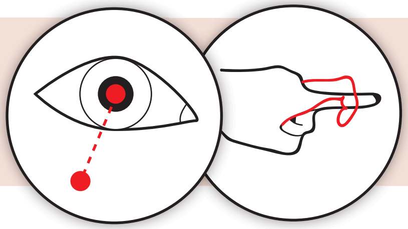
Gaze-augmented Manual Interaction



Goals and Motivation

Progress in the design of affordable, robust, and comfortable eye-tracking systems promises to bring eye-tracking out of the research laboratory to new applications in HCI: from built-in eye-trackers in laptop screens to wearable systems that locate the user's point of regard on large, wall-sized displays of tomorrow's workplaces (see Fig. 1). In preparing for this, new techniques will be developed in this research project to tackle two of the largest issues of gaze-based interaction techniques: the lack of precision of gaze data and the inherent unnaturalness of using gaze for interaction tasks. These new techniques will use gaze passively in order to improve the speed and precision of manually controlled pointing techniques.

Approach

Designing such gaze-augmented manual techniques requires an understanding of the principles that govern the control of gaze and coordination of manual actions and eye movements. This coordination is influenced by situational parameters (task complexity, input device used, etc.), which this project explores in controlled experiments.

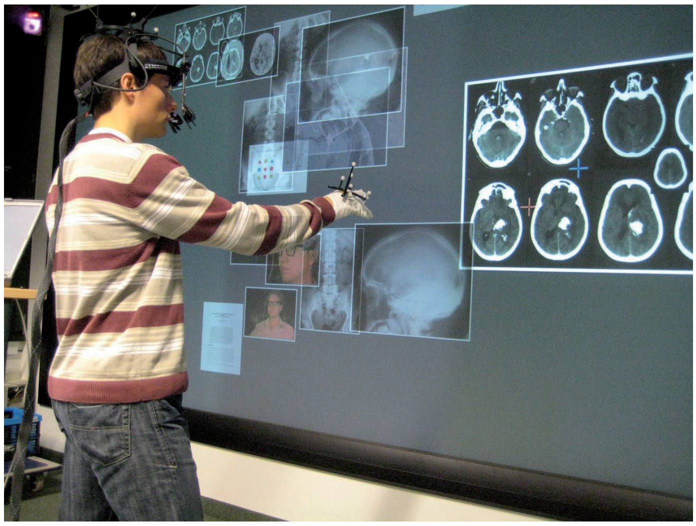


Fig. 1: Interacting via gaze and gestures on a 221" Powerwall display at the University of Konstanz. In this demo application, the user's analysis task is assisted through gaze-contingent zooming while he interacts with pointing gestures.

MAGIC Pointing Replication

Goals of the Study: The goal of this study was to assess an already existing gaze-augmented technique that was developed by Zhai and colleagues (1999). Their MAGIC technique combined gaze and manual input to „warp" the mouse pointer to the vicinity of the fixated item, resulting in movement-time savings. To see whether we could replicate the findings from the original pilot study we re-implemented the MAGIC technique and tested it against the de-facto standard of today's workplaces: the mouse.

Method: To assess whether the technique works in a more ecologically valid situation, four search and drag-and-drop tasks of varying complexity were used. 9 subjects performed 5 blocks of these tasks with a total of 130 trials for each condition (magic vs. mouse). To simulate a large screen environment, participants sat in front of a back-projected 1400 x 1050 px display and wore a head-mounted eye- (SR-Research Eyelink II with 250 Hz) and head-tracker (Vicon 120 Hz). With this set-up participants were able to move their heads without any constraints.

Preliminary Results: In contrast to the original study, the magic technique did not improve pointing performance (see Fig. 2). Analysis of user behavior revealed why:

a. Anticipation errors: Users often moved away their gaze before completing an action to search for the next target and thus failed to select or drop an item successfully. This was often the case in the more complex situations.

b. Corrective saccades & drift: Large saccades often missed the target. Subsequent drifting motions or small corrective saccades occurred (see Fig. 3). These motions were below MAGIC's sensitivity threshold (120 px) and thus required delayed and thus costly manual adjustments.

Conclusion & Outlook: These findings demonstrate the limits of this pioneering gaze-augmented technique and reveal potential approaches to improve it, e.g. by backtracking a selection location (a) or adapting the threshold based on saccade amplitude (b).

Reference: Zhai, S., Morimoto, C. H., and Ihde, S. *Manual and gaze input cascaded (MAGIC) pointing.* Proc. CHI, ACM Press (1999), 246-253.

Fig 2: Results per participant for a simple drag-and-drop task with a single target.

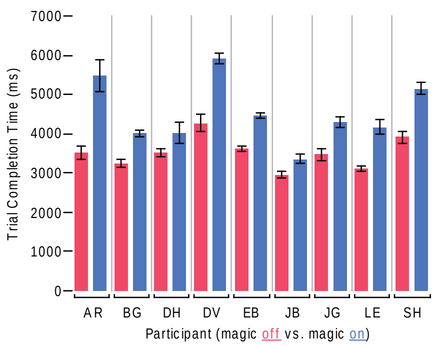
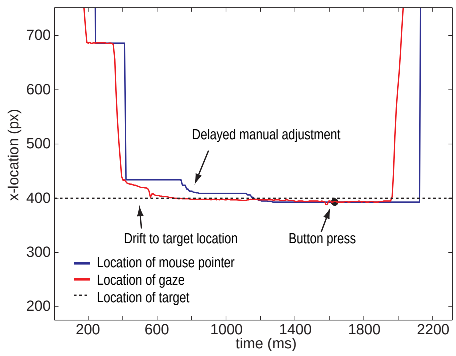


Fig. 3: Movement profile from participant BG. The profile illustrates how an inaccurate saccade is compensated by drift, resulting in problems for the MAGIC technique.



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