

Blueprint-basierte Modellierung architektonischer Artefakte

Blue-print based modeling of architectural artifacts

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Zusammenfassung:

Moderne PCs mit leistungsfähigen Grafikboards mit Beschleunigern sind so populär, dass sich die Menschen bereits an die räumliche Darstellung von Objekten gewöhnt haben. Die Navigation in einem dreidimensionalen Raum ist intuitiver geworden. Dieses stellt neue Herausforderungen an die archäologische und architektonische Visualisierung, die normalerweise durch Einsatz kundenspezifischer Software-Anwendungen auf dedizierten Hardware-Lösungen durchgeführt wird. Andererseits ist die Modellierung von dreidimensionalen Gegenständen nicht einfach. Das 3D-Scannen erfordert in Echtzeit handgemachte Modelle. Das Arbeiten mit grafischen Paketen in 3D setzt ein spezielles Training und Kenntnisse, die nicht für jeden verfügbar sind, voraus. Dieser Beitrag diskutiert einen Einsatz von Werkzeugen zur Programmierung von Spielen, um die architektonischen Artefakte umzustrukturieren. Das schnelle Prototyping mit einem Blueprint-Modeller bietet eine räumliche Genauigkeit des virtuellen Modells an und verspricht eine Beschleunigung des Umstrukturierungsprozesses. Das Tool ist im Anfangsstadium der Entwicklung für die digitale Rekonstruktion der Synagoge in Zielona Góra erfolgreich angewendet worden.

Abstract:

Modern PCs with accelerated graphic boards are so popular that people got accustomed to spatial representation of objects. Navigation in a 3D space is more intuitive now, as well. This presents new challenges for archaeological and architectural visualisation usually performed on dedicated hardware by customized software applications. On the other hand modelling three-dimensional objects is not easy. 3D scanning needs real-life hand made models. Working with 3D graphics packages requires special training and skills not available to everyone. The paper discusses application of game programming tools to reconstruction of architectural artefacts. Fast prototyping with a blue-print modeller offers spatial accuracy of the virtual model and promises speed-up of the reconstruction process. The tool in its initial stages of development has been successfully applied to digital reconstruction of the synagogue in Zielona Góra.

1. Introduction

There have been many recreations of historical places and architectural reconstructions done in Virtual Reality [2, 4]. Many of them have been done to very fine level of detail. The process of very accurate three-dimensional modelling is often meticulous. Usually huge amount of geometry data is acquired by 3D scanners and processed manually to create comprehensible virtual objects. Also megabytes of image/texture data is prepared to visualize artefacts with photorealistic quality. New technologies allow for passing haptic information to touch sense of the viewer. High-resolution models are stored and processed locally from CD-R and DVD-R disks. Access by the general public has been a limiting factor for many applications, then. Such visualization systems require dedicated hardware and customized software applications (like CAVE). On the other hand a modern PC worth less than 3000 Euro when connected via broadband to Internet opens quite new possibilities for information exchange, learning and leisure activities. Standards such as VRML or X3D accompanied by several VR browsers ensure wide access to less detailed but unlimited by

size or location virtual environments [3, 6]. High popularity of online 3D gaming known as MMORPG (Massively Multiplayer Online Role Playing Games) promises that technology has already matured. This also means that PC users can freely and intuitively navigate in 3D on a desktop VR system. On contrary to photorealistic reconstruction and film effects making, game developers use specific tools for rapid model construction, mesh optimization, interface design and real-time graphics with performance animations. More and more of those technologies are applied to educational services. The paper discusses application of the modelling tool that normally would be applied to game development, to reconstruction of architectural artefacts. A real-case situation was used as a test bed for reconstruction of non existing building.

2. Blue-print modeller

Main purpose of the application is to help with creating and editing 3D models, based on blueprints (scanned section planes or orthogonal projections of buildings). The application should have functionality to model low-count-polygon objects (objects with low number of polygons - elementary parts of every model). Certainly, user will decide how complex will be his model. Because complex objects are usually displayed slower than their less complex equivalents, so a lot of depends on scale and generalization of given artefacts.

The Editor allow to create models in three ways:

- to take advantage of blueprints (while acquiring coordinates),
- to use built-in interpreter for precise placement of points (vertices),
- import coordinates from external files.

As soon as coordinates are obtained user can create lines and indicate surfaces that fill the polygons. Polygons might be edited individually (along with setting their parameters). Program also enable user to group polygons in hierarchical sets, in order to make further edition less complicated and to enable animation of created models in the future. The interpreter mentioned above allows for setup of significant number of parameters. It will be possible to write a script that automates given activities. The Editor will be equipped with units for managing materials and textures, which allow user to create a model that looks more like a real one. This mini-editor will have procedures for texture mapping on a single vertex level (that increases precision of modelling). The Program is equipped with intuitive-looking icons and descriptions about creating the models. Existing help has ability to cooperation with a plug-in help. Also some tutorials will be provided (examples, how-to pages etc.). To effectively use the program it is recommended to have some knowledge in the field of 3D objects creation (e.g. ideas of texture mapping).

The program runs on Pentium PII 300MHz, with a graphic card supporting OGL in the Windows 95/98/2000/XP environment. Eventually the program will export given model to popular 3D formats.

3. Reconstruction of the synagogue in Zielona Góra

The virtual synagogue was to be constructed as a photorealistic rendering composed with actual view of the place in Zielona Góra. The construction process consisted of several stages: collection of descriptions and old photographs, fast prototyping of the geometrical model, discussions on accuracy of the model representation and detailed model with textures pasted in the final collage with reality.

3.1 Resources and data

The synagogue in Zielona Góra (Grünberg) had been built in 1883 on the former Glasser Platz on the property of Adolf Selowsky. During the Crystal Night (November 1938) the synagogue was burnt and all the documents were lost or destroyed. Not much has left except two old photographs (Fig. 1) and one municipal map with information on the building plots. Based on that information and on typical architecture of the century the synagogue was reconstructed as a series of orthogonal drawings at the Dept. of Civil Engineering (University of Zielona Góra). The drawings were the start material for virtual reconstruction.

3.2 Fast prototyping

The blue-print modeller (see Section 2) has been developed as a tool for fast prototyping. Based on scanned orthogonal projections of the building (Fig. 2, 4) a simple geometric construction was built in order to discuss accuracy and spatial relations of elements of the building. In particular some elements of a complex pavilion roof were not clear. Some areas of the building were incomplete or not accurate. This stage of the modelling [process was crucial for the development since it eliminated distortions in geometry. When the general structure of the model was accepted the process of detailed modelling started.

Since no information on interior left only the elevation of the building was to be reconstructed.

3.3 Photorealistic reconstruction

The geometry of the prototype was fairly simple. In the detailed reconstruction all the elements were included in the model (Fig. 3). Each wall, window was modelled geometrically in a 3DStudioMax. The second major stage involved extensive texture mapping of hand made images onto the geometrical model. Prior to this mapping the painted textures had to undergo image processing which accounted for the majority of the work in the project. After texture mapping the model was lit properly comply to the real-life scene shot to Zielona Góra (Fig.5). Finally image of the model was pasted into the scene replacing the Philharmonic Orchestra building (Fig. 6).

4. Conclusions

Virtual Environments when accessed form the web via a broadband connection can play a crucial part in supporting the educational processes. On the other hand the entire process of 3D modelling is not a simple task. The paper has presented a reconstruction tool based on architectural drawings from one side and on game programming technology from the other. The tool in its initial stages of development was applied to a real-life case of reconstruction. A prototype low-count-polygon model was developed and used for concept approval and discussions on the accuracy of virtual representation. The application proved to be a good common ground between computer modellers and architects. Based on the experience a photorealistic visualization was done. The tool can be used as a part of reconstruction, in the nearest future it will be developed to a functional VR modeller.

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Fig.1 An old photograph of the synagogue

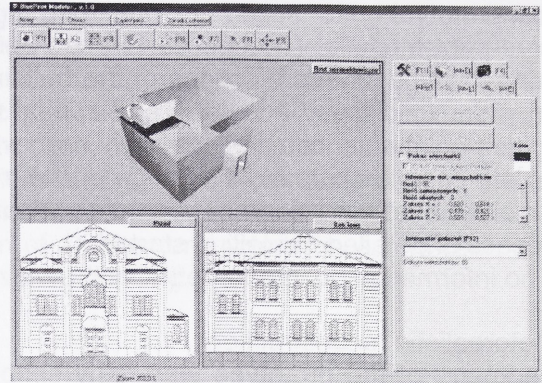


Fig.2 A blue-print modeler (screenshot 1)

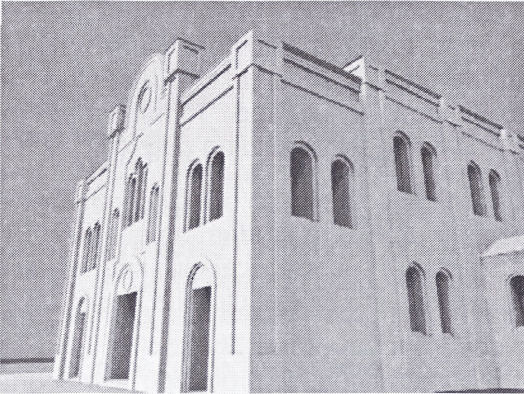


Fig.3 Digitally reconstructed synagogue

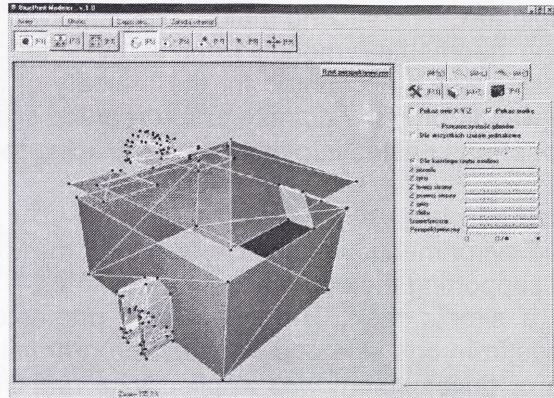


Fig.4 A blue-print modeler (screenshot 2)



Fig.5 Actual view of the place in Zielona Góra



Fig.6 Final composition of the scene and the object