Using Spatial Augment Reality for Appliance Design

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***Abstract*— Effective designs rarely emerge from good structural design or aesthetics alone. It is more often the result of the end product's overall design integrity. Added to this, design is inherently an interdisciplinary collaborative activity. With this in mind, today's tools are not powerful enough to design complex physical environments, such as command control centers or hospital operating theaters. In this demo a process for designing small appliances using spatial augmented reality is presented. The goal of this demo is to show how using a SAR environment can improve the design process.**

Keywords - component; SAR; Design;

I. BACKGROUND

The design process for white goods requires consultation during the entire process with stakeholders, such as clients, designers, engineers, managers, and most importantly end users. To gain a common view of the current state of a design, all the stakeholders evaluate a set of artifacts, images, drawings, and physical prototypes. The key problem with many of these artifacts is that the design cannot be easily modified during these reviews. This is especially true for physical prototypes since modifications to the prototypes are time consuming and avoided to maximize the economic viability. This demonstration shows a more flexible design process for these artifacts. To this end, we believe Spatial Augmented Reality [1] is a useful technology that can span the gap between design in the virtual space (CAD, 3D images, and animations) and the physical space (physical prototypes and 3D printing).

Spatial Augmented Reality (SAR) is a set of technologies that allow physical objects to be augmented with prospectively correct computer generated images. This approach can provide a number of advantages for the presentation of ideas including:

1) physical appearance attributes may be altered (color, texture and annotations),

2) fine detail can be iteratively added,

3) user interfaces can be simulated with full interactive functionality, and

4) users can physically touch augmented objects, unlike pure virtual implementations that usually do not provide suitable haptic feedback.

There are a number of previous works that have explored using SAR for assisting with design. WARP [2] allows designers to preview different materials on rapid prototype design mockups. Laser projectors have been used with SAR to assist the industrial processes, including marking weld points [3], and interactively programming robot arm paths [4]. Our own work has used SAR for digitally airbrushing onto physical objects [5], aiding prototype creation with augmented foam sculpting (see Figure 1) [6], and to act as virtual controls on physical control panels [7]. This demonstration further explores SAR for appliance design and the processes required to support a generic solution.

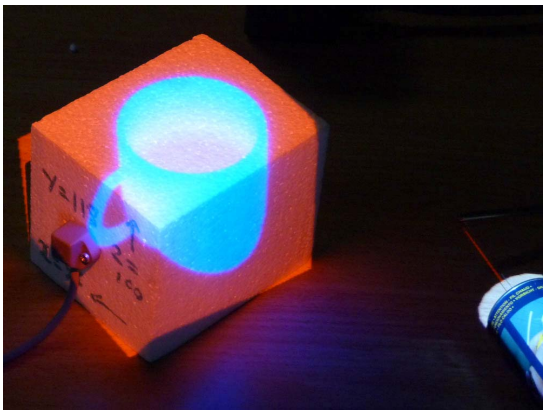

Figure 1. Creating a physical mug from a square block of foam using Augmented Foam Sculpting

II. DEMONSTRATION

In this demonstration we show how a SAR can make a significant difference to the design process. In particular, we show how the use of commercial off the shelf software in unison with a simple SAR installation to improve quality and speed of development. In this case study we show how kitchen white goods can be quickly and easily designed using a SAR system. We present the design iterations employed for the creation of a SAR based kitchen stove.

Consider the design aspects of a kitchen stove with respect to the placement of the oven door, controls and its appearance. To

begin the design process, a simple 600mm x 600mm x 900mm Waldo made of foam (shown in Figure 2) is produced. An approximate shape is constructed ready for projection. For this design we selected these dimensions, as they are the standard size of many kitchen components. Also the Waldo was made at a scale of 1:1 allowing stakeholders to interact with a realistic prototype. Blank Waldos can be created from foam or similar materials. In the case of kitchen appliances a small number of generic shapes would be sufficient to illustrate all the possible kitchen white good designs.

Figure 2. Blank Waldo (600x600x900mm) in the shape of a kitchen appliance that was constructed with white polystyrene foam.

The next step in the process is the construction of the virtual model using a commercial software package. This is used to build the box shaped model so we have matching physical and virtual models. This will give the SAR software a virtual representation of the stove shape without texturing or colors. This completes the initial setup of the virtual and physical design environment aspects.

Following this, the appearance details are created using image-editing applications to create the textures, controls and design details. This part of the process is iterative and will cycle through making changes to the stoves design. As design iterations are performed, the appearance information is projected using the SAR system to produce a realistic prototype. This process is summarized in the following six steps:

1. Edit the flat design for the stove on the computer.
2. Generate the appearance texture information (in our example the front and top view of the stove).
3. Pass the textures and model to the SAR system.
4. Project the SAR model on the Waldo.
5. Revise the design.
6. Return to step 1, as more changes are needed until the final design is created.

In our demo we use a simple editing program to undertake a design step of the stove. In a production environment this could be a commercial piece of design software rather than a simple drawing editor. Our software will generate textures such as those in Figure 3.

Figure 3 Texture Design For Stove

Figure 4 Top of Initial Design Project

Once we have loaded the model and textures into the SAR we will use the SAR to project the prototype (for example Figure 4 and Figure 5). This process will be repeated showing how rapidly changes can be made to the design with a realistic prototype being produced on each iteration. For the sake of brevity the demo will limit our design process to basic layout of components.

Figure 5 Initial Design Projection

III. PORTABLE SAR ENVIRONMENT

One of the advantages to the SAR modeling approach is the simplicity of setup using readily available hardware. To demonstrate the flexibility of a SAR system, we will prepare a mobile projection system used to present the demonstration. The system will consist of two projectors mounted on portable stands and a standard personal computer. Once the software initial calibration is performed, the above process can be easily applied with minimal training using our customized SAR software. In the demonstration environment we use only two projectors to minimize the size during travel. However, this number can easily be increase to support higher resolution projections and larger design artifacts. Figure 6 provides a mock-up of a large-scale environment that leverages many projectors so that very large prototypes can be visualized using SAR.

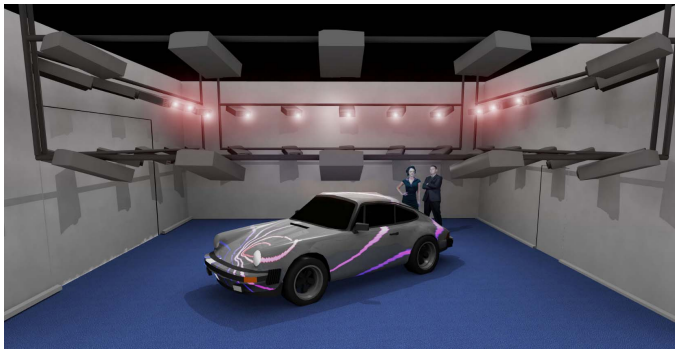

Figure 6 Mock up of a SAR projection environment to support visualisations on large-scale prototypes.

IV. CONCLUSION

This demonstration presents aspects of the future directions of using SAR as a design tool. The process of creating a realistic prototype allows non-technical stakeholders to take part in a design of a product. Our demonstration presents the design of a white goods appliance that was created using expertise of industrial designers that leveraged the SAR prototyping environment. The demonstration provides the conference attendees an opportunity to experience a rapid design prototyping scenario that will design a stove in-situ.

V. DEMO REQUIREMENTS

The demo does not have significant requirements other than sufficient space to setup two projectors, a laptop computer and a foam Waldo in addition to electrical outlets to support the hardware. The presenter will provide the required hardware to do the demonstration.

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