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MATHEMATICS AND ARCHITECTURE: Virtual Environments Dilemmas

The Povazske muzeum 3D online and Virtual 3D Bratislava comprises a family of academic projects at Comenius University in the years 2002-2006. Roughly speaking, they focus on virtual interiors and exteriors. Our leading metaphor is 3D xerox. We present the virtual habitat methodology and technology achievements and prospects. In particular, we discuss the project dilemmas and decisions in documentation, modeling, rendering, navigation, and cooperation phases of work. We advocate our project decisions with respect to the semantic web and digital libraries framework. Finally, we discuss the future research directions and selected ideas from our submitted project proposals.



Figure 1 - Považské múzeum 3D online.

Introduction

Virtual habitat consists from virtual environments and virtual populations. We try to create urban models for outdoor and indoor applications. Modeling of cyber city is the first step for having architectural context. Afterwards, we enter the prominent interiors, like museums. The requirements for both cases are different. For instance, the flyover mode of virtual visit is not suitable for a museum. The theory overview and details can be found in books by Qvortrup et al. In this paper we discuss the key project decisions.

The rest of the paper is structured as follows. Section 2 describes the image based rendering and modeling alternative. In Section 3 we refer to the urban database discussion. Section 4 describes the navigation and cooperation issues. We illustrate

particular solutions with selected results from our multiple projects.

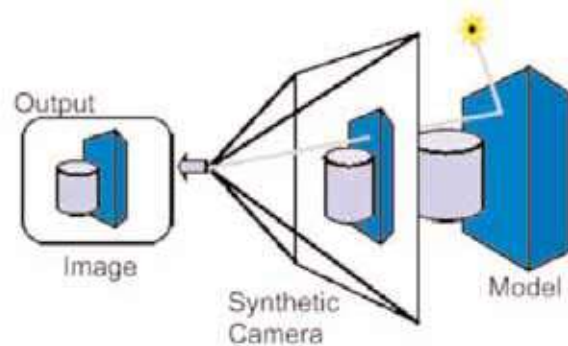


Figure 2 – Model Based Rendering.

Documentation, Modeling, and Rendering for Virtual Museum

Data used for objects and scene reconstruction are of several types. First of them are standard pictures taken by calibrated digital cameras. The data are used for creating models with high level of details, for proper model texturing and for panorama creating. Another scene capturing is done by a video recorder. Short walks throw a rare museum interior provides to the virtual visitor short and apposite invitation. The context of placement and surrounding of buildings is got by digital terrain model. Using this the old park with several distinctive trees near the Povazske museum can be modeled and added to environment of the model. The data are provided by Eurosense company.

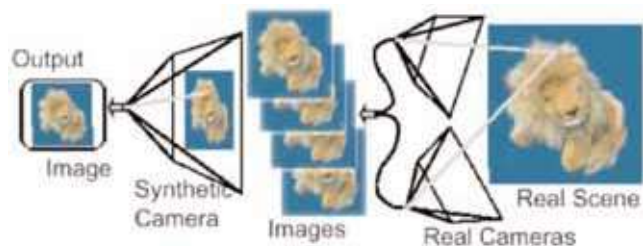


Figure 3 – Image Based Rendering.

Modeling of objects using only photographs is possible from two or more pictures of the object by using theory of epipolar geometry. There are several applications solving this problem. The one used for this project is Photomodeler Pro 5. The pictures designated for reconstruction should match several special rules. Different pictures with different properties are used for panorama creation. Here are the pictures taken from one place, using tripod.



Figure 4. Panorama of the Povazske muzeum exhibition room (Katarína Daňilková).

A free software suitable for transforming several images to one panorama is [Hugin], for example.

Urban Database Issues for Interiors and Exteriors

In database processing we need different data types for different user types. The data which are stored in the museum database can be categorized as follows: 3D objects, written documents, images, movies, audio files, others (building, surroundings).

The “existing” database solution can comprise all types of documents, but without the possibility of thumbnails (vector format, animations, VRML). Such documents are appended as a “common” document. We propose using of Linux MySQL – XML transfer from Windows XP database. When a search action is required, we perform a query to ESEZ. The output will be a webpage. The web site will act as a blender of museum physical exhibits data (museum collections) and virtually reconstructed museum data, which are not part of the museum collections.

We assume four types of users: visitor, researcher, filer, administrator. Visitor has the right to search and view the top level data, which are publicly available. Researcher (after granted permission) has access to specific data about the exhibits, without the possibility of changing them. Filer is a person, who fills the database and modifies the data. Administrator has R/W access to all data and to the structure of the database. The multimedia database solution is in progress.

Navigation and Cooperation in Virtual Museum

If there is a user exploring virtual environment (in our case virtual museum), it is really helpful to be able to get more information about the content of this virtual environment and of course not only visual information. The most suitable is to be able to get this information by natural communication with somebody. That is why we are introducing human-like autonomous agents ([QVO02], [QVO01]) as a part of user interface for exploring virtual worlds. At this time we are using middle precision autonomous agents based on minimal Perlin's face structure [PER00] and H-Anim 200x [HAnim] compatible body with few extensions. We call these

autonomous agents “avatars”, because by applying Perlin's noise on their faces and rotational joints of their bodies, they act like representations of real persons in virtual environment and some of them will represent real persons in virtual environment.

This work is still in progress but some achieved results (described below) are already used in VHCE project ([VHCE]) that is dealing with cultural heritage (see following figure). Our avatars are in this project used as virtual storytellers or tour guides and they will also be used in virtual museum as virtual storytellers and tour guides.

We created simple user interface for VRML environments that offers to user predefined viewpoints and predefined guided tour. Our avatar is a key object in this interface. On the following figure you can see example of created user interface used in VHCE project ([VHCE]) and description of it. Using this interface user can switch between predefined viewpoints, call avatar and also to view predefined guided tour that can be stopped or paused at any time.

For UI we created also graphical and functional prototypes that can be used to create custom interfaces depending on application. All this prototypes are used for creating of UI for prototype GuidedTour in VHCE project that has integrated our empathic avatar. These prototypes will be used and extended to fulfill the functionality needed for virtual museums.

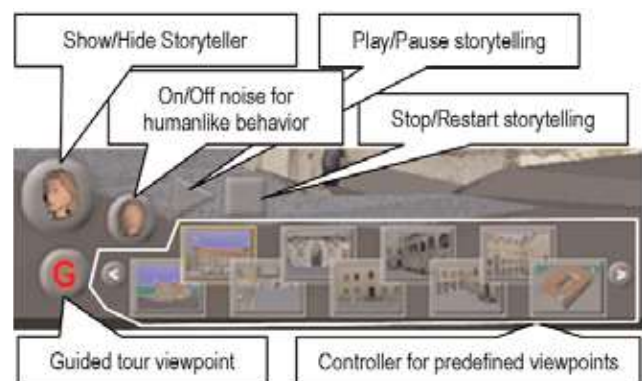


Figure 5. UI for VRML worlds with avatar functionality description.

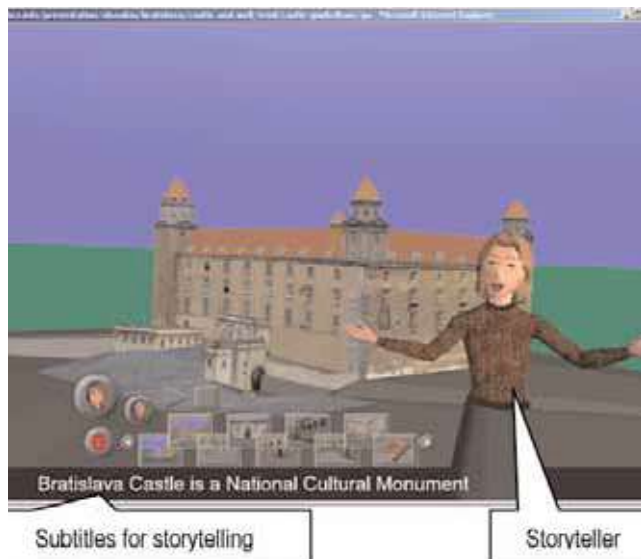


Figure 6. Screenshot from the VHCE project [VHCE]
(www.vhce.info - layout by Jozef Martinka).

Conclusion

We presented the virtual habitat methodology and technology achievements and prospects for cyber cities and virtual museums. In particular, we discussed the project dilemmas and decisions in documentation, modeling, rendering, navigation, and cooperation phases of work. Our leading metaphor is 3D xerox.

In documentation phase there is a need to opt for appropriate measurement of input data. Modeling phase main dilemma is to decide whether the standard 3D VRML model or image-based rendering representation (like panoramas) should be created. For rendering, there are contradictory requirements caused by huge datasets, security issues, and transmission bandwidth (data compression and precision). Navigation and cooperation functionality for virtual environments has no ultimate solution up to now. We advocate our project decisions with respect to the semantic web and digital libraries framework. Finally, we discuss the future research directions and selected ideas from our submitted project proposals.

References

- [PER00] PERLIN, K. 2003. Face demo applet using noise. SIGGRAPH 2000.
- QVORTRUP, L.: Virtual Interaction: Interaction in Virtual Inhabited 3D Worlds. - London -Berlin-Heidelberg : Springer-Verlag, 2002. - ISBN 1-85233-516-5.
- QVORTRUP, L.: Virtual Space: Spatiality in Virtual Inhabited 3D Worlds. - London-Berlin-Heidelberg : Springer-Verlag, 2001. - ISBN 1-85233-331-6.
- [HAnim] H-Anim
- [Hugin] Pablo d'Angelo at all. 2005. Hugin 0.5. <http://hugin.sourceforge.net/>
- Figure 6. Screenshot from the VHCE project [VHCE] (www.vhce.info - layout by Jozef Martinka).