MagicWand: The True Universal Remote Control

Jerry Alan Fails, Dan R. Olsen Jr.
Brigham Young University, Computer Science Department
Provo, UT 84602 USA
{failsj,olsen}@cs.byu.edu

ABSTRACT

This paper describes an inexpensive universal remote control device — a simple laser pointer. Using a single inexpensive camera, any interior space can be instrumented with device controls. The MagicWand allows users to manipulate data by pointing a laser at predefined widget areas.

KEYWORDS: Ubiquitous computing, computer vision, cross-modal interaction

INTRODUCTION

The remote control has become a ubiquitous part of modern culture. Many homes have several remotes laying around that service different devices. To combat this problem the universal remote was invented. In most cases a single device is multiplexed by buttons across the top that select the appliance to be controlled. We envision an environment where everything can be controlled simply by pointing at it with a laser pointer. Thus the controls for the TV are on the TV, light switches can be activated or speakerphones answered from across the room simply by pointing at them. If you lose your remote, one just buys another inexpensive laser pointer. Everyone in the home can carry their own remote in their pocket. A prototype of such an environment is shown in Figure 1. We call this the MagicWand.
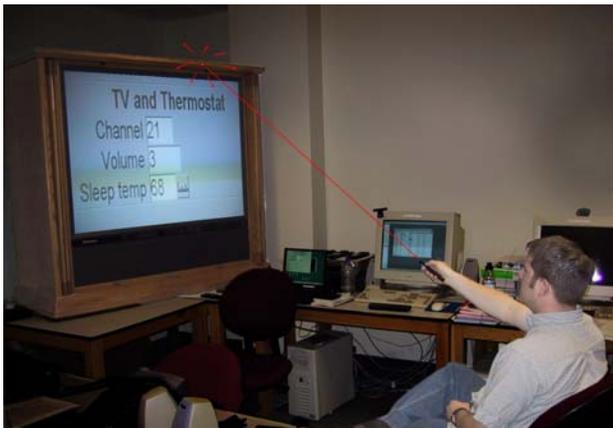

Figure 1 — MagicWand interaction

There are three issues in implementing the MagicWand: 1) tracking the laser spot, 2) setting up the room, 3) tying laser movement to widget interaction.

LASER TRACKING

In a prior system we used laser pointers to control formal interactions that were projected on a wall [3]. With the MagicWand, the subjects of the interaction are the physical objects scattered around the room. For the MagicWand we used the same techniques for following laser spots as we developed in our earlier work. The main problem with laser pointers is that they overdrive inexpensive cameras. The approach is to find the bright spots by means of a threshold and then perform a simple convolution to clearly identify the spot. System performance is improved by searching for the spot near the previous sighting.

SETTING UP A SPACE

To be useful it must be simple to configure an interior space with MagicWand widgets. To do this we use techniques that we developed in our LightWidgets [2] system. New interactors are added to a space by grabbing an image from a camera and drawing the widgets on the surface, as shown in Figure 2.

Figure 2 – Setting up MagicWand widgets

As in LightWidgets we can draw single spots that set or toggle values, linear areas (like those shown in Figure 2) that control a range of values and circular widgets. Linear and circular widgets function like GUI sliders by interpolating between maximum and minimum values.

The MagicWand has several distinct advantages over LightWidgets. In the LightWidget system, the users hands were tracked using a skin detector. If the user wanted to control the TV as in figure 2, they would need to get up and actually touch the surfaces. This is

awkward. An alternative is to place the light widgets near where the user might sit. This creates visual discontinuity between the widget and the object that is actually being controlled. With the MagicWand, the controls are on or near the objects being controlled, but the user can be anywhere in the room that they wish.

A second advantage is that only one camera is required. Because hands can appear anywhere in a three-dimensional space, multiple cameras were used to determine when the actual surface had been touched. With the laser pointer, spots only appear on surfaces and the 3D problem is eliminated. This decreases the monetary cost, since only one camera needs to be used. Although monetary cost decreases, user-cost increases as the user must now carry a laser pointer. LightWidgets requires no carried devices.

The increased-user cost by requiring the user to carry a device is a common trade off found in ubiquitous systems. Several systems, like NaviCam [6], Cyberguide [1] and Gesture Pendant [7] rely computationally on the user-carried device. MagicWand attempts to find the medium between instrumenting the environment and user to maximize ubiquitous usability.

CONNECTION TO CONTROLS

Our MagicWand implementation is tied directly into our XWeb protocol [4]. The MagicWand is just another interactive client. The MagicWand setup uses an XWeb client. When a widget is drawn, the designer selects an active widget and its value from the client. The MagicWand design software imports that XWeb control and attaches it to the laser widget. In figure 2 the television is showing an XWeb client designed for its screen resolution. This XWeb client is referencing the same data that the MagicWand is controlling. Thus, whenever the laser activates a widget, the new value appears on the TV. We have also connected the MagicWand to a speech client so that changes can be heard audibly if desired.

IMPROVEMENTS

The original laser spot tracking was designed to work on large images that are constantly changing. The widgets used by the MagicWand only take up a very small area. Looking for the spot only in those areas would greatly increase sampling rates. Because the background generally does not change, using image subtraction with a 4-5 second rolling average background image would also greatly improve laser spot detection.

ACKNOWLEDGEMENTS

Thanks to Gregory Abowd for suggesting the use of laser pointers within the Aware Home.

REFERENCES

[1] Abowd, G.D., Atkeson, C.G., Hong, J, Long, S., Kooper, R., and Pinkerton M. "Cyberguide: A mobile context-aware tour guide." ACM Wireless Networks, 3:421-433, 1997.

[2] Fails, J.A., Olsen, D.R. "LightWidgets: Interacting in Everyday Spaces." *Proceedings of IUI '02* (San Francisco CA, January 2002).

[3] Olsen, D.R., Nielsen, T. "Laser Pointer Interaction." *Proceedings of CHI '01* (Seattle WA, March 2001).

[4] Olsen, D.R., Jeffries, S., Nielsen, T., Moyes, W. and Frederickson, P. "Cross modal Interaction using XWeb." *Proceedings of UIST '00* (San Diego CA, November 2000).

[5] Olsen, D.R. "Interacting in Chaos." *Interactions*, Sept 1999.

[6] Rekimoto, J. and Katashi Nagao. "The World through the Computer: Computer Augmented Interaction with Real World Environments." *Proceedings of UIST '95* (Pittsburgh PA, November 1995), 29-38.

[7] Starner, T., Auxier, J. and Ashbrook D. "The Gesture Pendant: A Self-illuminating, Wearable, Infrared Computer Vision System for Home Automation Control and Medical Monitoring." *International Symposium on Wearable Computing* (Atlanta GA, October 2000).