Chapter 20
Virtual Reality in Architecture, in Engineering and Beyond

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ABSTRACT

Virtual Reality (VR) is a technology which has various application fields (from video games to psychiatry). It is indispensable in critical simulation, for instance in military training, in surgical operation simulation, in creation of environments which could set off phobias (in psychiatry), or in realization of virtual prototypes, for instance in industrial design. The aim of this chapter is to present how the VR also finds excellent application fields in architecture and in engineering. For instance, in the teaching of the basic concepts, in techniques of graphic rebuilding for the building restoration, in realization of virtual visits inside buildings, and in urban generative processes simulated by computer. Another use of the virtual reality is in the introduction of a new kind of architecture: Virtual Architecture, strongly connected to the Information and Communication Technology (ITC), to the Internet, and in the virtual prototyping in engineering.

INTRODUCTION

Virtual reality (VR) is a technology which permits to create virtual objects and 3D virtual worlds which are hosted on the computer’s memories. VR can be classified according to its methods of display; we have: a) immersive VR (which involves a high degree of interactivity and high cost peripheral devices, for example the head mounted displays), and b) non-immersive VR (often called desktop VR which is in the form of a windows into a virtual world displayed on a computer’s monitor). A virtual reality system has the following three primary requirements (Rosenblum & Cross, 1998): a) immersion (which permits to the user the physical involvement, capturing exclusive visual attention and responding to three-dimensional input. For example, through a head-tracker, 3D mouse, data glove, or fully instrumented body suit); b) interaction
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Different disciplines involve the application of VR. Recent studies have recognized the potential of VR in education in different disciplines (Winn, 1993; Pantelidis, 1995; Byrne, 1996; Youngblut, 1998; Ainge, 2000; Kaufmann et al., 2000; Mantovani, 2001, Gerval et al., 2002; Shin, 2004; Sala & Sala, 2005; Popovici et al., 2009). Virtual Reality offers benefits that can support the education and the design project, in particular in the faculties of architecture.

Sala & Sala (2005) applied VR technology in a course of mathematics oriented for architectural studies and dedicated to the connections between this discipline and the world of arts and design. VR has been used firstly to help the students to visualise in three dimensions, since this is arguably the most difficult part of understanding architecture. In this case, the students have used the Virtual Reality: to study and to manipulate virtual polyhedra, to observe and to manipulate virtual molecules of $C_{60}$ and $C_{70}$ (fullerene molecules), to analyse the symmetry inside the architectural shapes, to observe and to manipulate 3D virtual models of geodesic domes, and to study their analogy with the fullerene molecules (Sala & Sala, 2005).

In the same faculty, VR is also integrated in multimedia presentation to describe “virtual 3D walkthroughs” in the buildings, in virtual museums and in archaeological sites. This educational approach, based on the use of VR, is important,