iComponent - Gaze-data visualization and analysis tool: researcher-friendly approach [1]

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The growing interest in using eye-movements in human-computer interaction has also increased the need for tools to investigate and analyse the behaviour of human eyes. First such tools were developed roughly about the same time as the first eye trackers became available. However, these tools were bound with the structure of data produced by a specific eye tracker, and thus each tool supported only the eye tracker for which it was developed. This fact hampered the progress of moving toward using newer devices and required a lot of effort to transfer the functionality of the tools developed to new platforms.

Nowadays, there are many commercial and academic products available for researchers in this field and the quality and the accuracy of eye-tracking devices are constantly increasing. Several researchers have made attempts to develop tools to support data analysis gathered by different eye trackers, thus supporting different data protocols and formats by the same software. On the other hand, several manufactures of eye-tracking devices released eye trackers with data transfer and collection protocols that are recognized by a couple of most intelligent and advanced gaze-data analysis tools. However, there is still lack of effective tools to allow the gaze-data recordings and the real-time use of eye movements from multiple eye trackers. Although many methods have been developed for analysing and visualizing gaze-paths there are no general tools for the purpose. Such a tool would enable using multiple eye trackers and would allow the further analysis and visualization of gaze-paths with various methods already known.

iComponent software was developed in the TAUCHI Gaze Lab in the University of Tampere to fill this gap. iComponent has highly flexible architecture, which allows easy development of interchangeable plug-in modules to support various eye-tracking devices and experimental software. A unique data format and data transferring interfaces were developed based on careful analysis of existing hardware. At the moment, this tool supports all four (ASL, EyeLink, iViewX and Tobii) eye trackers in the Gaze Lab. It contains 11 experimental plug-in libraries; four of them are applicable for every-day use to demonstrate the capabilities of using eye trackers in human-computer interaction.

iComponent has 4 types of 2D visualizations of gaze data and one type of 1D visualization. The 2D visualizations are superimposed over the stimulus seen by the user during a session. Three of the visualizations are capable of showing several subjects' gaze paths simultaneously. All visualizations are highly adjustable by the users. The visualization called *Classic* shows the gaze-path with a classical style: fixations are shown as circles and saccades as lines connecting these circles. The *Heat-map* visualization shows the stimulus dimmed, but the areas observed by subjects appear gradually transparent and coloured according to endured observation time The visualization *Clustering* shows close fixations clustered into single units. The visualization is particularly effective while comparing gaze-paths of several subjects, since it shows the contribution of each subject. The visualization *Replay* replays the gaze path recorded during a session. iComponent introduces the term *selection* to define a collection of fixations which satisfies one or several conditions. Typically, a condition of a selection looks like "a particular property of a fixation is greater than X and less that Y". The fixation's property (condition criteria) can be an id number, a time of occurrence, a duration, an area inside which the fixation occurred, or an incoming angle of the last saccade. The user is then able to request for different statistics of the fixations selected.

The usability of the tool was evaluated. It confirmed the effectiveness of the tool, but also pointed out several issues and shortcomings. Some of those have already been corrected and the author plans to continue the project to make the tool more sophisticated and usable.

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[1] *The abstract is based on the work from which the author is just finishing his dissertation for Ph.D.*