Spatial Augmented Reality User Interface Techniques for Room Size Modeling Tasks

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ABSTRACT

This poster presents results of our investigations into using Spatial Augmented Reality (SAR) to improve kitchen design and other interior architecture tasks. We present new user interface techniques for room sized modeling tasks, including cabinet layout, viewing and modifying preset designs, and modifying finishes. These tools and techniques address key user interface issues for spatial augmented reality systems, and we discuss how they can be generalized for other applications. The techniques have been developed in the context of a demonstration application, *PimpMyKitchen*, which allows architects to design kitchens, working with clients in an interactive SAR environment.

Keywords: Spatial Augmented Reality, User Interfaces, Architecture.

Index Terms: H.5.2 [Information Interfaces and Presentation]: Graphical User Interfaces—Input Devices and Strategies; I.3.6 [Computer Graphics]: Methodology and Techniques—Interaction Techniques

1 INTRODUCTION

This poster presents a set of user interface techniques for Spatial Augmented Reality (SAR) [5] to aid in interior architecture work such as kitchen design. We have developed an example SAR design application, *PimpMyKitchen*, in consultation with architects from the University of South Australia's School of Design. PimpMyKitchen's user interface is comprised of Physical-Virtual Tools (PVT) [4] that support the designer in both the design process and designer/client meetings. The tasks supported by the tools are: *Cabinet Layout*, *Design Presets*, and *Modifying Finishes*. While these techniques have been developed in the context of kitchen design, they can easily be generalised for use in other application domains, and address important interaction issues for SAR systems.

A key motivating goal of this work is to enhance the understanding and decision making ability of the client. While architects are accustomed to visualizing the end result from plans and CAD drawings, the client does not usually possess these skills. PimpMyKitchen provides 1:1 scale previews of the designs early in the design process. A second motivating goal is to provide designers and architects tools to manipulate and visualize designs on a 1:1 scale. SAR provides a new medium to explore designs. Our expert consultants indicate SAR provides an extra dimension to the design process. To facilitate the manipulation of designs in the SAR environment, new tools and techniques are required beyond the current state of the art.

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Figure 1: A user resizes the height of a drawer using the resizing tools.

2 BACKGROUND

We are interested in creating 1:1 previews of designs early in the design process. Hare et al. [2] have demonstrated the importance of physical prototypes to industrial design. DisplayObjects [1] bring spatial augmented reality to product design by projecting user interface controls and other elements onto simple physical mockups. Schwerdtfeger et al. [6] have demonstrated how laser projectors can be used for quality assurance in industrial settings. WARP [7] shows how SAR can be used to preview materials on scale models of design mockups. Our work builds on this foundation, bringing SAR technology to kitchen design and architecture. We use white cabinet 'blanks', and use projectors to create the detailed appearance of the design. Low et al. [3] used SAR technology to build life sized dioramas for visualizing room size entities with a mixture of physical walls and virtual projected imagery. Physical-Virtual Tools (PVT) [4] support interactions within a large-scale SAR environment. The user interface is based around physical tools, with the operation modes supported by a tool are defined by the shape of the tool itself. The use of SAR allows for an understandable overloading of the tool's operation by projecting information onto the tool.

3 PIMPMYKITCHEN

PimpMyKitchen was developed to support the early design process of kitchens and designer/client meetings. To support an architect when developing the initial kitchen design, *blanks* representing the cabinets are placed in an environment the shape and size of the target kitchen. The architect decides on the basic layout of the kitchen by moving the cabinet blanks into the desired locations. Once the blanks are in position, the architect can focus on the layout of the cupboards, drawers, and other components. The second use case for PimpMyKitchen is during meetings where both the architect

and client are present. The goal of these meetings is to come to an agreement on the layout of the kitchen, and for decisions regarding material finishes and component selection to be made.

4 CABINET LAYOUT

A key task for the architect is to decide on the layout of components placed into the cabinets, such as cupboards, drawers, and appliances. In addition to components in the cabinets, other design features also need to have dimensions set by the architect. These include bench thickness and overhang, kickboard height and inset, and component spacing. The system automatically arranges the components to fit the available space. Once the necessary components have been added, the architect can move on to specifying dimensions to the components, as shown in Figure 1.

The two-handed manipulation tool has been developed for performing operations such as resizing components of the kitchen. The tools consists of two identical halves which are held in each hand. To resize a component, the user places each half of the tool against opposite edges of the component to be resized, and adjusts the distance between their hands until the desired size is obtained. This is an intuitive gesture, and is a similar motion to how people estimate and communicate distances in the real world.

5 DESIGN PRESETS

While cabinet layout is conducted exclusively by the architect, previewing and modifying kitchen designs involves the client. *SAR Swatches* facilitate loading and saving kitchen designs. SAR Swatches are a metaphor adapted from the color swatches used to choose paint colors. A SAR Swatch (Figure 2(a)) is a small board with a 3D render of a kitchen design projected onto one side. Clients can quickly evaluate different designs by holding several in their hands at once. Placing a swatch onto a blank causes the swatch's kitchen design to be loaded onto the cabinet blanks. The back of the swatch is used for saving designs. A new design can be saved to a swatch by placing it upside-down on one of the cabinets. The graphics on the swatch will change, indicating the system is asking for confirmation (Figure 2(b)). To confirm the save operation, the user simply slides the swatch to the right. This motion will save the current kitchen design to the swatch.
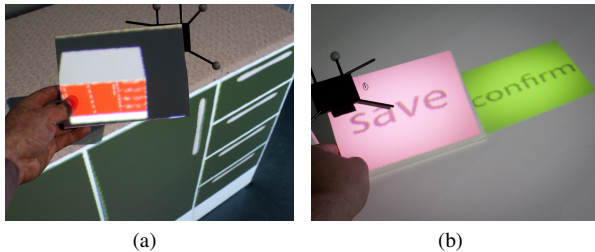

(a)   (b)

Figure 2: Comparing one design with another using a SAR Swatch (a), saving a new design to a SAR Swatch by placing the swatch on the cabinet, and sliding right (b).

SAR Swatches illustrate the tradeoff between several tools and a single tool. Rather than individual swatches, designs could be previewed one at a time on a tablet device. Alternatively, the system could only show designs on the full sized mock-up. SAR Swatches have several advantages compared to these alternatives. Swatches allow the user to compare different designs simultaneously, and to quickly flick through several different designs in a more natural way than using a menu. SAR Swatches adapt a device already in use in interior design: the paint color swatch. Swatches solve the problem of loading and saving data in a SAR environment in a way that is specifically suited to the nature of SAR. Text input is difficult in large scale SAR environments because there is not a logical location to place a keyboard. However, industrial design applications the data to be saved is often visual in nature. Therefore, there is no need for the user to enter filenames. Instead, they can access the data in a visual manner, and do not have to concern themselves with text entry.

6 MODIFYING FINISHES

The final use for PimpMyKitchen is to allow the client and architect to modify one of the presets in order to arrive at the final design. The client is able to select from several options to customize materials used for benchtops, doors, kickboards, and splashback, and fixture designs such as handles, power points, and taps. We have adopted a "magic touch" metaphor for the modifying finishes tool, as this greatly simplifies the user interface. To select different options, the user taps the surface of the cabinet blank with the Stylus. The system cycles through the choices one at a time. This mode of selection is acceptable because the number of choices is small. In addition, this tasks is fundamentally exploratory in nature. The client is interested in experimenting with different designs, and does not need to load specific finishes at this stage.

7 CONCLUSIONS AND FUTURE WORK

This poster has presented our work into using SAR for kitchen design and interior architecture. We have described the new PVT based interaction techniques for room-size modeling tasks, our demonstration application, PimpMyKitchen, and how these tools improve the design process. In the future we would like to extend PimpMyKitchen to allow functional analysis of kitchen layouts. For example, showing the available storage space once appliances, plumbing, and other components are in place. We could also optimize the functional layout by highlighting the predicted use of areas of the design, based on data on the clients actual usage patterns. In addition to these analysis tasks, we would also like to improve our graphics system. This would allow accurate previews of lighting configurations, based on models of actual light fittings.

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