Chapter 2.32
Adaptive Virtual Reality Museums on the Web

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INTRODUCTION

Museums have long been regarded as keepers and preservers of artefacts and cultural products. However, the notion of a museum with a primary goal of preserving has been changing during the past few years and is being replaced by one that couples education and entertainment. Under this view a museum is an institution open to the world with an objective of aiding visitors learn while they are kept content. To this end, the Internet and especially the Web has offered museums the medium to open up to the public and reach a wider, ever-increasing audience.

The technologies underlying the Web provide a strong background for building online multimedia applications that can help museums attract Internet visitors. Towards this objective, one key aspect in developing a successful Web application is the ability to supply the proper information for the targeted user group. This is especially true for Web-based applications where the users visiting may come from a variety of cultures, educational backgrounds, ages, and have different preferences and objectives. This requirement can be met by implementing an application that will adapt to the user's profile, and each time an Internet user visits the Web site, it will provide the appropriate set of information in the most efficient way.

Virtual reality (VR) technologies on the other hand have been evolving during the past few years, leaving research laboratories and finding application in a number of areas. Virtual reality promises the creation of environments that are vivid, lifelike, and highly interactive, and where the user will be able to emerge in a synthetic world that may not exist or may be too difficult or too dangerous to visit in a real-world situation. In this respect, virtual reality technologies may find direct applications in museums, providing

memorable experiences by helping users visualise and interact with exhibits.

The objective of this chapter is to specify the architecture of a system that combines the benefits of the aforementioned technologies in delivering adaptive virtual museums on the Web. Such a system may be used for both edutainment and research activities for a variety of potential target groups.

BACKGROUND

The term *virtual museum* was coined by Tsichritzis and Gibbs (1991), where they describe the concept of a virtual museum and the technologies needed to realise it. However, in past years the term *virtual museum* has come to denote anything from a simple multimedia presentation of selected museum content, to a high-end, state-of-the-art installation, with 3D projection facilities where the user immerses in a virtual environment. In the context of this work, we will use the term *virtual reality museum* to refer to a virtual environment built with 3D technologies, not necessarily immersive, but one where the user is able to navigate in a three-dimensional exhibition. To this end, an adaptive virtual reality museum denotes a dynamically custom-built environment that fits the user's preferences, as well as her cultural and educational background. An adaptive virtual environment provides each user with a different view of him/herself, taking into account the user's profile. A virtual reality museum comprises the structure of the virtual museum building, the objects that are placed and exhibited within, as well as the interaction methods by which the user can navigate and interact with the objects. All of the aspects of the environment may be adjusted to better meet the user's preferences and profile:

1. The structure of the 3D space, that is, the halls comprising the virtual museum, their interconnection paths (corridors, teleports, etc.), and the exhibit placement in each hall.
2. The exhibits that are available for viewing and the resources used for their presentation (audio, video, documents). For example, if the user's profile is one of a primary education student, the environment should change the presentation of exhibits, documenting texts, and even hide some exhibits if they are not suitable for display to children.
3. The interaction methods available to the user, both for navigation within the virtual environment and for the manipulation of the exhibits. For instance, users with little computer experience may only be allowed to walk around the exhibits, while more experienced users can be presented with the option to "grab" and rotate or move the exhibits. Alternatively, the same options may be available with varying degrees of complexity: for example an elementary school student may be allowed to disassemble some complex machinery by simply selecting the appropriate spot, while a trainee mechanic should perform the same task by precisely following the "real-world" procedure.

Information that will enable the system to appropriately adjust the content can either be directly provided by the user (e.g., "I am using a 56.6K modem," "I am a researcher"), or be inferred by the system from the user's interaction pattern (e.g., resources requested insofar, time needed for the user to download content, etc.). If during her interaction the user shows more interest in specific exhibits than others, the system should take this preference into consideration when constructing the next museum hall.

Virtual environments enable the user's immersion in a synthetic world and can provide a vivid, lifelike experience. Virtual environments have found applications in a number of different areas: Strickland, Hodges, North, and Weghorst (1997) describe a virtual environment for the cure