VR für die Stratigraphie architektonischer Artefakte

VR for stratigraphy of architectural artefacts

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Zusammenfassung:
Im Bereich des architektonischen Erbes stellt die Analyse der Entwicklung eine Kernaufgabe dar. Gebäude, Straßen und ganze Städte haben sich im Laufe der Zeit verändert. Die Dokumentation und Visualisierung dieser Prozesse wird Stratigraphie genannt. Das Offenkundigste in der Archäologie, die stratigraphische Visualisierung, wird bei der Analyse von Stadtbildern zu wenig geschätzt. auf der anderen Seite sind 2D- und 3D-Repräsentationen im Grunde genommen die Methode, wie Städte und einzelne Gebäude beschrieben, dokumentiert und verstanden werden. In statischer Form können virtuelle Rekonstruktionen relativ einfach erzeugt werden. Der Vortrag veranschaulicht die neuesten Forschungsergebnisse: Nutzergesteuerte Veränderungen des virtuellen Stadtbildes abhängig von ausgewählten historischen Zeitabschnitten.

Abstract:
In the field of architectural heritage, analysis of evolution is one of the key issues. Separate buildings, streets and whole cities changed over the past. Documentation and visualization of that process is called stratigraphy. The most evident in archaeology, stratigraphic visualization is underestimated in analysis of cityscapes. On the other hand, 2D and 3D representations have been at the heart of the way cities and individual buildings are described, documented and understood. Virtual reconstructions are relatively easy to make in a static form. The paper presents the recent developments of the research: user triggered changes in the VR cityscape that are related to a selected period in history.

1. Introduction

Historical buildings have often been destroyed or damaged by natural phenomena and human activities. It is a natural process to refurbish and modernize some objects or to destroy and reconstruct them. Currently among contemporary architecture put aside historical objects more and more historically-correct reconstructions are elevated to blend seamlessly in the city infrastructure. The whole process of changes takes considerable time due to technologies, economical demands and other limiting factors. When analysing architectural history and evolution of the cities, researchers have to interpret and compare a mass of documents with different credibility and format strictly related to a certain period of history.

The interdependence between the documentation, analysis and visualization has a history that originates in renaissance and now is one of the key issues in architectural visualization [1,2,3]. It is assumed that visual results are in no way the elements of information in a research if they are not accompanied by documentation that validates their content. On the other hand, documentation analysis would be far more complicated without visual clues that enhance understanding. That is particularly visible in education and edutainment, where visual models may be a firs step to understand changes. This may invoke the need to go deeper in fact and document analysis in order to reveal reasons behind the historical facts.

Documents and visualization of historical processes that are reflected by the cityscape are closely related to the scale of analysis. Each scale needs appropriate representation that matches the complexity of the objects considered. For the whole city, 2D GIS (Geographical Information System) is the best solution to illustrate changes in parcels, streets etc. [4]. If separate buildings are considered, three-dimensional visualization is far more appropriate to describe spatial relations between the object elements. 3D graphics is widely used in the field of architecture and history, notably in the virtual reconstructions of buildings targeted at wide public [5,6,7,8]. The research mainstream focuses on the end-user issues such as real-time rendering and mobile technologies [9,10,11]. Unfortunately most of the visualizations depict static environments without atmospheric effects (weather, seasons) and very often without context (pedestrians-humanoids and foliage). On the other hand, the game and entertainment industry offer new user engaging experiences with better graphics, surrounding sound and complex interaction. This induces demand for better quality of non-commercial visualizations for wider (game-educated) audience. The idea presented in the paper is not new, but the use of VR environment to perform stratigraphic visualization that is user-triggered is not a common solution in non-commercial systems.

2. Stratigraphy and architectural referencing

Stratigraphy is a common tool in archaeological analysis of excavations and artefacts described with their location context. It usually deals with data represented in various scales and formats, but almost always depicted by two-dimensional images and diagrams. Architectural objects correspond to a given scale that is comparable to a level of detail in computer graphics. GIS information may convey data on plots, streets and orientation points. Such a system is based on the GPS oriented digital map with links to other RDBS stored information to additional documentation that vary in sizes, formats and styles. There are no natural interfaces between 2D GIS and 3D visualization. The simplest way to implement such an interface is to put on a GIS map references to virtual reconstructions stored on a dedicated web server, linking VR object with a selected position on a digital map. The stratigraphy assumes time-related control of the visualized scenes and objects. This is relatively simple in 2D but much harder in 3D representation of architectural objects in details.

3. 3D VR interfaces to stratigraphic information

Applications of the VR (VRML and X3D) standards in architecture have often been discussed. The web-based VR language provides features that represent both geometry of 3D objects, they appearance and make possible to assign actions and events to introduce interactive manipulation and modification of the scene content. The virtual scene can be built and assembled off-line in any of the modelling environment, as long as the modeller remember about mesh optimisation before exports to VRML/X3D formats. It is possible to create visually correct scene that supports comparative analysis and understanding of different aspects of architecture (like shape, styles, appearance, materials, etc.). It is possible to re-create appearance of the building in different periods in history. Much harder problem appears if we want to swap some elements in real-time, where user choices trigger animation sequences and changes in reconstruction, that are vital to stratigraphic visualization. VR usually provide human-view of the content that fits the human scale of the observer-pedestrian wandering on the streets of a virtual city. There have been many examples of the 3D interface applied to time-related visualizations [12,13]. They include highlights of selected buildings, transparency triggers (switching on/off visibility of selected buildings)(Fig.2) and view-point controlled actions (through proximity sensors, triggering visualization process when the observer approximates the location). The most popular for startigraphic applications in VR is a global scene control, usually placed as a separate 2D GUI control slider, that provide a client-side control over the whole scene [12]. The slider usually marks certain periods in a building morphology and triggers download of several virtual scenes representing different stages of the object development.

4. A case study, stratigraphic visualization of the city hall in Poznan

A sample four-dimensional (3D + time) model was designed to illustrate the concept of user-triggered changes that took place in the construction of real-life building. As a target object, the city hall in Poznan was chosen. The city hall has a long history and several refurbishments over the past époques, till the currently recognized complex renaissance form (Fig. 1). The idea of stratigraphic visualization, due to lack of resources, was limited to a case study illustrating changes of some elements over a short period of time. Some key elements of the building and surrounding environment were chosen to illustrate possibilities of interactive VR visualization. The changes depicted in the project took place before and after World War 2. User can choose three modes of navigation: browse web pages with embedded VR visualization accompanied by other digital documents giving credibility to the reconstruction (Fig. 6), switch a few events that change reconstruction of the object or choose the "guided tour" to navigate surrounding of the city hall and observe changes that were made to the object in real-time (Fig. 3,4,5)

5. Conclusions

The work presented in this paper positions visualization of the architectural heritage as an interactive experience that follows the ambition of visual realism and visual understanding of changes that took place in the past. It is possible to greatly enrich the usefulness of 3D representations provided that some attention is put to credibility of the information depicted in the virtual reconstruction. The Virtual Reality Systems can offer more appealing and intuitive access to historical data. They can help to illustrate evolution of architecture in context of the cityscape, allowing user to interactively compare recognizable images and constructions of the buildings with those virtually recalled from the past.

Acknowledgements

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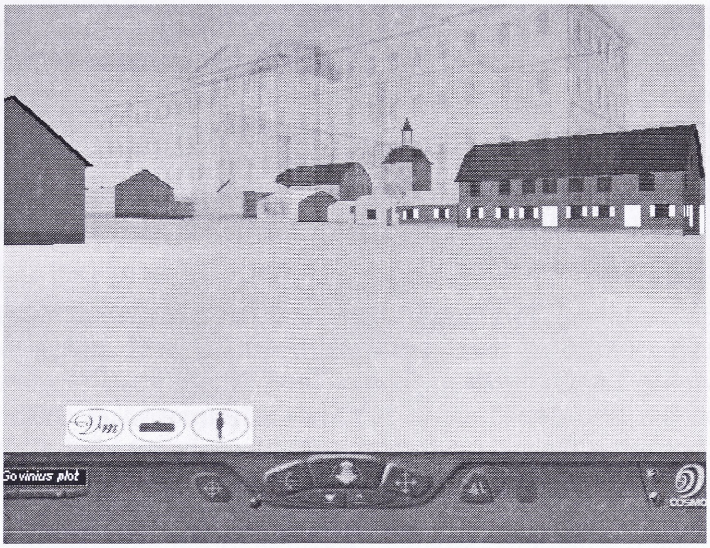
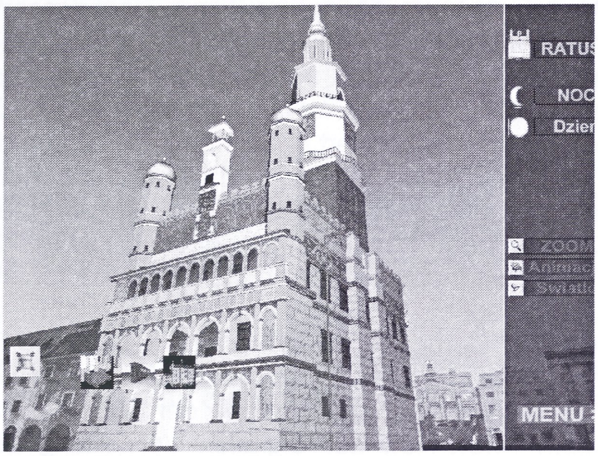


Fig.1 The city hall in Poznan

Fig.2 The virtual Helsinki



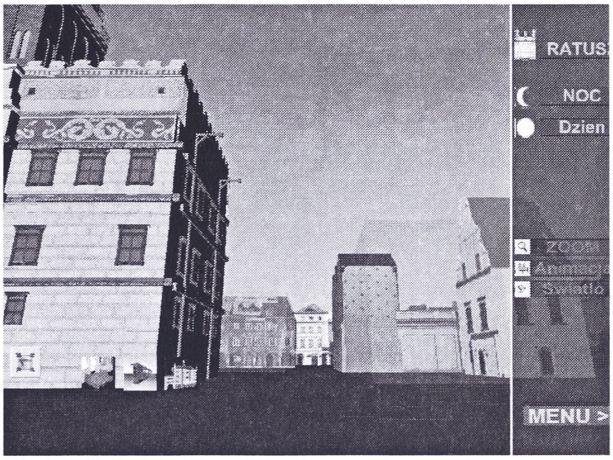


Fig.3 A virtual reconstruction of the city-hall Ver. 1

Fig.4 Virtual representation of the city hall

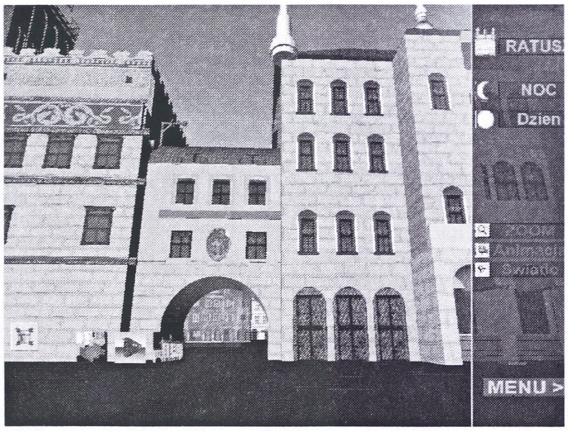


Fig.5 Virtual representation of the city hall Ver. 2

Fig.6 Sample digital document, illustrating changes in construction