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Chapter XII

Virtual Sets: Concepts and Trends

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INTRODUCTION

Techniques of filming using special effects have existed since the 1920s, well before the advent of computers. Two of them are known as *Back Projection*—when an actor acts in front of a screen that reproduces other footage (very common in train scenes), and *Blue Screen*—when an actor acts in front of a blue wall for later composition with another scene (Fielding, 1985). However, it was computer graphics and the technological advance of the computers that made possible the great evolution in this area.

Virtual Sets or *Virtual Studios* are denominations given to the integrated use of computer-generated elements with real actors and objects in a studio. Its main advantages are: more flexibility in changing the scene, risky scenes can be made safely, allowing the production of complex special effects and also providing economy in the production of sophisticated designs, along with flexibility in making quick changes. With the advent of high-speed networks, there is the possibility of remote operation.

Real-time Virtual Sets is a very recent area for computer graphics with potential applications in the film and television industry. The literature about this topic is scarce although there are few commercial systems available, which will be described later.

This work approaches Virtual Sets, describing its conceptualization and showing its correlation with other areas in computer graphics. The Virtual Sets' pertinent technologies are identified in computer graphics and have their given solutions and unsolved problems argued.

RELATED SYSTEMS

Virtual environment refers to a virtual world composed by computer-generated objects and places based on a 3D data set that describe them geometrically to simulate a real place. This virtual environment can have the feature of being immersive or not, depending on the handling given in the system. *Immersion* means to allow the user to experience the sensation of presence in this virtual environment and to interact with it, navigating in the environment, touching objects, listening to sounds.

This sensation of being part of the virtual environment, as well as the 3D vision with depth experienced by the user, has been possible only by using stereo vision equipment that propitiates the vision of an image with depth, obtained from two images that are generated with a small difference in the observer positioning, called parallax information. Stereo vision equipment can be *active*—when the user determines the view according to the head's movement—or *passive*—when the user just receive the image, for example—the passive polarized glasses used in 3D cinemas.

The systems, whose purpose is to **integrate real and virtual worlds**, need different techniques and aim at the most diverse applications. Its common features are: virtual environment, immersiveness, to match virtual and real worlds and real-time.

The different approaches in these systems are the function of the virtual environment and its real-world correlation. Some systems grant immersion to the user, others have different degrees of interaction between the user and the virtual environment and some are characterized by the total absence of interactivity and immersion. Based on that, we will focus on research areas that have technologies in common with virtual sets, pointing out their features and main applications and explain why they are in themselves not enough to do Virtual Sets. The more related areas are described as follows.

Virtual Reality

Virtual reality is a very important research domain that presents multi-sensorial information, all generated in accordance with the user's behavior, in real-time.

In virtual reality there is a 3D computer-generated environment in which the person, in the real world, can interact having the sense of being immersed in this environment. For that, the user needs to wear an optical device that induces him to this integration with the virtual environment, and makes him lose the bond with the real world. The most common device is the Head-Mounted Display (HMD), that is a type of eyeglass-helmet that allows vision with perspective and depth in the virtual world. In some systems, the use of special gloves also allows the tactile interaction with objects in the virtual world (experiencing the sensation as if the person was touching the virtual objects). The aim of these systems is to have the user completely immersed in an artificial world.

In these systems, the movement of the user's head determines the vision angle; therefore it is necessary to make the accompaniment of this movement, called *head tracking*. The head-tracking device supplies information of location and orientation of the user's head to a computer graphics station that calculates the images to be displayed on the screen, which should be consistent with the direction where the user is looking at in the virtual world. Almost the totality of the applications in this area is in real-time and based on the observer positioning.

Other types of virtual reality systems are called semi-immersive, based on wide-screen projection for large audiences. People wear low-cost polarized passive glasses which do not allow looking down without losing immersion; this problem occurs with any normal audience seating arrangement, like 3D movies. In this kind of application, the glasses are passive because the system cannot track more than one person at a time.

Some of the most important projects developed for virtual reality are described below.

- **CAVE**, Electronic Visualization Laboratory (EVL), University of Illinois, Chicago. The most well-known modes of virtual reality are *head-mounted displays* and *binocular omni-oriented monitor (BOOM) displays*. In addition, the Electronic Visualization Laboratory introduced a third one in 1992: CAVE, the name selected