinformatik*, 1997. [[Link](#)]
- [2] J. G. Wang, E. Sung, R. Venkateswarlu: "Eye Gaze Estimation from a Single Image of One Eye." In *IEEE Computer Vision*, 2003. [[Link](#)]
- [3] Y. Ito, W. Ohyama, T. Wakabayashi, and F. Kimura: "Detection of Eyes by Circular Hough Transform and Histogram of Gradient." In *21st International Conference on Pattern Recognition*. Tsukuba, Japan, 2012. [[Link](#)]
- [4] E. Y. im and S. K. Kang: "Eye Tracking Using Neural Network and Mean-Shift." Springer-Verlag, Berlin, Heidelberg, 2006. [[Link](#)]