Abstract PhD thesis

“Committing Eye Tracking”

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This dissertation is about applying off-the-shelf hardware for non-intrusive eye tracking. The emphasis is on the application of eye typing for disabled people. The thesis embodies three main topics. One topic is about using reduced keyboards for eye typing. The second is exploring priors for robust eye tracking using off-the-shelf hardware and the third is about gaze determination.

The main body of work is focused on exploring various priors for eye tracking. Several eye trackers are presented, ranging from a full model of both shape and intensity, through contour models to the least committed optic flow tracker. The color of the eye region is generally distinguishable from its surroundings. Surprisingly, the use of color has not received much attention in eye tracking research. It is shown that colors can be used for robust eye tracking using off-the-shelf hardware. Two color-based trackers are proposed. Finally, a general contour tracker with application to iris tracking is presented. The contour model avoids explicit feature detection and thus eliminates the need for thresholds.

The use of off-the-shelf hardware introduces several problems not encountered by the current standards of eye trackers. One is low accuracy in gaze determination. For the task of enabling disabled people to type using their eyes, language modelling are shown to be effective for reducing the number of buttons needed for text entry. This facilitates fast text entry, even with a low accuracy of gaze determination. As the requirements for high accuracy of gaze determination are relaxed, the foundation for the use of off-the-shelf hardware for eye typing is laid.

The final topic is focused on gaze determination. A lower bound on the number of conjugate points needed for calibration is presented and a new method for gaze determination is proposed. Contrary to many gaze determination methods this one also provides estimates on the errors in gaze determination. Error bounds can be used as a means for estimating the state of the eye tracker.