

[Demo] Placing Information near to the Gaze of the User

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ABSTRACT

Gaze tracking facilities have yet mainly been used in general for marketing or the disabled and, more specifically, in Augmented Reality, for interaction with control triggers, such as buttons. We go one step further and use the line of sight of the user to attach information. While any information may not conceal the view of the user, we displace the information by an angular degree and provide means for the user to capture the information by looking at it. With such an approach we see a potential for faster resuming times of the original task for which a required information needs to be accessed.

The demonstration shows a comparably complex primary task assisted by our gaze-mounted information and illustrates the inherent differences for information access w.r.t. conventional methods, such as listing action items at a fix position in space or on a screen.

Index Terms: H.5.m [Information interfaces and presentation]: Miscellaneous

1 INTRODUCTION

Augmented Reality (AR) adds virtual information, mainly on a visual basis, such as 3D objects or textual labels, to the view of the user. The superimposed information is placed - or mounted - in the environment. The augmented content is usually placed w.r.t. the world or an entity in the world, or it is mounted to a human, either another person or the user himself. Concerning information mounted to a user, mostly the head or the hands define the respective coordinate system. However, no system has yet addressed information placement w.r.t. the gaze of a user.

This work specifically places information w.r.t. the user's gaze. This enables new paradigms for information access. Information capture no longer requires the user to determine the actual location of the information in its respect to placement (i.e., a location in the world or on a head-mounted screen). Rather, the information is always near to the direction in which the user is looking. Especially in cluttered and visually complex environments, a gaze related information is thus constantly accessible in the same way by a somehow dedicated glance. This option bears the potential to allow for faster information access and also a faster return to the original gazing direction and this way a faster return to the actual primary task.

While mounting information directly to the gaze would conceal the physical world, displacing the information by an angular offset would make information capture impossible as the information would constantly maintain this offset. Required are dedicated placement strategies for the information. The information shall float nearby the gaze while the user is looking around but shall be accessible on demand.

This work demonstrates exactly such dynamic information placement and access. The information is placed off the line of sight but can be captured by looking at it. The concept and the so

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far existing algorithms are presented in context of a rather complex searching task, an environment in which such a information presentation technique may reveal its potential.

2 RELATED WORK

Toyama et al. [5] developed a text translation system for use with a head-mounted display. Looked-at text is translated and shown directly besides the original text.

Orlosky et al. [3] use gaze tracking to support the user in getting back to their original operating location, in their case text passages.

In the work by Gustafsson et al. [1] interaction elements only appear when looking at an off-center region of the display.

Ishiguro and Rekimoto [2] developed a system to annotate usually unused regions of a users vision, the peripheral regions. In their concept any location in the peripheral field of view can be used, yet their implementation shows the annotation at a fix display position besides the straight forward line of sight.

3 DIFFERENTIATING BETWEEN FREE GAZING AND INFORMATION CAPTURE

A just in time analysis of eye motion history estimates whether a user aims at capturing the gaze-mounted information or if the user is gazing elsewhere. The analysis inspects three time windows with associated capture-triggering conditions. First, the gaze must only have slightly moved for at least 50 ms to ensure that the pupil has not already been in motion. Second, a quick eye movement (i.e. a saccade) must have been performed within another 50 ms. The time frame is derived from the general maximum time for a saccade in the average visual field. Third, a target location must have been fixated within 2.8 angular degrees (which approximately equals the foveal field of view) for 200 ms. The target fixation time aggregates the averaged 100 ms any person requires to focus on a target location and an additional 100 ms to ensure that this is the aimed-at spot. If all three conditions are valid, the information is captured and placed at the line of sight.

4 HARDWARE

We use a Sony Glasstron head-mounted display (HMD) which we equipped with a small analog camera (see Fig. 1). The digitized camera picture provides an image of the eye which is used to register the eye-position w.r.t. the user's head, or more specifically the infrared marker target attached to the HMD. After that initial registration phase, the gazing direction is combined with the position and orientation of the head which is received from an ART tracking system.

5 REDUCTION OF RETURN COMPLEXITY ON A CHESSBOARD EXAMPLE

The demonstration setup employs a generalized abstraction of complex tasks. Such tasks may require to determine a specified position, i.e., a soldering point on a circuit board, and to execute a different action for each pin, such as measuring resistance or conductivity. Given the potentially long description for such specific actions, a user might forget a piece of the task and may have to reread the task description in between.

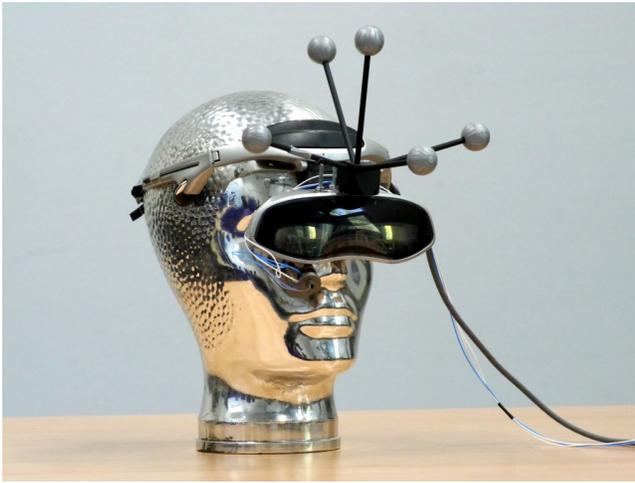


Figure 1: A Sony Glasstron HMD equipped with an eye tracking camera

In our demonstration we let users count colored balls on a 2D chessboard. The colored mables are distributed on the chessboard like structure (see Fig. 2). A user with a conventional task description would read the given task, find the corresponding row and column and then still would have to remember the actual task. If this task were forgotten until the specified position has been found, the user would have to reread and find the correct tile again, again determining the row and column.

With the gaze-mounted information, one degree of freedom is taken out of the localization demand while a second degree of freedom is restricted to a fix gazing angle. Based on the investigation of boundary conditions [4], the information is displaced to the right by 8 angular degrees and maintains a rigid offset until looked-at. Thus, the obsolete degree of freedom in our demonstration is the row. When a user looks at the information, the gaze remains on the same row. When resuming the task, only the column needs to be determined. However, getting back to the column requires an exact counter-saccade as executed to capture the information.

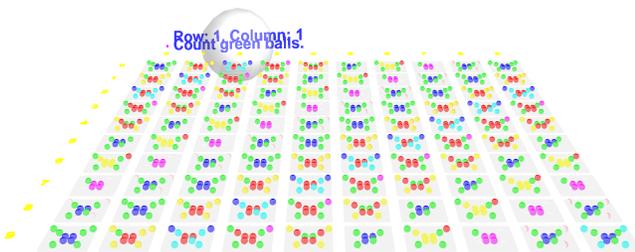


Figure 2: Chessboard with differently colored balls on each tile. Task is visualized 8 angular degrees to the right of the gaze of the user

6 CONCLUSIONS

Mounting information to the user's gaze is a yet unexplored field in Augmented Reality. Such an approach bears a large design space which has yet just begun to investigate. The current algorithms differentiating between free gazing and planned information capture are already at a presentable state of development. Yet, its demonstration is more of a personal experience than a show for a wider audience. However, the experience is what might draw a wider group of researchers to get into that field.

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