CptS 543 Assignment #2

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

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Summary. In the article “Improving User Experience of Eye Tracking-Based Interaction: Introspecting and Adapting Interfaces” (Menges, Kumar, & Staab, 2019), the authors mainly discussed a new input approach of interface and analyzed how gaze-controlled-interfaces can improve user experiences. Firstly, the authors introduced the benefits of eye tracking applications and the benefits of gaze-controlled applications. For further explanations, the authors provided several instances such as a commonly used eye gaze system is to emulate mouse and keyboard devices through an additional command-translation layer. Based on the introduction of the background knowledge about eye-tracking input methods, the authors argued that the interface introspection and adaptation strongly impact the web accessibility with gaze-based interaction. In addition, the authors provided several methods including reducing the input action and the inspection overhead to improve the users experience of gaze interaction.

The article continues by discussing a methodology in GazeTheWeb (GTW) which could improve gaze interaction experience through applying the method of interface introspection to retrieve the semantics and also adapt the interface of Web elements. In order to verify the effectiveness of improving fixation interaction experience compared with simulation methods, a task-based laboratory study with 20 participants was conducted by the authors. The study was designed to test the time taken by participants to complete search and browsing tasks through Google Chrome, which is related to GazeTheWeb and OptiKey. The authors found that it is obvious that GTW could make users complete tasks faster, and the survey showed an over-average acceptability rate of the gaze-adapted system of GTW. Moreover, in order to verify the feasibility of GTW, another study on testing the long-term use of GazeTheWeb was conducted. The results showed that GTW is feasible for patients with dyskinesia to complete their daily browsing activities. Finally, the authors concluded that their goal is to continue supporting such developments and avail GTW with updates and improvements in the future.

Critical Review. Three authors have been listed which are Raphael Menges, Chandan Kumar, and Steffen Staab. Raphael Menges is a researcher at Analytic Computing at the University of Stuttgart, and he used to be the project leader of the Institute for Web Science and Technologies at University of Koblenz. Chandan Kumar is also a researcher at Analytic Computing and used to be a researcher in Interactive Web and Human Computing at the institute for web science and technologies of University of Stuttgart. Steffen Staab was a professor on database and information system at Universität Koblenz-Landau, and now he hold a chair for Web and Computer Science at University of Southampton since 2015 and a chair for Analytic Computing at the Institute for Parallel and Distributed Systems of Universität Stuttgart since 2020.

All three authors are studying in computer science field, and all of them are experts in Analytic Computing area and the field of Web and Human-Computer interaction. Thus, the article can be considered as authoritative. However, biases might occur since all of them are the experts in computer science. It could be better if there are some experts from other fields such as anthropology, psychology, and ethology, participate in the research and write the article together, the experimental results and the article might be more authoritative and unbiased.

One weakness could be improved in the article is about the MAMEM project. During first and second phase of MAMEM trials, the number of participants is not enough at all. In the second phase of the MAMEM trials, the number of male participants is much higher than that of female participants. People with motor deficits tend to be different with normal people in other aspects, such as mental state. In conclusion, there are too many variables in this experiment such as gender, age, and mental state, so the number of participants is not enough. In this case, the data researchers gained from the project might not be convincible.

When the authors arguing how to improve the gaze interaction experience, they mentioned several design principles such as “minimal input actions” and “visibility of system status”. However, after discussing on

improving gaze interaction experience by interface introspection, the authors did not apply design principles to theoretically check whether the adapted interface will improve gaze interaction experience. My suggestion would be applying design principles such as Norman's principles and Johnson's principles to judge the goodness of improved interface.

An obvious strength of the article is providing a number of images to help explain the studies. For example, in the chapter 4, the figure 4 shows the data flow for real-time element classification and tracking and that makes the process visible and more understandable. A number of figures not only makes the article easier to be understood, but also makes the reading more interesting.

Integration with Related Work. Comparing to the previous articles, this article aimed to propose new methods which can improve user experience of eye tracking-based interaction. This eye tracking-based interaction can strongly help disabled people to perform actions when they interact with computers. One previous paper from Sirvent Blasco et al. (2012) proposed visual evoked potential-based brain-machine interface applications to assist disabled people. From my perspective, Sirvent Blasco et al. aimed to apply visual based interface to assist disabled people, and Menges et al. were aiming to improve the visual based interface to assist disabled people and users to have better experience. Another closely related previous work from Rebeca et al. (2014) proposed a P300-based brain-computer interface. The interface is not only used on the web, but also used to operate electronic devices at home for disabled people. Menges et al.'s work might help improve that interface and provide better use experience for disabled people.

A recent work which has done by Li et al. (2020) applies eye-tracking assisted interfaces to E-shopping website. Li et al. found that eye-tracking interface can short the total time of completing the tasks and increase users' focus on the tasks simultaneously. From my perspective, Li et al. extended the application of eye-tracking based interfaces based on the Menges et al.'s work. Another related and interesting work has done by Sengupta et al. (2020) is about leveraging error correction in Voice-based text entry by Talk-and-Gaze. It also explored the topic since Sengupta et al. combined vision and talking together. Experimental results in this paper show that this error correction method is faster and more efficient.

Implications for HCI. A major implication for HCI researchers is the idea of introspecting and adapting interfaces. After the article is published, researchers will clearly know that introspection method is more acceptable than simulation method in web development. Moreover, the authors mentioned that GazeTheWeb as an open-source browser provides a framework for researchers to investigate methods for improved interaction with eye gaze and other input modalities in the Web environment.

One main implication for HCI practitioners is that user experience should be considered as the most important factor when optimizing UIs. All studies should aim at improving user experience. More specifically, HCI practitioners can apply introspection and adaptation method to optimize UIs and then user experience can be improved. In addition, the authors suggested that stable calibrations, intuitive interaction paradigms and rewarding user experience would be helpful for everyday use of eye tracking. It might also give HCI practitioners a hint when they develop UIs.

One of the implications for users of the technology is that the article points out what kind of eye tracking-based interaction method in Web can enhance user experience. For this reason, users of the technology, especially disabled people, can intentionally choose to use the Web UI applying with introspection and adaptation method for better use experience. The more users choose to use this kind of UIs, the more data developers will collect. In this case, developer can optimize the interface better.

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