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Gaze-supported Interaction

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Abstract

Considering the increasing diversity of display arrangements including wall-sized screens and multi-display setups, our eye gaze provides a particular high potential for implicit and seamless, as well as fast interactions. However, gaze-based interaction is often regarded as error-prone and unnatural, especially when restricting the input to gaze as a single modality. For this reason, we have developed several interaction techniques benefitting from gaze as an additional, implicit and fast pointing modality for roughly indicating a user's visual attention in combination with common smartphones to make more explicit and precise specifications. In our demos, we showcase two examples for more natural and yet effective ways of incorporating a user's gaze as a supporting input modality. The two application scenarios comprise (1) gaze-supported pan-and-zoom techniques using the example of GoogleEarth and (2) gaze-supported navigation and target selection in a virtual 3D scene.

1 Introduction

We are surrounded by an increasing variety of display configurations in our daily lives and with that more convenient and yet efficient means to interact with such setups are required. While traditional mouse input works excellent for pointing tasks in desktop environments, it does not apply well for situations in which a user is standing in front of a wall-sized display or needs to interact with several spatially distributed screens. Even with remote input devices or gestural interaction it is difficult to tell what the user's interaction refers to. In addition, pointing tasks are often awkward to achieve with decoupled non-mouse input modalities. In this context, a user's eye gaze can act as a fast and natural indication about what a user's attention is currently focused on. In combination with other modalities, gaze input can support more efficient selection and navigation tasks in diverse user contexts.

To support this claim, we present several demos in which users can deploy a combination of gaze input and a mobile touchscreen to interact with a distant display. In our first application, we present gaze-supported pan-and-zoom techniques in Google Earth (Stellmach & Dachselt, 2012a). A user can seamlessly zoom towards a location that is currently looked at by performing a simple touch gesture on a handheld touchscreen. This provides a convenient and quick pan-and-zoom interaction that is applicable for diverse display setups. Our second

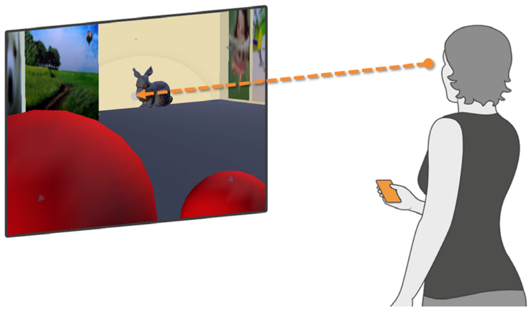

Figure 1: Basic idea for gaze-supported steering and selection using a combination of the user's eye gaze with a handheld touchscreen.

application comprehends a set of gaze-supported interaction techniques to steer (Stellmach & Dachselt, 2012b) and to select targets in a virtual 3D scene (Stellmach & Dachselt, 2012c).

2 Gaze-supported Pan-and-Zoom

As we describe in (Stellmach & Dachselt, 2012a), we investigated ways in how to augment pan-and-zoom interaction in a geographical information system (e.g., GoogleEarth) with gaze input. For this purpose, we compared four combinations of gaze-directed panning with different zooming modalities: (1) a mouse scroll wheel, (2) tilting a handheld device, (3) touch gestures on a smartphone, and (4) a combination of tilt and touch input. These techniques and a control condition (using the mouse) were tested in a user study with ten participants. While the mouse-only condition yielded in the fastest task times, the combination of gaze-directed panning with a scroll wheel and with touch-based zooming was assessed very positively by the participants. Especially the possibility to zoom in towards the current point-of-regard was positively emphasized. In our demo application at the conference, we give users the possibility to test the different gaze-supported pan-and-zoom techniques in combination with a Tobii table-mounted eye tracker (see *General Setup*).

3 Gaze-supported 3D Interaction in a Virtual Scene

Gaze input can also help in supporting basic interaction tasks in 3D virtual environments (VE), such as steering through or selecting targets in such scenes. We previously reported work on gaze-based steering UIs (Stellmach and Dachselt, 2012b) and gaze-supported target acquisition (Stellmach and Dachselt, 2012c). These techniques have been further advanced for a seamless *gaze-supported distant interaction* in combination with a smartphone as illustrated in Figure 1.

Figure 2: General demo setup – a Tobii T60 eye tracker to collect gaze data and a mobile touchscreen.

3.1 Gaze-supported Steering

In previous work, we investigated the design of eye gaze user interfaces (UIs) as overlays over a virtual 3D scene to steer in it (Stellmach & Dachselt, 2012b). For this, we described the development of 2D eye gaze steering UIs that mainly differ in input condition (discrete vs. continuous) and velocity selection (constant vs. gradient-based). In this context, the continuous gradient-based input allowed for a smooth continuous gaze-based steering by combining different motion directions and velocities within one UI, which reduced the need for time-consuming dwell activations.

Based on these findings, we advanced the *gaze-only* steering UIs to be used in combination with a mobile touchscreen. The handheld touchscreen is used to move forward, backward, left, and right in the 3D VE, whereas the gaze input is used to rotate the camera up, down, left, and right. This allows for implicitly moving objects of interest towards the screen center, while in parallel translation tasks can be performed using the handheld.

3.2 Gaze-supported Selection

Gaze can provide a quick indication about a target of interest, but is a rather inaccurate pointing modality. Therefore, we have elaborated several techniques to support reliable and precise gaze-supported selections even of small and overlapping targets (Stellmach & Dachselt, 2012c). According to the principle *"gaze suggest, touch confirms"* gaze is mainly used for roughly indicating the position, whereas the mobile touchscreen provides means of fine-tuning the selection. We distinguish variants ranging from a local gaze-directed cursor to gaze-dependent local zoom lenses, and a combination of eye gaze for rough cursor positioning with means of manually accomplishing the final target selection using touch.

4 General Setup

Whereas our goal is to explicitly support gaze-supported interaction on larger distant displays, we will use a basic setup to showcase the described demo applications. For tracking a user's eye gaze in a reliable and convenient way, we use a Tobii T60 table-mounted eye tracker: a binocular eye tracker that is integrated in a 17-inch TFT flat panel monitor with a resolution of 1280x1024, a 0.5° accuracy, and sampling rate of 60 Hz. To reduce cursor jitters due to imprecise gaze data, the gaze position is stabilized using the speed reduction technique described by (Zhang et al., 2008). Based on our prior experience, we use a ratio of 8% of the current with 92% of the previous gaze position. We can also adapt this on-the-fly based on user preferences. An iPod Touch (or iPhone respectively) is used for the interaction on a mobile touchscreen. For the communication of the devices, we use a similar system setup as described by (Stellmach et al., 2011) for which data between the devices are handled via a customized VRPN framework using a TCP/IP communication.

5 Conclusion

Eye gaze has a high potential as a supporting, i.e. implicit and yet efficient rough pointing modality. With the addition of another input modality, e.g., a touch-enabled smartphone, it can benefit the seamless interaction with diverse display setups and user contexts. To illustrate this claim, we provide two demonstrators for gaze-supported interaction in combination with a mobile touchscreen. This includes (a) gaze-supported pan-and-zoom techniques using the example of GoogleEarth and (b) gaze-supported selection and navigation in a 3D VE. With our contribution we want to support the general idea of using eye gaze as a promising additional input modality within the wide spectrum of natural user interfaces.

References

Stellmach, S., Stober, S., Nürnberger, A. & Dachselt, R. (2011). *Designing gaze-supported multimodal interactions for the exploration of large image collections.* In Proc. NGCA'11, ACM, New York, NY, USA, S. 1-8.

Stellmach, S. & Dachselt, R. (2012a). *Investigating Gaze-supported Multimodal Pan and Zoom*. In Proceedings of ETRA'12, ACM, New York, NY, USA, S. 357-360.

Stellmach, S. & Dachselt, R. (2012b). *Designing Gaze-based User Interfaces for Steering in Virtual Environments.* In Proceedings of ETRA'12, ACM, New York, NY, USA, S. 131-138.

Stellmach, S. & Dachselt, D. (2012c). *Look & touch: gaze-supported target acquisition*. In Proceedings of CHI'12. ACM, New York, NY, USA, S. 2981-2990.

Zhang, X., Ren, X. & Zha, H. (2008). *Improving eye cursor's stability for eye pointing tasks*. In Proceedings of CHI'08, ACM, New York, NY, USA, S. 525-534.

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