Eye-Tracking as an Augmented Input

Using Eye Gaze in *Addition* to Keyboard and Mouse

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Motivation:

What if your computer (or any form of computing device including automobiles) knew what you were looking at and thereby know what your attention is on or what your intent is? Could it help to make your computing device smarter or more intelligent? What if eye-gaze information could be used as a first class input in order to augment the input from keyboard and mouse?

What if it is possible to build an eye-tracker so inexpensively that it can be deployed in a mass-market environment? Embedded into every laptop, desktop, cell-phone and automobile? How would you use the eye-gaze information to design better user interfaces and customize the user experience? What alternative forms of interaction could be devised based on access to eye-gaze information on devices?

Research Hypothesis:

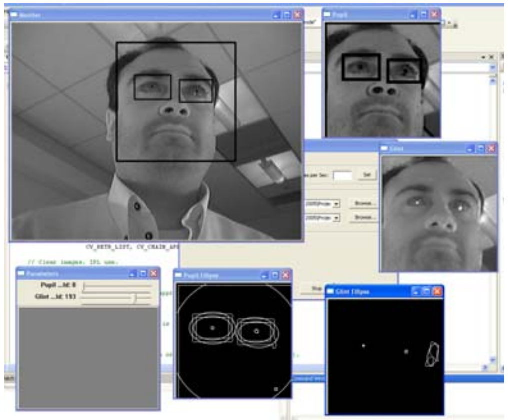
Using gaze information in *passive* control tasks to enhance the user experience can not only prove to be useful but also a welcome addition in making our computing devices appear to be smarter and more intelligent.

Research Goals:

- Validate the technical feasibility of building a low-cost mass market eye-gaze tracking device
- Develop a taxonomy of application/use scenarios in which the user's gaze information serves as an accurate proxy for his/her attention/intention
- Develop applications/interface enhancements which use the gaze information to enhance the user's experience of interacting with the computer
- Validate whether gaze-information can be used as a first class input for computer systems

Low-Cost Prototyping:

Prototype in development uses commercial-over-the-shelf cameras modified to work in the infrared spectrum and low-cost parts such as IR LEDs.



GazeTracker software built on open source Computer Vision libraries (OpenCV) uses machine learning to identify faces in the image and then looks within the face region to identify eyes. Simple image processing (erosion/dilation) help to separate the pupil and the glint images. Ellipse-fitting provides the center of the pupil and the glint. The relative position and distance of the glint will then be used to determine the gaze vector.

Applications:

- Enhanced pointing and selection
- Task/Application switching
- Automatic adaptive scrolling
- Attention-based notification
- Gaze-contingent semantic zooming
- GazeMarks (bookmarks for what you've looked at)

A commercial eye-tracker using a seamlessly integrated, non-encumbering design and providing high accuracy gaze-tracking will be used for prototyping a range of gaze-contingent applications and user interface enhancements.

Research Plan:

- Prototype low-cost gaze-tracker (in process)
- Prototype applications/interface enhancements
- Usability testing of application/interfaces
- Analyze and publish results