A VIRTUAL REALITY RECONTRUCTION OF THE RASHID AGHA HOUSE IN THE CITADEL OF ERBIL FOR INTUTITIVE WALK THROUGHS AND EXPLORATION

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in agreement and collaboration with HCECR (High Commission for Herbil Citadel Revitalization) and its director Arch. Dara al-Yaqoubi.

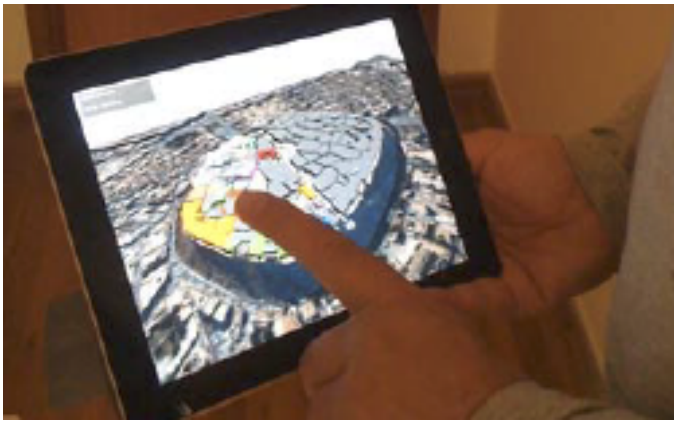
Key Words:
Cultural Heritage, Architecture, Virtual Reality, 3D Visualization, real time interactive 3D simulation, virtual environment, tourist information systems, information systems.

Abstract:
This paper describes the concept and prototype architecture for a Virtual Reality (VR) based Information System. Our case study investigates the possibility of creating a three-dimensional model of a building of Architectural Heritage significance located in Erbil (Kurdistan-Iraq) by processing data obtained through an earlier survey campaign carried out by the 'Studio 3R' firm within a High Commission for the Erbil Citadel Revitalization (HCECR) and Italian Cooperation (Italian Ministry of Foreign Affairs) project. It may serve also as a base architecture for different kinds of Information System domains, such as a VR based Tourist Information Systems or a VR based Geographic Information Systems. It is clear that the achievable level of detail and accuracy, considering the specific characteristics of every single data acquisition technique, determines a considerable variety of attainable products that vary from navigable three-dimensional models for tourists or other mass distributable applications to 3D Informative Systems suitable for technical/scientific analysis as for example in Architectural Heritage building conservation and restoration.
Generally such applications are used in computer games, but the R&D division of FGTecnopolo/Risviel/Studio3R is using such VR architecture for visualizations, simulation and planning for tourism, navigation, facility management, architecture, cultural heritage and city planning.
A condition of such modeling and visualization is a complete 3D acquisition of real world objects. In our case, after all the necessary data was acquired we were able to reconstruct the 3D model of the object of our study through the use of various types of software in order to identify the merits and the defects of each of them.
The obtained results are amazing and can be used in Virtual Reality applications in order to enable public knowledge and fruition of monuments, and through a more rigorous approach, the study and conservation of the Cultural Heritage.
The application is structured in programming interaction

with objects, movement and interaction with movement devices in order to achieve a virtual tour of the house. The modular structure of the project components allows modification of content, object interaction and dialog graph content.

INTRODUCTION

The ever increasing computing power and storage capacity of low-cost computer systems enables the implementation of multimedia applications that integrate different components such as text, images, graphics, voice, music, computer animations, or video for the presentation and manipulation of information made available to tourists. The development of the graphic devices between a 2D visualization to a 3D one in the '90s covered various areas of interest in sciences, simulation and Computer Games. Younger generations all over the world are accustomed to and are continuously trying out different game systems. This means that 3D graphics, computer games and simulations have become a regular experience or even part of everyday life. Teachers in schools, visitors in museums, architects in reconstructions, engineers in simulations use 3D reconstructions and visualizations. Nowadays archaeological, historical and artistic fields are also starting to appreciate the potential of computer graphics and 3D visualizations.



We would like to underline the importance of Virtual Reality systems even from the cultural point of view. For example, one of their strengths, compared to classical means of sales support such as color brochures, catalogues or videos, lies mainly in their interactivity and dynamics concerning information presentation and manipulation. A visit to a museum becomes as "real" as a videogame; kids and teens like to play and if you also learn while enjoying yourself and by interacting with the objects and the environment, the educational effectiveness can be enhanced tenfold.
"A picture is worth more than thousands of words", and a "3D computer generated model is worth more than a thousand printed pictures".
The aim consists in offering an interactive, integrated, updatable, educational and open system for using real time interaction with objects in a recreated virtual environment.

RECONSTRUCTION

The case study is based on the archaeological research and activity in the north region of Iraq thanks to a High Commission for the Erbil Citadel Revitalization (HCECR) and Italian Cooperation (Italian Ministry of Foreign Affairs) project. This prototype project has been presented during the "Italian Cultural and Archaeological Conference" in Erbil on April 1st.

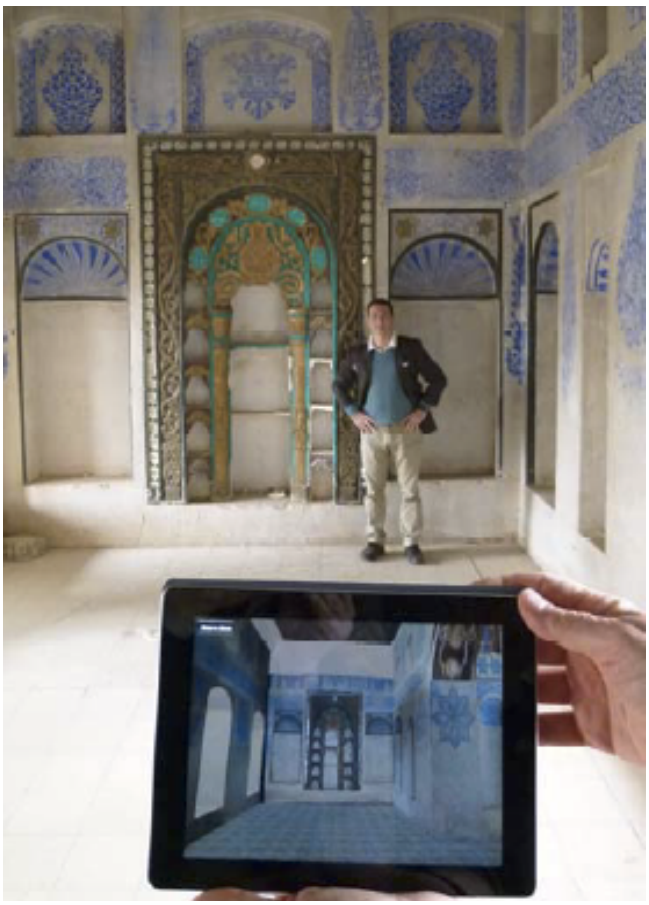
The Conference saw the presence of all local institutional representatives, Italian and Iraqi Kurdistan universities, Italian Ambassador, Italian Consul, etc.
For the architectural survey of the Rashid Agha House which was carried out essentially through the use of a Total Station, an adequate number of stations were positioned, for the measurement of all the points necessary for the realization of plans, sections/ prospects, and of the markers needed as control points for the terrestrial stereo – photogrammetry. The latter was obtained thanks to a system developed by Menci Software s.r.l. (Arezzo, Italy) in which stereoscopic images are acquired through a calibrated camera mounted on a specially designed bar and successive processing capable of creating 3D point clouds of the surface under exam. This mean was helpful in particular for the documentation of vertical surfaces such as walls especially where these were covered by decorations, whether painted or in relief. The main product of this system is a 'true orthophoto', an image of the surface to be documented devoid of any perspective aberrations (creation of prospect views) and reproducible in any appropriate scale.
This detailed documentation of the house led to the creation of a full set of digital drawings representing the plans of all the house's levels (basement, first floor and roof top) comprising the adjoining structures and, in addition, a total of more than 20 prospects/sections. This documentation is instrumental for the laying out of a restoration project, the main aim of the operations concerning the Rashid Agha House. Nevertheless, once acquired, such wealth of data and information could be also useful for other objectives as for example the creation of a complete digital 3D model of the house itself to be used within a virtual environment as is being described here. By using this data, all phases concerning the creation of digital 3D content such as the digital 3D modeling of the structure and its successive "texturing", thanks to the orthophotos mentioned before, were effectively carried out.

SYSTEM CONCEPT

Interaction with large volumes of multimedia type data puts a high burden on the underlying hardware and software resources.
Because of main memory limitations, the design and implementation of a real-time simulation environment has to take into consideration special data handling techniques to offer efficient and effective information presentation and manipulation conditions for the user.
The main idea of the Risviel R&D department (which has a strong historical background in computer graphics and simulations) is based on the principle of adopting the latest technologies from the "game development" in different contexts and scenarios.

The core component is a real-time 3D engine that allows you to import 3D CAD models from popular software (freeware and commercial) type: 3D Max, Maya, XSI etc., renders them with texturing and lighting in real time.

Thanks to the script adds the ability to customize any aspect of the reality represented by writing small pieces of program modeling the behaviors, events and user reactions.
This allows you to have a level of interactivity than ever before. The user is no longer "tied" to a fixed route but can freely explore the represented world with no limits.
Last but not least the modern technologies allow you to export the virtual representation to any type of platform (web, pc, smartphone, tablet, console) reaching any type of user.



APPLICATION SCENARIOS

As already mentioned above the present application may also serve as a software architecture for a VR based Tourist Information Systems.

Through the help of new sophisticated 3D data representation and interaction techniques, the user may explore and experience tourism related data in a more intuitive and natural way. This new paradigm for man-machine-interfaces offers potentials that go far beyond conventional based information systems.
For example this prototype architecture will be capable of operating on handheld devices such as tablets and smartphones as well as PCs, laptops etc. the actual high-speed and high-bandwidth digital networks, offer the potentials to revolutionize the way communicative and collaborative work is done: a user may log-in into a remote host in order to plan her/his next holiday trip, or on demand a touristic virtual trip can be experienced in order to see the interesting sights to visit while planning one's stay.

But above all, this application contemplates the incorporation of the 4th dimension, that is of time into the concept of visualization.
The future focus of the work will be on travelling through time: the ability to view a heritage building or object at different points during its history.

CONCLUSION

This prototype architecture gives first insights in the development of a real-time interactive walk-through application. This paper represents a case study and the resulting product, a navigable three-dimensional model which with its accuracy, permits a wide range of applications: from tourism applications to 3D Information System for Architectural Heritage Conservation and restoration. This model can aid image analysis operations, supporting future Restoration and Conservation project decisions.
It is clear that there has to be a focus on efficient data management and access techniques to fulfill the requirement for real-time performance within virtual environments. Special techniques , such as SW based data access structures, clustering of objects, Level-of-detail, parallel loading of scene data were implemented to maintain real-time performance and interaction within the virtual environment. The actual application offers the possibility to manage large amounts of data and launching data queries that go far beyond the capability of traditional file system based interactive simulation systems.
Adding the present technology to information systems, such as TIS or GIS, offers the potential to experience large volumes of complex information and allows a faster and more intuitive problem understanding. Benefits gained from such new intuitive and natural interaction paradigms have also implications in reducing the information retrieval and manipulation costs.