Adaptive 3D Web Sites

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Abstract. In recent years, technological developments have made it possible to build interactive 3D models of objects and 3D Virtual Environments that can be experienced through the Web, using common, low-cost personal computers. As in the case of Web-based hypermedia, adaptivity can play an important role in increasing the usefulness, effectiveness and usability of 3D Web sites, i.e., Web sites distributing 3D content. This paper introduces the reader to the concepts, issues and techniques of adaptive 3D Web sites.

14.1 Introduction

In recent years, technological developments have made it possible to build interactive 3D models of objects and 3D Virtual Environments (hereinafter, 3D VEs) that can be experienced through the Web, using common, low-cost personal computers. As a result, 3D content is increasingly employed in different Web application areas, such as education and training [18, 30, 40], e-commerce [26, 36], architecture and tourism [42, 44], virtual communities [2, 45] and virtual museums [4].

Web sites distributing 3D content (hereinafter, we call them 3D Web sites for simplicity) can be divided into two broad categories:

- sites that display interactive 3D models of objects embedded into Web pages, such as e-commerce sites allowing customers to examine 3D models of products [26], and
- sites that are mainly based on a 3D VE which is displayed inside the Web browser, such as tourism sites allowing users to navigate inside a 3D virtual city [44].

In the first case, the primary information structure and user’s interaction methods are still based on the hypermedia model, with the additional possibility of inspecting 3D objects. In the second case, the primary information structure is a 3D space, within which users move and perform various actions. For example, a furniture e-commerce site might be based on a 3D virtual house where users can walk, choose furniture from a catalogue, and place it in the various rooms [36].

3D Web sites are not meant to substitute the hypermedia model which is the mainstream in today’s Web, but they can be more effective when there is added value in
interacting with a 3D visualization, or in providing a first-person virtual experience close to a real-world one. For example, in the case of e-commerce, 3D models give customers the ability to visually inspect, manipulate, try and customize products before purchasing as they are accustomed to do in the real world [27]. In the case of cultural heritage, a Web museum implemented as a 3D VE allows one not only to display the museum items, but also to convey their "cultural setting" by placing them in a proper environment.

As in the case of Web-based hypermedia, adaptivity can play an important role in increasing the usefulness, effectiveness and usability of 3D Web sites. For example, an intelligent adaptive navigation support system could help users with different navigation abilities in finding targets, orienting themselves, and gaining spatial knowledge of the environment. Unfortunately, there are currently no well-established techniques or commercial tools to build adaptive 3D Web sites. Moreover, because of conceptual and technical peculiarities of 3D Web sites, most approaches, techniques and software tools developed for the Adaptive Web cannot be straightforwardly applied to personalize 3D Web content, navigation and presentation. However, some research projects have addressed the issue of adaptivity for 3D Web sites. For example, a first software architecture [17] for dynamic construction of personalized 3D Web content has been proposed and applied to e-commerce [14,16] and virtual museums [13]. Some researchers have developed methods for personalized navigation support [12,27], adaptive interaction [11] and content presentation [24] in 3D VEs. Recently, there have been some attempts at experimenting with general-purpose frameworks for Web adaptivity to deliver personalized 3D content [15,21].

This Chapter will introduce the reader to the concepts, issues and techniques of adaptive 3D Web sites. We will mainly focus on 3D Web sites based on 3D VEs, since this category is the most general and complex one (but most of the techniques we will present can be applied also to Web sites with interactive 3D objects). The Chapter is structured as follows. Section 14.2 provides an introduction to 3D Web sites for the novice reader, overviewing the major application areas, and mentioning the main technologies, with a focus on standards. Section 14.3 discusses adaptivity in the context of 3D Web sites and with respect to Web-based hypermedia, separating the problems of modeling and adaptation. Section 14.4 describes an example of a full generic architecture for adapting 3D Web content, which is instantiated in Section 14.5 considering a detailed example in the domain of e-commerce. Finally, Section 14.6 concludes the Chapter.

14.2 3D Web Basics

The languages, protocols and software tools that make it possible to build 3D models and 3D VEs that can be experienced through the Web are collectively identified with the term Web3D technologies. Nowadays, thanks to the increase in network bandwidth and processing power (especially 3D graphics capabilities), Web3D technologies allow a large number of users worldwide to experience complex 3D Web content, such as virtual cities, visualizations of scientific data, or virtual museums.

Web3D technologies are based on the basic technical and architectural choices typical of Web technologies: content, represented in a proper (and typically textual)