Chapter 9
Virtual Reality Systems for Industrial Design Application

Alice Pignatel
Politecnico di Milano, Italy

Fausto Brevi
Politecnico di Milano, Italy

ABSTRACT
3D digital models are an essential tool that supports every step of the industrial product design process. For example, during the design review step photorealistic models are used as virtual prototypes for aesthetic and ergonomic evaluation of new products, in order to anticipate design evaluation and choices and to shorten the overall process. For this reason, industrial design enterprises usually have special rooms equipped with a projection based large display, for the realistic visualization of digital models. Usually, the interaction with 3D models is still based on mouse and keyboard, even if this kind of input is not fully adequate to the interaction needs concerning such special application. The aim of this chapter is to investigate different interaction techniques and outline their benefits and drawbacks compared to the interaction tasks required in this special field.

3D DIGITAL MODELS IN THE INDUSTRIAL DESIGN PROCESS

Today, Industrial Design is a key factor to get competitive advance over market competitors. In fact, the role of the ID is to understand the needs of the potential user in order to create more attractive and useful objects. In the global market, the fundamental issue for a successful product is the shortening of time-to-market.

In this context, 3D digital models are a powerful tool that can support all the steps involved in the Industrial Design process for new products development. In fact, digital models are quicker to prepare than physical maquettes and they allow faster changes to the original shape. Moreover, they are less expensive and easier to store. Thus, digital models can sometimes replace the physical models in the Industrial Design process. For example, 3D digital models can be used as virtual prototypes to check both technical and aesthetic qualities of...
the industrial product, in order to anticipate the evaluation step of the process.

A virtual prototype is a 3D model that reproduces the features of the real object that must be developed. When a specific issue is under evaluation, it is necessary to set up a system that allows to interact with the virtual object exactly in the same way as if it was real. For instance, during the so called Design Reviews, when the aesthetic of a new product is under evaluation, it is important to display the digital model as it would really appear, with realistic looking materials and with the possibility of moving all around the object to consider every detail. This activity is crucial to achieve high quality products, because all the issues related to the final user’s perception of the product are discussed by the design project team. In fact, these discussions are generally more focused on generic subjects rather than on specific technical problems. Usually the chief designer, or project leader, shows to other people attending the design review the product details and features, in order to check the new product before proceeding to further development steps. People attending Design Reviews usually belong to different production departments, not only to the design workgroup. In fact, while discussing the shape and the object features, it is important to consider all the issues involved during the life cycle of the new product, in order to avoid or at least to correct design errors, saving time and money.

During the Design Review it is necessary to display highly realistic looking 3D models, and also to perform some basic interaction task in order to present the best visualization of the different product parts. For this reason the Industrial Design Companies attention towards real-time rendering software is always increasing. This kind of software allows not only to visualize digital objects in a realistic way, but also to show product and material variation in order to evaluate different product configurations. Moreover, the virtual camera can be interactively displaced, according to user’s visualization needs.

For this reason, an always increasing number of private Industrial Design Industries built “Virtual Theatres” fully dedicated to design review activities.  

TYPICAL VIRTUAL ROOM SET-UP AND RELATED ISSUES

A Virtual Room is expensive and space consuming, because it needs special equipments that must be installed in a large room fully dedicated to 3D models visualization purposes. Thus, virtual rooms are a convenient investment when dealing with highly complex products with a long life cycle.

Usually they are equipped with large screen that allows the visualization of the virtual object at the real scale. People attending to the review need to move freely in front of the screen; for this reason retro-projection techniques are used and projectors are connected to one or more workstations, according to the needed rendering performances, equipped with the high end real time rendering software. Moreover, additional devices allow stereoscopic visualization of the digital models in order to improve the realistic look of the virtual prototype.

Usually ten or fifteen people attend to the design review and their seats are placed right in front of the large screen, while the workstation is placed on their back, in a room corner, so that it is scarcely perceived during the work session.
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