VisionWand: Interaction Techniques for Large Displays using a Passive Wand Tracked in 3D

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Abstract
A passive wand tracked in 3D using computer vision techniques is explored as a new input mechanism for interacting with large displays. We demonstrate a variety of interaction techniques and visual widgets that exploit the affordances of the wand, resulting in an effective interface for large scale display interaction. The lack of any buttons or other electronics on the wand presents a challenge that we address by developing a set of gestures and postures to track state and enable command input.

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

Keywords: vision tracking, large displays, gestures, interaction techniques, input devices, buttonless input.

1 Introduction
Large-format upright displays enable us to work with very large quantities of simultaneously displayed visual data. Although the visual quality of commercially available large displays is already very high and continues to further improve, and the range of research applications available are quite impressive, the question of what input technology to utilize when interacting with displays of this scale remains an open one. While a variety of interaction techniques have been investigated, including single finger/pen input, 3D trackers, laser pointers and the use of computer vision to track users' hands, they all have some limitations and none has yet emerged as the standard input mechanism. Our VisionWand is one attempt to build effective and fluid interaction techniques for large displays by the use of simple passive physical tools.

2 VisionWand System
We explore using a passive wand that is tracked in 3D space using computer vision techniques as an input device for interaction with large scale displays. This *VisionWand* is a simple plastic rod with colored ends, without any embedded electronics, that is tracked by a pair of commodity cameras (Figure 1). Since both endpoints of the wand are tracked in 3D, the resulting input is a 3D ray, allowing for a richer vocabulary of actions than is possible with standard 2D point input. Given that the device is passive and thus cannot directly communicate any state information to a computer, we indirectly infer actions from movements and postures of the wand. Users can also take advantage of the affordances of the physical wand, allowing for "rich-action" input.

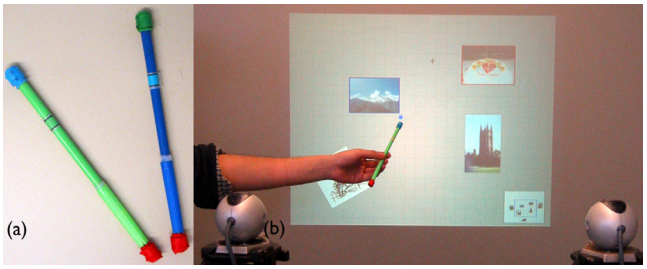

Figure 1. (a) VisionWands (b) System Setup.

Our techniques are carefully designed to exploit the 3D information afforded by the wand. For instance, the user can scale objects by changing the distance between the wand and the display. Various visual widgets are designed to help the users to perform more complicated tasks with the basic gestures, thus reducing the need to learn a large set of gestures. An example widget is the Dial Panel (Figure 2) where continuous parameter adjustment is achieved by rotating the wand. Granularity of the adjustment is controlled by the distance between the wand and the display. Multiple wands can also provide additional functionality.

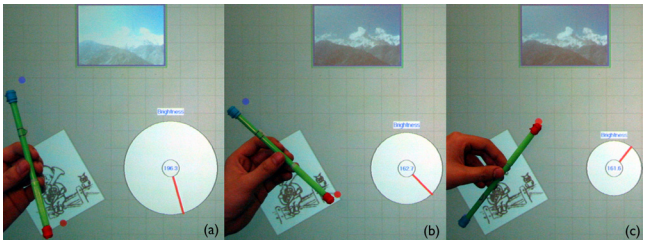

Figure 2. Example of visual widgets: Dial Panel controlled by wand rotation and distance from the screen.

3 Conclusions
Our work has explored a variety of techniques and widgets for interacting with large scale displays using a buttonless passive wand tracked in 3D. While our tracking implementation could be improved, it was more than sufficient to explore a wide range of alternatives. Our own experience with using the system, and observations during our informal user study, indicate that the gestures and postures of wand based interaction is easily understood and used. As our interaction with computers increasingly moves away from the standard desktop to other form factors, including large displays, it is critical that we continue to explore alternative input and interaction modalities that are well suited to the new media. The work presented here is one step in this exploration.

Reference
Cao, X., Balakrishnan, R. (2003). VisionWand: Interaction Techniques for Large Displays using a Passive Wand Tracked in 3D. In Proceedings of UIST 2003, ACM Symposium on User Interface Software and Technology, ACM CHI Letters 5(2), p. 193-202.