Interacting with Large Displays from a Distance with Vision-Tracked Multi-Finger Gestural Input

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Abstract

We explore the idea of using vision-based hand tracking over a constrained tabletop surface area to perform multi-finger and whole-hand gestural interactions with large displays from a distance. We develop bimanual techniques to support a variety of asymmetric and symmetric interactions, including fast targeting and navigation to all parts of a large display from the comfort of a desk and chair, as well as techniques that exploit the ability of the vision-based hand tracking system to provide multi-finger identification and full 2D hand segmentation.

CR Categories: I.3.6 [**Computer Graphics**]: Methodology and Techniques – Interaction Techniques.

Keywords: large wall, interaction, bimanual, multi-finger, touch-sensitive surface, gesture, visual touchpad.

1 Introduction

The increased screen real estate provided by large wall displays allows for sophisticated single- and multi-user applications that cannot be easily accommodated with standard desktop monitors. While many interaction techniques have been proposed to deal with the difficulties in manipulating content on a large display, the majority focus on *within arms-reach* interactions that assume users will be standing close to the screen. In this work we propose a set of *from-afar* interactions that provide the direct manipulation benefits of multi-finger touch-screens while still allowing users to remain seated comfortably at a desk or conference room table.

2 Visual Touchpad System

A flat, rigid surface with a small identification tag and a large black rectangular region serves as our wireless multi-finger touch-sensitive device over which a user can make finger manipulations and gestures, while two low-cost web cameras mounted over-head are used to capture live video of the hands and black regions for real-time vision processing. Our hand tracker can detect all ten fingertip positions of a user's bare hands, while also providing finger labels and finger orientation. Figure 1a shows our prototype touchpad, which is a simple piece of cardboard with the black region and identifier tag printed on regular paper. By attaching unique tags to different touchpads, the system also allows multiple touchpads to be easily detected.

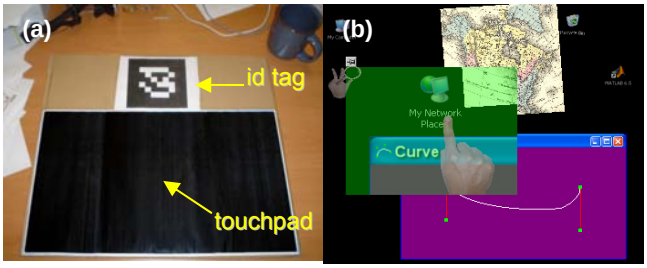

Figure 1. (a) The Visual Touchpad; (b) Bimanual interactions with live on-screen video of the hands.

3 Interaction Techniques

We developed several one- and two-handed interaction techniques that allow a user to perform a variety of general purpose graphical interface operations such as fast navigation, multi-finger object manipulation, zooming or resizing of the workspace, and cutting or pasting operations. Since our system can extract the full 2D image of a user's hands in real-time, we can display the segmented hands directly on the large display which provides for a more compelling direct manipulation experience when compared to simple arrow cursors or visualizations that show only fingertip positions (Figure 1b).

4 Conclusion

Our work explored a number of techniques for interacting with large displays from afar using a vision-based hand and touchpad tracking system. By allowing users to sit comfortably at a table in front of a large display in a familiar posture, we believe that our techniques provide the benefits of multi-point touch-sensitive upright displays, but without the fatigue and discomfort normally associated with such devices.

Reference

Malik, S., Ranjan, A., Balakrishnan, R. (2005). Interacting with Large Displays from a Distance with Vision-tracked Multi-finger Gestural Input. In *Proceedings of ACM UIST*. p. 43-52.