rAir Flow Menus: Toward Reliable 3D Gestural Input For Radial Marking Menus

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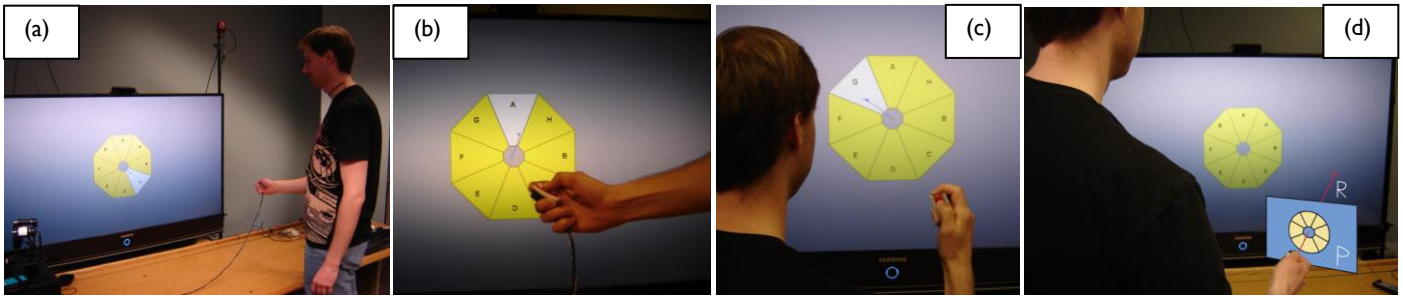

Figure 1*: rAir Flow Menus variable-distance interaction styles (a) User decides to stand at a small distance from the display. (b) Magnetic hand tracker (c) User's hand is pointed up away from display. (d) Interaction technique conceptual model.*

1 Introduction

Despite the many challenges understanding how best to interact with large format displays, they are becoming increasingly popular for data analysis tasks in a variety of domains, including scientific, information, and geo-visualization. (Figure 1a shows a relatively small, 60" display; even larger, wall-size displays are also popular.) In order to make the most effective use of the full display, users typically stand and walk around in these environments. In fact, this physical navigation has been shown to be beneficial in data analysis tasks [1]. Since immobile input devices, such as mice, keyboards, or pen-tablets, do not naturally support interaction "on the move", new interactive techniques are needed to facilitate fluid interaction across a range of distances when working with large-format displays. We believe body-centric 3D, gestural input is particularly promising in this regard. Our work investigates techniques for reliable menu selection based upon these ideas, introducing new 3D input strategies for controlling menus. Our work builds upon previous techniques, such as rapMenu [3], which uses rotational hand movements and finger pinches to control menus from a distance.

2 Approach

rAir Flow Menus are modeled on traditional Flow Menus [2], a Marking Menu implementation that requires the user to return to the menu center to commit selections. This tablet technique helps the user navigate to an arbitrary menu depth quickly without lifting the pen for each menu selection. Our contribution is redesigning this approach to be driven by 3D input.

In rAir Flow Menus, the user activates the menu by pressing down a hand-held button attached to a 6-DOF, magnetic tracker. The tracker's orientation and position at the time of the initial press are used to specify the ray, *R*, shooting out of the hand; and the plane, *P*, centered in front of the hand with normal equal to the inverse of *R*'s direction (see Figure 1d). After the initial click, as the user's hand moves, the direction of *R* (but not the origin) is updated continuously based on the tracker's orientation, and strokes are drawn over the menu by mapping the intersection of *R* with *P* into the coordinate space of the menu. Thus, regardless of the user's initial hand position or distance from the display, the menu will always be available directly in front of her hand. She may point directly at the display, or she may operate the menu more naturally with her hand by her side. By updating only the *direction* of *R* with each hand movement, the technique ignores accidental translational movement of the hand.

To better understand the efficacy of our technique, we conducted an informal pilot evaluation of a hierarchical menu selection task. Participants were given a two-minute introduction to the technique and an additional two minutes to practice. They were then asked to spell a three-letter word by traversing three levels in a simple menu hierarchy, where all menus had the same letters [A-G] placed in the same positions; participants were asked to spell: "BAD", "FED", "BEG", "GAG", and "ACE". On average, task completion time was roughly five seconds per multi-level selection, and participants made an average of one error over the course of the five trials. These pilot data suggest that further refinement of the technique will be valuable to increase speed and accuracy; however, the fact that novice users were able to quickly understand a radically different style of menu selection, based upon flowing motion of the hand in the air, is promising.

3 Future Work

We plan to conduct formal user studies to determine how performance is affected by the number of menu items, the inner menu circle size, and alternatives to direction-based control. We are currently incorporating rAir Flow Menus into a 3D application running on a large, tiled display.

References

[1] BALL, R. NORTH, C., and BOWMAN, D. A. 2007. Move to improve: promoting physical navigation to increase user performance with large displays. *In Proceedings of CHI 2007 (May. 2007).*

[2] GUIMBRETIERE, F. and WINOGRAD, T. 2000. FlowMenu: combining command, text, and data entry. *In Proceedings of UIST 2000 (Nov. 2000).*

[3] NI, T., MCMAHAN, R. P., and BOWMAN, D. A. 2006. Tech-note: rapMenu: Remote Menu Selection Using Freehand Gestural Input. *In* Proceedings of IEEE 3DUI 2008 *(Mar. 2008).*

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