TractorBeam: Seamlessly Combining Remote Pointing and Touch on Tabletop Displays

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ABSTRACT
This paper presents details of the TractorBeam interaction technique. Implemented with a six degrees of freedom magnetic tracking system, TractorBeam is a hybrid point-touch interaction technique which allows users to seamlessly interact with both remote and close items on a tabletop display by either touching or pointing with a stylus.

ACM Classification H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

General Terms Design, Human Factors

KEYWORDS: Interaction techniques, input, tabletop displays

INTRODUCTION
While tabletop display research has become more prevalent in recent years, there is still no widely accepted standard input device for these displays. When using a direct input device such as a stylus, reaching objects on the far side of a large tabletop display can be difficult. Augmenting a stylus to allow remote pointing may facilitate this process.

Using a top-projected tabletop display and a Polhemus magnetic tracking system we developed the TractorBeam, a hybrid point-touch interaction technique. Our goal was to develop an interaction technique that would enable acquisition of distant targets, while also providing efficient interaction with closer objects on tabletop displays.

Remote pointing has been proposed as an input solution for large wall displays, with varying degrees of success [1, 2]. While devices such as laser pointers allow input from a range of distances, they have been found to be slow and inaccurate by some researchers [1]. However, given that the distances users typically need to reach on a tabletop display are much smaller than with a wall, and the fact that people typically sit at a tabletop display with their arm supported, a laser pointer style of interaction performs better on a tabletop than a wall display.

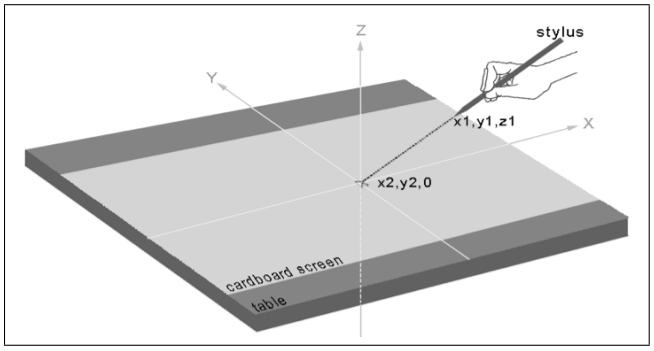

Figure 1: Mechanics of the TractorBeam

We have evaluated the TractorBeam with target selection tasks and have found it to be an appropriate technique for interaction with tabletop displays [3]. We have also explored a series of selection aids in order to improve acquisition of small, distant, targets using the TractorBeam [4].

TECHNIQUE OVERVIEW
The technique works as follows: Using a stylus, the user points at or touches the tabletop display. A cursor appears on the display to show the current trajectory of the stylus (Figure 1). The user moves the stylus around until the cursor is on the desired item. To select the item, the user clicks the button located on the top of the stylus.

HARDWARE
The TractorBeam is implemented via a corded stylus and receiver attached to a Polhemus Fastrak (a six degrees of freedom tracking system). The Fastrak receiver is secured to the underside of the table. Using information from the stylus and receiver, the Fastrak base provides continuous information about the position and orientation of the stylus in space to our software through a serial connection. Included in the information it provides are: x position, y position, z position, azimuth, elevation, and button state (up or down) of the stylus.

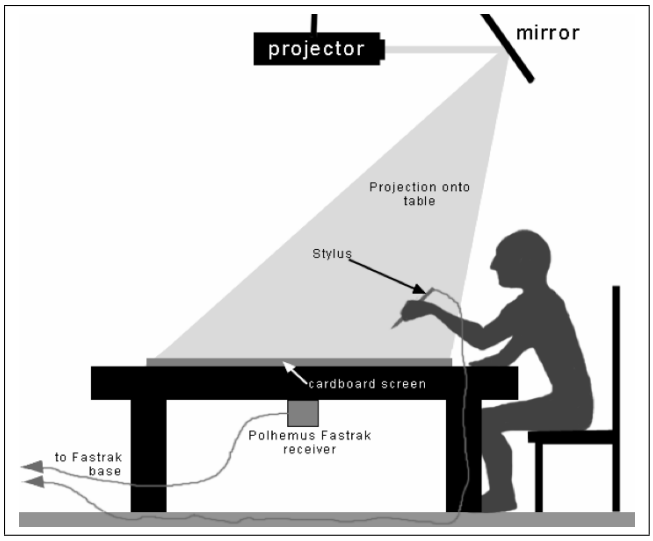

Figure 2: TractorBeam hardware setup

Our hardware setup also includes a top-projected tabletop display, consisting of a ceiling-mounted projector, mirror, desktop PC, and wooden table. The PC is connected to the projector and its output is projected onto the mirror, which reflects the image onto the table (Figure 2).

SOFTWARE

A Java API is used to retrieve continuous position and orientation information for the stylus. With this information, we calculate the projection of the endpoint of the stylus onto the table (Figure 1) and the cursor is drawn in this position.

Our software includes a TractorBeamMouse class which generates standard Java mouse events. This class ensures that, rather than being limited to use in our research studies, the interaction technique can be easily implemented in other Java applications as well. A TractorBeamMouse can be added to any Java application to allow input via the TractorBeam technique, providing that the necessary hardware setup is in place.

PROJECT STATUS

In the near future, we plan to implement multiple TractorBeams on a single display to explore the effectiveness of this technique for collaborative interactions around a tabletop display.

Currently, in addition to our experimental trial software (Figure 3), we have developed several games that users can play using the TractorBeam on our tabletop display (Figure 4). UIST 2005 attendees will be able to play these games to explore usage of the TractorBeam interaction technique.

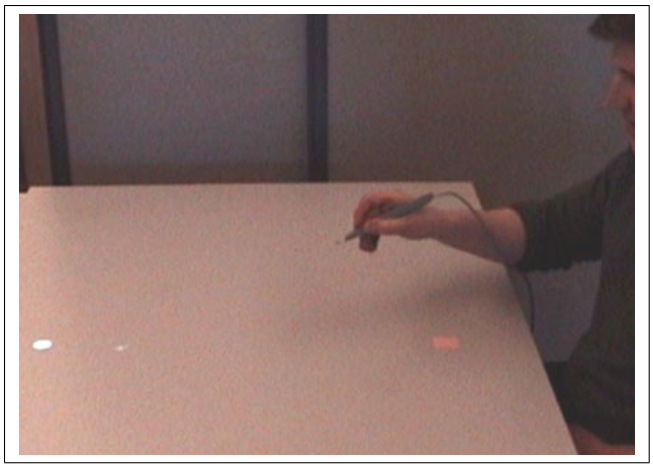

Figure 3: Using TractorBeam to acquire targets.

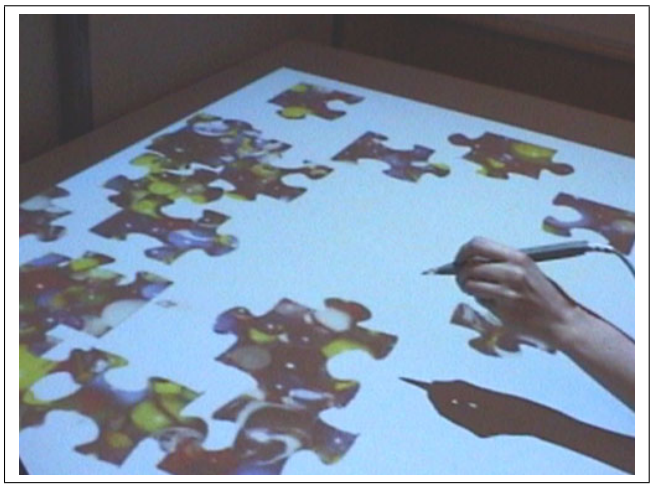

Figure 4: Using TractorBeam to complete a virtual jigsaw puzzle

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