Using Eye Tracking Glasses to Analyze Mobile Device Interactions

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Eye tracking is a well-established method to analyze how people interact with devices. To capture eye movements most systems take a video-based approach using head mounted or remote cameras (Duchowski 2009).

Interactions with screen based devices (PCs, laptops) are usually evaluated using remote eye trackers that are attached to a static screen. In addition some require the head to be stable and use a chin rest to ensure this is the case. Consequently users look at the screen from a relatively stable distance and angle and the eye tracking software on the device can map user gazes to the content on the screen.

A second possibility to capture fixations is to use eye tracking glasses. It is a less intrusive way of recording real-world visual behavior. Increased mobility enables users to interact more naturally with the surrounding environment. This corresponds more to the natural way of using mobile devices like tablets and smartphones. Eye tracking glasses are therefore a useful technology to evaluate their use (Bulling and Gellersen 2010).

We use the binocular mobile eye tracking glasses from SensoMotoric Instruments (SMI). Its software provides a number of visualizations and analyses that allow for a research setting that combines qualitative and quantitative evaluations (Cheng 2011).

Qualitative analyses can be done by using the gaze replay function or by analyzing fixations and saccades using the scan path function. This provides insights into sequence with which users are looking at screen elements, how they navigate through multiple screens and when they look away from the device to gather further information for completing a task.

Furthermore, it is possible to define areas of interest (AOIs) using layered geometrical shapes to calculate typical statistical indicators (Pool and Ball 2005) like sequence, entry time, dwell time, hit ratio, revisits, revisitors, average fixation, first fixation, fixation count, glance duration and appearance count. Since the gaze angle of a user's eye changes over time, the positions of these AOIs need be adapted accordingly. Based on these quantitative KPIs we can evaluate a number of usage aspects like the attention to certain items (dwell time), whether users understand the interface items (fixation duration) or whether items are hard to find (fixation count).

If interactions of two or more participants are to be compared, a mapping of their gazes on a common reference view is necessary. This is done by mapping fixations in videos to their corresponding position on a static picture. Based on these mappings the software can compare gazes of multiple users and calculate attention visualizations like focus maps, heat maps and bee swarms. If AOIs are defined on reference views, compound statistics can be calculated. Since gazes of multiple participants have to be mapped manually to a common reverence view and the positions of AOIs have to be adjusted, these analyses are a very time-consuming task, especially if users move their head constantly and positions of the investigated device change frequently. It is therefore more efficient to create these compound quantitative measures just for screens that have been identified as crucial in a qualitative evaluation.

Furthermore we plan to combine the results of these analyses with interaction and context data. Besides visual aspects especially when using mobile devices further usability issues emerge through touch interaction problems or the context of use. Users tend to interact with the device without examining all objects on the screen, without even looking at it or while performing other activities (e.g. walking). Currently, gaze data, interaction data and context data are analyzed separately. Thus we are developing a plugin for mobile apps (Android) that tracks user interactions (touch position, used gestures etc.) and the context of use (current location, current activity, position of the device etc.). Combining this data with eye gaze data should help us identify further usability problems.

To discuss our approach, the methodology and further possible areas of application we want to demonstrate how we track and analyze mobile device interaction data using the eye tracking glasses.

References

- Bulling, A., and Gellersen, H. 2010. “Toward Mobile Eye-Based Human-Computer Interaction,” *IEEE Pervasive Computing*, (9:4), pp. 8-12.
- Cheng S. 2011 “The research framework of eye-tracking based mobile device usability evaluation,” *Proceedings of the 1st international workshop on pervasive eye tracking & mobile eye-based interaction*, pp. 21-26.
- Duchowski, A. 2009 Eye Tracking Methodology: Theory and Practice London, UK: Springer Verlag, pp. 51-156.
- Poole, A., Ball, L.J. 2005 “Eye Tracking in Human-Computer Interaction and Usability Research: Current Status and Future” in *Encyclopedia of Human-Computer Interaction*, Ghaoui, C. (ed.), Pennsylvania: Idea Group, pp. 211-219.