CptS 543 Assignment #2

Improving User Experience of Eye Tracking-Based Interaction: Introspecting and Adapting Interfaces.

Oluwafemi Ajeigbe

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Summary: This article describes ways to enhance the user experience of eye tracking-based interactions. Although eye-tracking devices have enabled users with disabilities to communicate unobtrusive with computers, most graphical user interfaces are not designed to be controlled with eye-tracking devices, which provides gaze data with limited accuracy. By utilizing knowledge about interface semantics, the authors examined how interaction and visual overhead can be reduced for users who use eye-tracking devices. Correspondingly, the authors highlighted that gaze control requires unconventional selection techniques to distinguish between perception and inspection behavior or a selection intention of an end-user.

Due to these unsatisfying issues with eye-tracking devices, the authors developed a Web browser; GazeTheWeb, this software was designed to help users introspect Web page interfaces while adapting both the browser interfaces and the interactive elements on the Web pages for gaze input. To this end, this study came up with a set of propositions to improve eye-tracking-based interactions by reducing interaction and visual overhead. Also, the authors proposed using introspection to retrieve the interface semantics of interactions for eye-tracking. Finally, a summative lab was conducted to evaluate the experience of eye-tracking-based users, and this was done by comparing gaze-controlled interfaces using task completion, workload, design assessment, and explicit feedback. Reports of the study showed that these participants used the GazeTheWeb browser to complete pre-defined search and browse tasks much faster, with less workload and more satisfaction than the conventional emulation approach. The authors also reported that the GazeTheWeb browser effectively aided users with motor impairments in accomplishing other daily Web browsing activities.

Critical Review: This paper has three listed authors: Raphael Menges Chandan Kumar and Steffen Staab. Raphael's research interests are the Web, computer graphics, computer vision, machine learning, and eye-tracking. At the time of this publication, Raphael was the project team lead for the Institute for Web Science and Technologies at the University of Koblenz–he was the project lead for about three years. The project's main objective was to analyze eye-tracking data to capture Web sessions semantically while obtaining a complete picture of visual content, perception, and user interactions to understand users' intuition and identify the potential way to improve usability studies. Currently, Raphael works as the project lead for the Analytic Computing Group- University of Stuttgart [7]. Chandan is presently leading the research group of interaction designs and technologies at the Fraunhofer Institute for Industrial Engineering IAO, Stuttgart, Germany. He works with his team to understand user/customer behavior through quantitative and qualitative analysis. His research interests are user experience, Multimodal Interaction, Eye Tracking and Usability, Geo-analytics and Visualization, Web Information Retrieval, Personalization, and User Modeling [1]. Steffen Staab holds a Cyber Valley endowed chair for Analytic Computing at the University of Stuttgart, Germany, and a Chair for Web and Computer Science at the University of Southampton, UK. His research interests are in Artificial Intelligence, Knowledge Graphs, Semantic Web, Intelligent User Interfaces, and Web Science[2].

All the authors appear to have a well-grounded and extensive background in Human-Computer Interaction, especially in the user-centered aspect of improving accessibility and usability. The three authors have worked on eye-tracking-based interactions and usability at the University of Koblenz-Landau in Germany. These authors have published many papers together, and most of these papers were on eye-tracking. The citations in their report draw on excellent past research, which showed the authors' strengths. One of these

strengths was how they could explain, in detail, the different lodestars and theories applied throughout the study to develop a heuristic that has improved users' experiences of eye-tracking-based interactions.

Past studies In HCI show that practical research contributes more to revealing unknown insights about human behavior and its relationship to technology. One of the biggest strengths of this study is how the study used a summative lab approach rather than a theoretical-based approach. The study also developed a Web browser that contributes to the literature on the improved usability of eye-tracking interactions. It was fascinating to read about how the study examined 20 participants in a usability test.

A weakness found in this study was the limitation of the software (GazeTheWeb) designed to improve the user's experience of eye-tracked-based interactions. The study limited its invention to the interfaces only supported on the Web interface. I imagine it would have been more beneficial if the study also explored ways to improve gaze-based user experience on other applications outside Web-based applications.

Integration with related works: In terms of studies preceding this work, this study offers several novel insights. In comparison to [4] previous publications on the subject of gaze-based interactions, this current paper, with the use of interface semantics, extends this research [4] by investigating some of the techniques that would improve gaze-based interactions for its users[4]. This study was one of the first studies that compared eye-gaze with other pointing mechanisms like the mouse, pen, or touch. This study further discussed some human factors and technical considerations when using eye movement as an input medium. In the same vein, [8] assessed eye-tracking usability as an input method per the device comfort ISO 9241-9 questionnaire, primarily used for traditional input devices like mice, pens, or joysticks. Reports of the study revealed that the eye-gaze input method had a lower performance than the conventional pointing mechanism. Placing these two studies in view, we immediately see that they provided a framework that the current study [6] used in developing their theories around gaze-based interactions, particularly the concept of trying to understand how gaze-based interactions is used with other pointing devices (mouse, pen, and touch)

This work offers excellent building blocks in terms of studies after this study. According to google scholar, this study has been cited by 11 different publications, all centered around gaze-based interactions and how usability and interactions can be improved. [5] introduced a TAGSwipe, a bi-modal method that combines the simplicity of touch with the speed of gaze for swiping through a word. The study used the TAGSwipe on the GazeTheWeb browser designed by [6]. Results from the study reported a more efficient and comfortable heuristic that was better than conventional swipe-based and dwell-based methods in terms of efficacy and user satisfaction. In the same vein, the study by [3] further explored the current research to investigate one of the issues that this present study [6] did not explore – and this is in terms of the limitations with the approaches investigated in the study. These emulation approaches developed in their study did not have access to underlying data structures and interaction possibilities for most applications or websites. To this end, the study by [3] encouraged that it will be beneficial if researchers design unique graphical user interfaces adapted for eye-gaze inputs.

Implications for HCI: For at least three decades, gaze-based interaction has been studied as a communication channel for interaction between human and computer systems. However, there is limited literature on how gaze-based technology can be used as a standard input device. Thus, a significant implication for HCI researchers introduced by this study and related work is the opportunity this creates for HCI researchers. The study by [6] presents a framework that can help HCI researchers develop a more efficient way to use eye-tracking technology as an input technology for daily use. The current study only explored the interface introspection technique on a Web-based application. HCI researchers can then further this research to see how the methods used in this present study are expanded for use on the standard devices we use nowadays (e.g., smartphones, Pcs, tablets).

One of the beneficial uses of eye-tracking in HCI is its usefulness in usability studies. It employs a technique whereby an individual's eye movements are measured so that the researcher knows both where a person is looking at any given time and the sequence in which the person's eyes are shifting from one location to another. HCI practitioners will benefit from this study as it provides a better framework to improve the users' experience in usability studies. In simple terms, the better the eye-tracking framework, the better the users' experience in usability studies or other related studies.

One main implication of this study for end-users, particularly users with motor disabilities, is that it creates an avenue in which the framework explored in the current study can be implemented in today's eye-tracking technology. Examples of these eye-tracking technology are the Tobii Dynavox windows control and visual interaction myGaze power. This study extensively investigated some of the many issues present with gaze-based users' experience – one of which is the issue associated with gaze control. It requires unconventional selection techniques to distinguish between perception and inspection behavior or a selection intention of an end-user. From an HCI perspective, we want a design that does not disrupt the user's experience or violate important aspects of user-centered design involved with the natural means of interaction. To this end, I think the current study provides an excellent prospect for eye-tracking technology designers to design better usable technologies that better place the user's experience in view. In other words, the study offers a helpful avenue that will benefit end-users in the long run.

References Cited

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