Online Photorealistic VR with Interactive Architectural Objects

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This paper describes how Virtual Reality (VR) technologies can be used for modelling photorealistic environments with interactive and changeable architectural content. This application of VR allows us to create photograph-based panoramic models of real places that include a variety of interactive architectural objects and details. The user is able not only to navigate through a virtual environment (look around, up and down, zoom, jump to another viewpoint or location) but also to change buildings or their architectural details by clicking, moving or rotating. The following types of interactive objects are completely integrated with a virtual environment: 2D image-based objects, 3D image-based objects, 3D VRML-based objects and onscreen world controls. The application can be used effectively for teaching, including distance Internet-based education, project presentations and rapid prototyping. A sample VR environment is presented and some of the key creative and technological issues are discussed.

Keywords: *Virtual Reality Modelling, Architectural Design, Interactive Contents, Photorealistic Environments*

Introduction

Using Virtual Reality technology for visualising architectural spaces and objects is becoming a common task among architects and designers. There is a great deal of software and technologies available to help them with creating the precise models of 3D buildings and environments. At the same time, a huge amount of architectural work is connected with the reconstruction of existing buildings or embedding new buildings into existing urban environments. In this case, there is a need to create a photorealistic virtual environment showing all the proposed variants of its improvement as well as to make this environment accessible for many concerned organisations and people including the general public. The Internet is the only effective means of the delivery of such a virtual environment. The environment is accessible from any computer with an ordinary specification and Internet modern connection. Making files as small as possible is one problem. Another, more important and difficult problem is to make this 3D space highly interactive to enable the user to have a personal immersive experience by choosing different versions of the changes proposed by architects and designers.

This paper shows how VR technologies can be used for modelling photorealistic environments with interactive and changeable architectural contents. This use of VR allows us to create photograph-based panoramic models of real places that include a variety of interactive architectural objects and details.

Figure 1 (right top). By clicking on a building the user can experience a variety of its possible architectural variants

Figure 2 (right bottom). Image-based visualisation of Variant 1 and its description is displayed

Hybrid VR Technology: Image-Based Panoramic VR with Embedded VRML97 Objects

Virtual Reality technology exists in two different forms. The first of them is based on Virtual Reality Modeling Language (VRML) and consists mostly of three-dimensional (3D) objects and a variety of multimedia components. The second form is based on photographic panoramic images and was firstly implemented as QuickTime VR. Hybrid VR technology integrates both geometry- and image-based approaches (Debevec et al, 1996). This technology is presently being developed by LivePicture Inc. [1]. Photorealistic Hybrid VR includes a great variety of multimedia components such as 360 degree panoramic navigable images, 3D geometry-based objects, 3D photograph-based objects, 2D on-screen and world image-based objects, 3D spatial sound, 2D and 3D animations, and so on.

Photorealistic Hybrid VR opens new possibilities for architects to create architectural spaces with rich and interactive multimedia content. It combines successfully the main positive features of both PanoVR and VRML VR. Because of its image-based nature, Hybrid VR seems to be more suitable for the online presentations of architectural works than "pure" VRML- based VR. This technology allows virtual environment designs that are not only three-dimensional and image-based but also extremely interactive and changeable.

A Sample VR Environment

To show the possibilities of using Photorealistic VR, a sample virtual environment has been developed. The environment consists of the interconnected photorealistic views of the Hoe area in Plymouth. Users can visit this photorealistic environment online using the Netscape Navigator or Internet Explorer browsers. Its Web pages consist of two frames. The right frame includes a LivePicture viewer that enables users to navigate VRML-based environments with panoramic backgrounds. The left frame may display any additional information about the architectural objects, which the user interacts with or about the new locations, which the user enters.

The screen shots below show some samples of user interactions with a photorealistic virtual environment. Figures 1 and 2 show how the user can experience new proposals for changing an existing architectural environment by interacting with the objects in question. Just by clicking on these objects, the user is able not only to see their new image-based versions (fully integrated with a real-based environment) but also to get information in any form (text, speech, photographs, sketches etc.) about a specific part of the architectural proposal.

The use of image-based objects such as photographs, sketches or drawings create a new

architectural environment very quickly. But the possibilities of the user interaction are limited in this case by clicking on a building or its specific details. The virtual world in Figures 2 and 3 contains not only image-based objects but also true 3D, VRML-based objects. Such objects can be moved or even visited by the user. In the situation shown in these figures, a fairy tale castle as well as a plastic palm tree and cactus can be placed in any location within the panoramic environment. The user can enter the castle and walk around. Notice that the interface of this environment includes three onscreen controls (in its right lower corner) that toggle the appearance of the three VRML objects (i.e. the castle, cactus and palm tree).

Navigating through 3D buildings embedded in photographic real-life environment is a really unique experience. This enables both users and architects to notice some unexpected details of integrating new architectural objects with existing surroundings. Figure 5 shows some views from an embedded 3D building.

The above samples have shown only some of the possibilities provided by the Photorealistic VR technology. Because this technology enables the integration of panoramic and non-panoramic images with VRML-based objects and multimedia components, its possibilities seem to be unlimited.

Application Areas of the Technology

The technology based on the integration of panoramic image-based VR with geometry-based VRML VR can be effectively used to achieve a variety of purposes. The rapid prototyping (both photorealistic and sketch-based) of reconstruction of existing environments is one sample.

The most important use of this technology lies in a variety of architectural education areas (online courses for university, life-long or on-demand education). For example, a public discussion about the reconstruction of an urban space may become indeed successful if it is supported by an Internet-based virtual environment which any individual is able to visit, to navigate through and to change in order to get a unique immersive experience of architects' ideas. This application of the VR technology has a strong educational flavour because it opens new

Figure 3 (top left). Real-life panoramic environment with onscreen controls

Figure 4 (middle left). Moveable VRML-based architectural objects embedded into panoramic VR

Figure 5 (bottom left). Real-life environment as viewed from the windows of a 3D embedded building

possibilities for general public to get unique architectural knowledge and experience.

Conclusions

The development of our prototype of an online photorealistic VR environment with interactive architectural objects shows a high potential of this technology especially in the areas of Internet-based education, project presentations and rapid prototyping.

References

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Web Reference

[1] LivePicture Web Site, http://www.livepicture.com

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