Special Report

by Todd Zazelenchuk, *Ph.D., Global Consumer Design, Whirlpool Corporation*
e-mail: editor@appliance.com

Virtual Housewares?

Designing portable appliances for the kitchen is not easy, and in recent years, it's become even more challenging. An increasing emphasis on understanding one's consumer has seen design teams conduct more intensive user research than ever before.

Rising material costs have demanded a more conservative approach to material selection. For instance, in a recent 9-month period, cold-rolled stainless steel increased more than 65 percent in price. Additionally, an increasingly competitive landscape has required designers to focus on brand, creating a coherent, unified family of products for the marketplace. Amidst all of these increases, however, two things remain unchanged—the time and budget allotted to bringing new products to market are never enough.

In an effort to help reduce time and costs during the development cycle, appliance designers have long relied on creating prototypes. Crude mockups made of foam core, followed by higher fidelity resin models, allow designers to see and convey their initial sketches and renderings in physical form. A more recent prototyping tool in the design of kitchen housewares is computer simulation. Like its physical model counterparts, computer simulation can help speed up the design process and reduce some of the uncertainty around a new product, particularly the way users are expected to interact with it. The best may still be around the corner, however. Virtual reality and haptic technologies represent the next level of prototyping available to housewares designers, one that may completely revolutionize current prototyping methods.

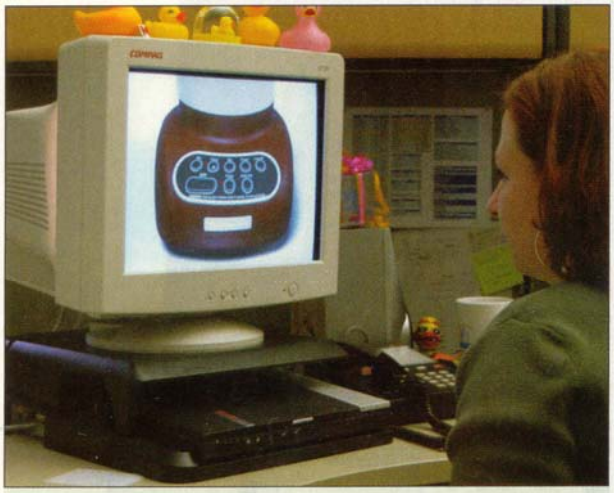

Figure 1. Pictured is a Flash simulation of blender controls for a KitchenAid blender.

Prototyping Electric Housewares

Physical Prototyping

Traditionally, the housewares industry has made extensive use of physical prototypes during the design process. Styrofoam mockups, gray foam, Fused Deposition Modeling (FDM), and Stereolithography (SLA) models are all relatively quick and inexpensive to produce. These models afford the design team an opportunity to assess the overall footprint of the product, its possible orientations on the kitchen countertop, and its relationship to other products within the same family.

The price paid for a quick and inexpensive physical model, however, is typically a lack of fidelity, resulting in models that are rarely representative of the final product's weight, texture, or individual parts.

Table 1.

Advantages of computer-based prototypes:

- reduces the number of more costly and time-consuming physical prototypes required in the design process
- helps the design team understand the product's interaction model early in the design phase, thereby avoiding uncertainty and confusion among team members about the final design's operation
- allows human factors engineers to evaluate the product's interaction model with actual users early and often throughout the design phase
- allows marketing to verify early concepts with consumers
- can be edited easily to incorporate new ideas or address problems identified during evaluations and then re-tested again as part of the iterative design process
- provides customer service personnel with valuable support tools during customer service calls

Disadvantages of computer-based prototypes:

- certain product behaviors lack fidelity in a computer simulation due to the requirement that users interact with a computer mouse or other input device, rather than the actual object itself (e.g., turning a dial, lifting a lid, flipping a switch)
- often end up being a "throwaway" tool once they have served their initial purpose since the actual coding required for the final product generally needs to be redeveloped from scratch following the simulation. Companies such as eSim (maker of RapidPlus) and Amulet Technologies are two software producers currently tackling this problem by offering applications that more effectively reuse the code from the prototyping process.

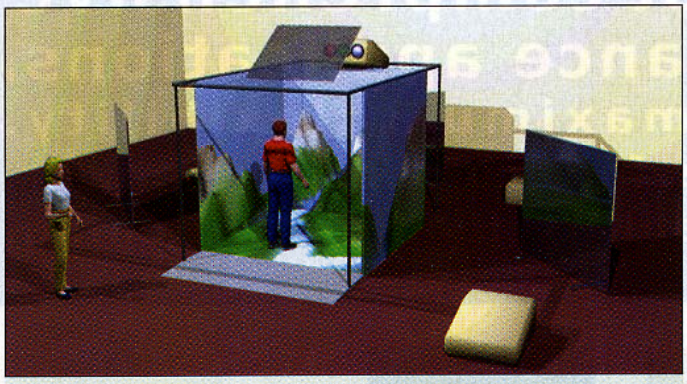

Figure 2. Example of CAVE (CAVE Automated Virtual Environment). Photo courtesy of Dr. Eric Wernert, UITS, Advanced Visualization Lab, Indiana University.

This can limit the design team's ability to evaluate such models effectively with target consumers. The one-piece design of most physical prototypes also makes it hard to incorporate changes, resulting in entirely new models being created for each iteration.

Paper Prototyping

In concert with the foam and resin models created by the designers, the human factors engineer will commonly use paper prototypes of the system's interface to evaluate initial concepts for the system's interaction model. This typically occurs very early in the design phase to allow for maximum user testing and iterations. For simple products such as toasters and hand-held blenders, paper prototypes may be more than sufficient to evaluate the design questions at hand. As the complexity of the product increases, however, features such as scrolling text messages, audio signals, and flashing lights introduce a level of interaction that can be hard, if not impossible, to simulate using paper.

Computer-Based Prototypes

Computer-based prototypes offer design teams a valuable supplement to physical and paper prototyping methods. Similar to paper prototyping methods, computer-based prototypes excel at letting design teams test their assumptions regarding the product's interface. Will users be able to turn it on? How will they operate the primary features? How will they monitor their progress? In contrast to paper prototyping, however, computer-based prototypes offer an increased level of fidelity and interaction, making it possible to represent a product much more accurately.

At the most basic level, Microsoft PowerPoint and similar presentation software programs provide acceptable prototyping tools, capable of combining images, text, and sounds, together with hot spots that allow users to navigate through a proposed design. Macromedia's Flash and Director software applications are perhaps the most popular programs on the market today for creating intermediate to advanced computer-based prototypes. Both are capable of combining images, text, audio, and animation to create more polished prototypes that can easily be distributed via CD-ROM or the World Wide Web.

As with the physical and paper prototyping methods, today's computer-based methods require that designers have access to the necessary skills and software to create the prototypes in a timely manner. As with any prototyping method, designers need to be aware of both the advantages and disadvantages associated with computer-based prototyping (see Table 1).

A Virtual Blender?

In a recent project at KitchenAid, the design team had questions about the design of its latest blender. Jar weight and user interaction topped the list at that particular point in the project. To investigate the issue of jar weight, physical prototypes were the only recourse for the team. By the time the necessary tooling costs, production time, testing, and recommendations had been completed, more than 3 months and several thousands of dollars had been expended.

In contrast, the interaction question was addressed by visiting Whirlpool's Vizlab, a specialized studio of computer animation and 3D modeling professionals with the ability to create high-resolution renderings and interactive models for presentation and testing (see Figure 1). In this case, three different Flash-based animations of the blender control panel were produced within a week. Incorporating audio files for the various blender speeds and corresponding LED lights to indicate the currently selected feature, the computer-based prototype provided the design team with high-quality, highly realistic models that were then available for actual users to interact with during usability testing.

Interestingly, the prerequisite activity of mapping out the interaction model in order to create the prototype was a valuable exercise in itself, as it required the design team to consider the finer details of their proposed interface. User testing subsequently confirmed some of the anticipated issues with the proposed controls, and adjustments were made prior to final production. The entire time required for prototype development and testing combined was less than 2 weeks and was completed at a fraction of the cost required for the physical prototyping.

The Future of Prototyping

So what might prototyping in the kitchen appliance industry look like a few years down the road? If the current virtual reality environments that exist at major research universities are considered, and it is assumed that the costs and configurations of CAVE (CAVE automatic virtual environment) systems will drop in price similar to other technological advancements, it is reasonable to believe that current physical prototyping methods may soon become obsolete (see Figure 2).

Imagine members of the design team immersed in a virtual reality environment, able to experience how their full-size, rendered models are going to look from any angle, as well as how they might be integrated into multiple kitchen environments. Add to this scenario the ability to sense haptic, or tactile feedback, such as that being developed by Sensable Technologies, and it's easy to imagine target consumers easily interacting with what are truly virtual blenders, directly experiencing their size, shape, and weight, and even the forces required to manipulate them. Observe a user turn a dial or lift a blender jar and express dissatisfaction with the forces required? No problem. The researcher will simply adjust the product's specifications on the fly and ask the user to give it another try. Following a series of such sessions, designers will return to their desks, equipped with specific, quantitative data that will allow them to close in on the optimal design for their product.

In short, it seems safe to say that prototyping will fundamentally change in the coming years. Advanced computer simulation technologies will allow design teams to combine their physical and computer prototyping into a single, seamless effort, letting them validate their interaction models at the same time as they validate the aesthetic and ergonomic assumptions that are inherent in their designs. By permitting design teams and target consumers to view, touch, manipulate, and fully experience new appliance concepts in this high fidelity, highly realistic manner, products may soon pass through an entire design cycle with the first physical model being the finished appliance that comes off the production line.

About the Author

Todd Zazelenchuk, Ph.D. is a human factors researcher with the KitchenAid Portables design team of Whirlpool Corporation in Benton Harbor, MI, U.S.

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