Augmenting a Retail Environment Using Steerable Interactive Displays

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ABSTRACT
This paper describes a prototype retail environment in which information interactions occur *in situ*, within the actual space of the merchandise. By combining a steerable projected display and recognition of user gestures and actions and user position tracking through peripheral cameras, we have developed several innovative interaction techniques designed to augment the reality of a retail store.

Keywords
Augmented reality, projected interfaces, vision-based recognition, user tracking, tangible interfaces.

INTRODUCTION
Bringing information to users on location often involves users carrying or wearing some form of personal devices. Our group is investigating an alternative approach in which users move around in space without any devices and, by naturally exploring objects in the space, trigger information to be projected in proximity of the objects being explored. Some of these displays allow users to further interact with the information using their hands.

We are particularly interested in using steerable devices (such as the Everywhere Displays projector [1]) to render such interfaces, so they can be easily created or modified onto different surfaces as the environment changes through time. Those novel modalities of computer interaction may be a more natural approach to explore the augmentation of public spaces such as museums, airport lobbies, or malls. Our current application focuses on users in a retail context.

APPLICATION ENVIRONMENT
We replicated a 16x11 foot (5x3.3m) retail store space in our laboratory. Three different applications were designed, developed, and tested, including: interactive bins for women's pants, projected product directories, and an augmented table of Halloween products.

The interactive shelf seen in Figure 1 consists of bins that hold clothing merchandise (women's pants) and solid panels for projection. When the user is at a considerable distance from the bins, a circulating series of advertisements for women's clothing are shown on the panels, aiming to attract customers to the merchandise area. As the user approaches the bins, the display changes to introduce specific clothing items in each bin and also store promotions. If the user gets interested and start to examine pants in a bin (as shown in Figure 1), the act of putting his hand in and out of the bin triggers information pertaining to the pants of that particular bin to be displayed in the proximity of the bin. Figure 1 shows the user looking up a size chart. The user can also easily check if an item is in stock by touching the corresponding icon (seen on the bottom right panel of the bins in Figure 1).

Figure 1. User examines information related to the pants in the bin in front of him.

Another application is the use of projected interactive product directories to provide a way for users to locate merchandise throughout the store. At the product directory table located at the entrance of the store, the user can move a red slider on the left of the table to find a product as illustrated in Figure 2. A list of products is projected to the right of the slider and the list scrolls to mirror the up and down motions of the slider. Once the user touches the "where" symbol, arrows pointing to the location of the highlighted product are projected on the signage boards hanging from the ceiling as illustrated in Figure 4. In

Figure 2. Product directory table.

Figure 3. Product directory on the wall.

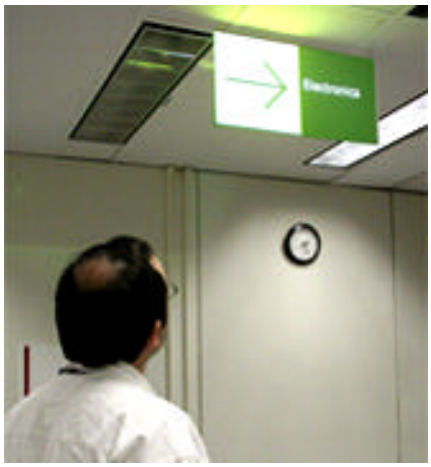

Figure 4. User follows signs for direction.

Figure 5. Halloween products table.

addition, the user may use wall-mounted product directories from other locations in the store as shown in Figure 3.

Figure 5 shows the augmented Halloween product table. It contains books, CD-ROMs, DVDs, and videotapes related to Halloween. As the user walks around the table, her position in a particular quadrant triggers the highlighting of a set of products and information about them. Each quadrant corresponds to different Halloween characters: witches, ghosts, vampires, and cats. Figure 5 shows the information and highlighted products when the user stands in the "witch" quadrant.

UNDERLYING TECHNOLOGIES

Making interactions happen at the location of user activities requires several components working in synchrony. Projecting a visual interface in any desired location is possible through our Everywhere Displays projector [1] – a combination of an overhead projector and a pan/tilt mirror for steering the display. User interactions are recognized via a gesture recognition system that processes video signals coming in from a pan/tilt camera working in coordination with the projector [2]. User location in the store is tracked by a two-camera vision module, which tracks and maps user location to a 3D model of the store [3].

Notice that the augmented store is created using devices that can steer the interface and display to different surfaces. No surface contains any sensor or wire. For instance, a single system can be used to create the augmented clothing shelf and the Halloween products table, as long as they do not need to run at the same time. Also, as layout, products, and storage devices change through time and seasons, it is easy to introduce new interactions or to adapt the existing ones. For instance, in the case of the product directory, moving one of the wall panels shown in Figure 3 to another location is an extremely simple process, not involving any kind of rewiring or repositioning of projectors or cameras. A simple recalibration procedure [1,2] moves the interface to the new wall position.

We see steerability, since it allows such easy creation and adaptation of interfaces, as a key element to make the use of interactive projected displays (as augmented reality) economically feasible in the real world.

RESEARCH AND ONGOING WORK

Our research focuses on the new interaction paradigms created by steerable interface systems such as the ones described here. For example, we exploited user positional information, specifically user distance from the clothing bins and user position around the table, to trigger contextual information and interactions. The design attempted to home in on what is natural as users move around and perform their normal activities in the store space.

An initial design walk-through study with a small number of subjects suggested some design changes to improve the ties of the information display with the physical objects. We are conducting further studies to improve the current design and to evaluate how users perceive and react to this new interaction paradigm where projected displays are seamless integrated to the physical world.

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