GazeShare - An Eclipse IDE Plugin for Remote Dyadic Gaze-mediated Communication

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Abstract
We investigate the role of gaze in communication and collaboration between humans in computerized environments. In this paper, we describe a software solution for gaze tracking and gaze point transfer between collaborating partners based on the ECF/DocShare plugin for Eclipse IDE that provides simultaneous document editing and instant messaging for collaborative environments, in order to provide shared context for remote collaborators. Further, we elaborate on the previous research and respective theoretical background, also describing the future work made possible by this software tool.

Author Keywords
Dual eye tracking; remote collaboration; eye movement visualization

ACM Classification Keywords
H.5.2 Information Interfaces and Presentation User interfaces, Evaluation/methodology

General Terms
Design; Theory; Human Factors

Introduction

In this research we are interested in enhancing the collaboration during complex problem solving, namely, we focus on various forms of programming as it takes in the global geographically distributed development environments. In pursue to achieve more efficient and satisfiable remote collaboration by enabling people to communicate better, we created Eclipse IDE plugin for gaze-mediated communication. In this paper, we describe a solution for gaze point transfer and visualization between remote collaborating partners using eye movements as additional communication medium.

Many nowadays believe that, in some way, gaze-based interaction may eventually become a standard human computer interface [5]. In extend to HCI, gaze can also be used in Human-Computer-Human interaction by mediating the location of visual attention in order to support the communicative function (signal receiver and producer). Here, the focus is on the function of gaze in mediated form, through the use of eye tracking technique to estimate where the visual attention is focused and transfer of the gaze position to interlocutor representing the target location of the gaze with a graphical overlay. In the following, we elaborate more on the previous research on aspects of overlaid and mediated gaze.

Previous Research

In order to have efficient collaboration, collaborators need to share common ground and be able to signal and infer what their partners are attending to [6][8]. In [9] expert's eye gaze was found to be an effective cue when debugging a software program. In [11] visual attention strategies where evaluated while doing a code review.

Still, few studies have been made using eye tracking to support collaborative remote activities. For example i[3] showed that there is a relationship between collaborators' gaze distance and probability of misunderstandings. In [8] the effects of gaze display on collaboration were evaluated resulting 40 percent performance gain in distance problem solving either using mouse pointing or superimposed eye marker in contrast to only verbal protocol. There was a significant performance increase when novice's eye movements were superimposed demonstrating that gaze position transfer will be useful where deixis is impossible. GazeShare enables referencing concurrently with other development activities by using your eyes to reference while at the same time leaving hands free to e.g writing program code. In the following, we describe the enabling system in detail.

The GazeShare System

We developed a gaze-display-based collaboration solution to distributed software developers by extending an existing Eclipse plugin called DocShare, originally intended for synchronous document viewing and editing between collaborators. This context was selected because it offers a general synchronization mechanism and is fairly easy to extend with eye gaze data. Compared to similar purpose software, a VNC (shared desktop software) based system described in [1], GazeShare has the benefit of minimizing the needed network bandwidth by not being based on pixel values but rather content changes in document editor/viewer, therefore having the disadvantage of

supporting only limited set of media types. Support for additional media formats can be implemented.

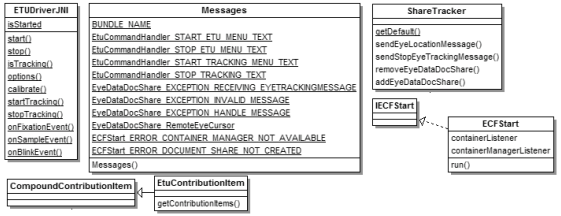

Figure 1. Class diagram of the GazeShare architecture

GazeShare is implemented with Java programming language and connects to an eye tracker using the ETU-Driver created by Oleg Spakov [7]. For accessing ETU-Driver, a JNI interface (Figure 1) is used. Parts of the plugin needed to be implemented as a fragment, because they overlapped with the existing class structure. EtuContributionItem is used for putting the menu buttons into the user interface. ECFStart creates the connection between Eclipse Communication Framework (ECF) and the DocShare plugin. We also plan to implement a version if this tool without Eclipse dependency.

The data model is designed to contain large variety of information that can be used in different kinds of overlays in the receiving end. Both users can start and stop the tracking using command messages. Currently, only the raw gaze data is overlaid with a moving dot, but we plan to incorporate other kinds of visualizations in order to overcome some of the inherent challenges discussed in the following.

Discussion and Future Work

Multiple stimuli present in the visual stimuli need to compete for neural representation. Therefore, we could visualize the point of gaze with proper level of salience (color, shape, size), or better yet; make the saliency adjustable for the receiving party.

Mouse pointing is relatively intentional but in comparison gaze pointing is much more difficult to control having also unintentional components. The two-fold purpose of visual attention, perceiving and producing pointing gesture, are in rivalry. Interestingly we do not see this happening that much in natural settings for the reason of not being that aware of where we are looking at all the time and therefore do not try to over control our direction of visual attention.

To our knowledge, no studies exist particularly investigating this 'inter-stream' i.e. between signal synchronization problem with gaze and other types of media. In [10], as an example, audio relating to a pointer (pointing to a item) has skew limits of -500ms and +740ms still producing a satisfiable effect. Further, the illusion of continuity can be achieved according he's to initial result by updating pointer location 15 times per second.

Most computer-mediated communication systems do not preserve well the non-verbal, spatial and turn-taking cues important for efficient group activities [2] and therefore engaging in joint attention calls for more verbal communication or other forms of index making, such as mouse or gaze pointing, to be successfully established. With our solution, gaze point overlay makes it possible to mediate more contextual information, which can possibly lead to better

understanding of utterances and better temporal resolution in the contextual information.

We do not always focus our visual attention and other attentional resources (e.g. mind) on the same place, and therefore can speak about very different things respect to where we are looking at. Indeed, before better knowledge of how things really are, there is room to doubt the usefulness of computer-mediated gaze as general communication tool. Either way, our tool can work as an eye movement recorder for researchers enabling more than one person's eye movements to be recorded simultaneously in remote settings with shared collaborative task and is available for free download.

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