Chapter 64
Realistic Simulation of Cultural Heritage

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ABSTRACT

One of the most challenging problems in the simulation of real environments is to generate worlds that appear realistic and more attractive. It becomes increasingly challenging when the simulated environment focuses on minors (students), because the young generation has high demands on simulation systems due to their experience in computer gaming. Virtual museums are among the most important simulation environments, which present cultural and educational content for everyone. Their purpose is to enrich the users experience by allowing an intuitive interaction with the museum artifacts and to offer knowledge with the most pleasant ways. This paper focuses on the aspects of realistic simulations in the development of virtual 3D environments for Cultural Heritage applications. This study includes aspects regarding some of the most high-tech image effects, applicable artificial intelligence methods, powerful game engines, how real object can be reconstructed realistically and how all those features may be combined to produce realistic, pleasant, productive and educative environments.

INTRODUCTION

In realistic simulations of Cultural Heritage, virtual museums have a prominent role. Virtual museums are virtual environments that host virtual exhibitions created to tell the stories of the real museum artifacts to their visitors, just like in real museums, in a richer context and a wider range of possibilities. In the context of a real museum, this is achieved by combining exhibits and information in a carefully designed order and presentation style (Lepouras & Vassilakis, 2004). In the creation of virtual museums, contemporary IT technologies, such as multimedia, 3D computer graphics, spatial sound and virtual reality, can be used to enhance the presentation (the virtual presence), offering a more vivid and enjoyable

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experience. Although each of the different technological innovations involved pushes towards their own respective, there are two main goals that are universal in such systems: *realism* and *speed*. In addition, the continuous development of Web services and computer infrastructures complemented by the increasing availability of computer game development platforms (also known as *game engines*), contribute towards a continuous release of serious games in diverse fields including entertainment, cultural heritage, education, artificial intelligence, sociology, military and health systems (Breuer & Bente, 2010). In a sense, serious games can be considered as an efficient approach for blending domain specific activities, like in cultural heritage and education, with gaming. By utilizing contemporary visualization and simulation technologies, serious games enhance the user's experience through photorealistic interactive environments (Van Eck, 2006). This form of stimulation is considered to be one of the primary factors for successful user engagement, in which playing, assumes the role of the driving force that promotes concentration in the activity process and user encouragement for further self-improvement. Stimulation is largely considered by the scientific community as a desired mechanism to achieve the desired results (Rogers, 1996).

Numerous works utilize various technologies to provide solutions for history teaching and learning, or to enhance actual museum visits. The notion of virtual museums and exhibitions has been introduced as an approach to overcome the limitations of the physical space and to provide a vivid experience to remote visitors (Tsichritzis & Gibbs, 1991). An overview of virtual museum technologies is presented in (Sylaiou, Liarokapis, Kotsakis, & Patias, 2009). The Augmented Representation of Cultural Objects (ARCO) (Patel, White, Walczak, & Sayd, 2003) (Wojciechowski, Walczak, White, & Cellary, 2004) was among the predominant efforts towards a dynamic virtual museum system accompanied by a 3D digitization technique to provide a framework to produce and exhibit 3D digital replicas of their artifacts. ARCO was also, evaluated as an Augmented Reality Interface (ARIF) (Sylaiou, Mania, Karoulis, & White, 2010) by focusing on the user experience in relation to the technologies of ARCO. In 2004, Lepouras & Vassilakis (2004) presented the concept of creating virtual museums focused primarily on educational content and related services by using a game engine. This virtual exhibition space took advantage of the high visual quality of modern game engines. Pavlidis et al. (Pavlidis, Tsiafakis, Provopoulos et al., 2006), proposed a Web-based 3D digital replicas management system with a dynamic virtual exhibition showroom. In addition, in (Pavlidis, Makarona, Arnaoutoglou et al., 2008) a more advanced framework for digital museums has been presented, where a non-photorealistic digital replica of a real museum is used to demonstrate educational activities rather its actual exhibition, aiming at increasing the museum's visitors. Sookhanaphibarn & Thawonmas (2009) presented a 3D virtual museum developed in the Second Life 3D world engine. The virtual museum was equipped with an innovative intelligent guidance system that was able to provide a customized navigation route based on the visitors' preferences (2009). In (Djaouti, Alvarez, Rampnoux, Charvillat, & Jessel, 2009) an interactive serious game is used for the promotion of a prehistoric heritage site. Anderson et al. (Anderson, McLoughlin, Liarokapis, Petridis, & Freitas, 2010) reviewed the state-of-the-art of theories, methods and technologies utilized by serious games as cultural heritage promotion tools by showing case studies that exploit such technologies. Papastamatiou et al. (Papastamatiou, Alexandridis, Tsergoulas et al., 2010), presented a dynamic Web-based 3D e-shop system for commercial use, offering a WYSIWYG graphical user interface. Furthermore, Sillaurren & Aguirrezabal (Sillaurren & Aguirrezabal, 2012), presented 3DPublish, a content management system that was developed in Unity3D game engine and allowed the generation of dynamic 3D exhibitions. Furthermore, works like (Bellotti, Berta, Gloria, D'ursi, & Fiore, 2012) focus on a generalization of the task-based learning theory in applications using smart mobile devices. In addition, Koutsoudis & Pavlidis (2011), proposed a novel approach for navigating within complex cultural scenes by exploiting content-based retrieval descriptors.