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THE POSSIBILITIES FOR IMPLEMENTATION OF 3D VISUALIZATION TECHNOLOGY IN THE DOMAIN OF CULTURAL HERITAGE PRESERVATION

Abstract. Praxis of 3D visualization developed during last two decades as successor of hand-drawn presentations and wood-and-paper model construction. It incorporates all the vital aspects of project and its technical documentation and synthesizes them into accurate, visually rich and even photo-realistic form. Three-dimensional simulation combines technical and theoretical information in a medium which is realistic and more forthright.

The Balkans represents historically turbulent area which has left deep physical trace on cultural heritage, making some of monuments almost unrecognizable and some utterly destroyed. In this context 3D visualization could play a role of a specific "bypass" which could overcome some of most serious conservation and restoration problems during research and project design period.

Key words: 3D visualization, CG, architecture, restoration

Introduction

In the contemporary architectural workflow the process construction of digital 3D visualization doesn't represent revolutionary innovation any more. Three-dimensional model of an object with all the necessary details – configuration of terrain, details of a facade and plastic decoration, precise simulation of materials – enriches the basic technical documentation and, in fact, becomes its integral part.
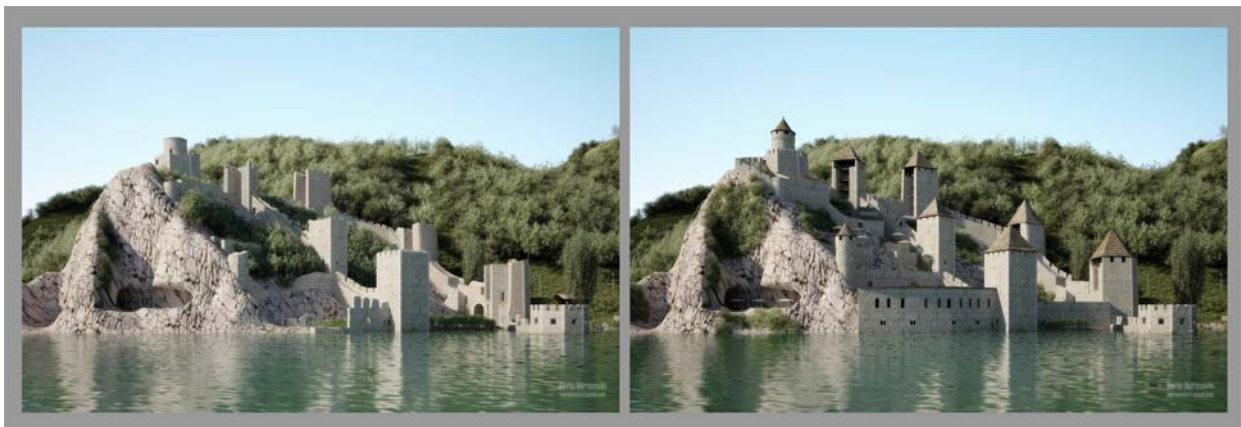
Fig. 1 – Golubac Fortress, parallel presentation of existing state and proposed design

Praxis of 3D visualization and presentation pushed out and practically replaced long tradition of hand-drawn presentations and wood or paper model construction. This is quite understandable if we have in mind all the advantages of this new method:

-   accuracy, precision and absolute synchronization with basic technical documentation, which is nowadays made mainly in an adequate Autodesk application or some similar software
-   the possibility of realistic and detailed representation of masses and facades of an object with all the details, as well as of terrain and the landscape (in this purpose additional segments of technical documentation can be used: photos, ortho-photo recordings, geodetical data etc.)
-   the fact that the acquired material in its original state represents digital information makes it functional, flexible and easy to access for various users on different locations, using only computer and internet
-   multipurpose character of this material makes it easy to use in many different ways: for publications and other printed material, *fly-through* and *walkthrough* animations, interactive multimedia presentations or even actual physical models made with 3D printer

Fig. 2 – Golubac Fortress, 3D visualization of proposed design

Potential and perspectives

Architectural 3D visualization can be defined as part of much larger process called *computer graphics*, or more popularly *CG*. It is a large and multifarious phenomenon including not only three-dimensional modeling and rendering, but also vector graphics and animation, digital photo manipulation, in fact, any sort of visual crafting in digital form – on a computer, using adequate software. As such, CG found its place and purpose in many professions: from film and entertainment industry, commercials, to architecture and civil engineering.

The implementation of these new methods and technologies has shown itself very useful in the domain of preservation of cultural heritage. Naturally, the first significant break-through in this field has been made in the United States and developed Western European countries. However, it would be fair to say that our region quite enthusiastically follows these new trends. The CG artists and programmers from Eastern Europe are highly regarded, developing good and popular software (for example, excellent rendering software *Vray* made by *Chaos*

Group or Dreamscape plug-in package made by *Sitnisati*). Several projects in 3D visualization of cultural monuments were conducted in last few years in Serbia and surrounding countries, using various methods ranging from traditional software modeling to photogrammetry and 3D scanning methods: 3D presentation of Travnik Fortress in Bosnia and Herzegovina (Jovišić V. and Rizvić S. from Faculty of Electrical Engineering, University of Sarajevo), 3D scanning of Kosmač Fortress in Montenegro (*3D-Caddit D.O.O.*), 3D visualizationof Palace in Gamzigrad (*MapSoft* for RZZSK Beograd) etc. One of the most ambitious enterprises for presentation of archeological sites, Archeoguide, was developed and implemented in Greece. It uses sophisticated informational technologies in combination with 3D visualization and image-tracking methods. We should not forget to mention the *XV century virtual Belgrade*, an ambitious project, enthusiastically developed by a group of archeology professors and students led by Vitomir Jevremović.

Fig. 3 and 4 – 3D model of object 144 in Rajacke Pivnice

Here is one example for practical use of these innovative technologies. Some Museums and cultural heritage preservation institutions recently started using 3D scanners. These optical devices are designed to get an absolutely precise data on physical appearance of an object, such as sculpture, art object or plastic decoration of a building. Data gathered in this manner becomes integral part of documentation for this object, a sort of "digital matrix" or "digital mold", based on which special machine made for shaping various materials can make an identical copy. Many museums use this method to make copies and souvenirs but it can also be used in conservation and restoration procedures. For example, quite recently a popular public monument in Belgrade, bronze statue made by prominent national sculptor Simeon Roksandić was stolen and afterwards destroyed. Except for photos there was no other useful documentation on this monument. Luckily, there was good, private-made 3D scan of this monument which was used to make an exact copy of the destroyed object.

The state of cultural heritage in the Balkans

When searching for possibilities of implementing new technologies and methods in cultural heritage preservation in Serbia one should first try to grasp the state the national cultural heritage is in. The fact is that the Balkans represents historically a turbulent area, shaped by frequent migration processes, unpredictable demographic changes and above all numerous wars and conflicts. All this has left deep a physical trace on our cultural monuments, making some of them almost unrecognizable.

Fig. 5 – Gamzigrad-Felix Romuliana, the Palace, detail, visualization of existing state

Some of the most important landmarks of national culture and history are utterly destroyed, many of them in only last few years. The "Bogorodica Ljeviška" Cathedral in Prizren was only one of many monuments in Kosovo severely damaged in the period after the year 2000. Fifty years before that, during WWII the National Library in Belgrade containing many rare books and medieval manuscripts was burned to the ground. In the same period the towers flanking entrance in the grand Smederevo Fortress were also destroyed. Going way back we could see the millennia long period during which almost every important cultural monument

was either destroyed or severely damaged. Some of most important national cultural monuments are known only from archeological excavations and rare fragments. Once powerful st. Archangels monastery near Prizren is such an example; we can only partially suggest its original appearance based only on fragments of stone blocks and decoration which was used to build Sinan-Paša's Mosque during the Turkish period. Another important monument lost in this period was famous "Banjska" Church, built by King Milutin as his entombment place. Nowadays it represents just the pale shadow of its former grandeur and monumentality.

On the other hand, there are those objects that continued with their life, but changed appearance fundamentally as a result of numerous retuning, reshaping and rearranging processes during ages. Typical example for this is ss. Peter and Paul Church near Novi Pazar, one of the oldest known cathedrals in this part of Europe. This originally central-plan building looks completely different today, thanks to several large annexes, some of them built almost millennium after the church was originally erected. Especially interesting is the problem of forts and castles, which represent valuable and authentic segment of Serbian cultural heritage. Some of them today just linger as dead stone-marks in time and space and, without any practical function and purpose, slowly but inevitably decay.

Fig. 6 – Golubac Fortress, visualization of existing state

All the examples given here lead to important conclusions regarding conservation and preservation problems:
- some of objects are heavily devastated and there are no valid material, written nor any other sort of data concerning their original state, which makes it hard or impossible to initiate any sort of restoration work
- Integral parts of an architectural complex which were added after the erecting of original object may also have cultural and historical significance (we should have in mind a possibility that they are maybe not yet adequately valorized). Therefore a question: what if during search for original appearance of an object we make more

damage than good? This dilemma is as old as cultural heritage preservation profession.

-   There is also one clearly practical factor playing a significant role – an acute deficit of funds needed for research and actual works on conservation or restoration. Also, a large part of funds gathered in this purpose represent donations from private persons, international organizations or foreign states. It would be rather unrealistic to expect this problem to just disappear any time soon.

Practical implementation

Having all this in mind one can understand the full potential of digital visualization. To summarize: a good 3D presentation should incorporate all the vital aspects of project and its technical documentation and synthesize them into accurate, visually rich and even photo-realistic form. In context of cultural heritage preservation it could play a role of a specific "bypass" which would be able if not to remove, than at least to temporarily go around some of the stated problems during research and project design period. For example, it often happens that there are several different, even opposed opinions on original appearance of an object, which can slow down or put in doubt any physical action on preservation. Three-dimensional visualization makes it possible to design high-detail simulation of original appearance of an object, a monument or archeological site, based on these different presumptions. Using comparative analysis of several 3D models we could summarize and evaluate these different theories, we could put them on test, which would eventually represent a good ground for further professional debate and research. In the same manner it would be possible to design comparative 3D models simulating different segments and layers from different historical periods, to analyze them separately or as a whole.

Another important function of 3D visualization could be the educational function. Generations of art and architecture students have been learning about monuments from written descriptions marked by abstract terminology or technical drawings poorly depicting ideal reconstructions, plans, facades or fresco decoration. Art or architecture students are supposed to memorize enormous data on physical characteristics of monuments and their decoration but are not able to see them frequently, since they are either too far or inaccessible. Three-dimensional simulation combines technical and theoretical information in a medium which is realistic and more forthright. The user could be able to uphold model from different perspectives, to closely examine the configuration of masses and the organization of interior or to even "walk" through or around the object. If we agree with old saying that "picture is worth 1000 words" than it's simply logical that any information supplemented by adequate visual material is easier to acknowledge and comprehend. We should also have in mind the growing need for popularization of scientific achievements as one of the main trends in science in last decade. Modern technologies offer us a way to bring the facts about national culture and art to wider and inexpert audience using interactive and multimedia

Finally, let us not forget the primary function of 3D visualization, and that is presentational and promotional function. The good presentation plays vital role as a part of tender documentation. As we know, people deciding about projects and their funding are not very keen to interpret technical drawings and calculations; they usually just want to know how much something is going to cost and how it will look. And this is where the good presentation plays its part: It summarizes all the significant aspects of a project and presents them in attractive and interesting manner.

Conclusion

Having in mind all the possibilities for implementation of technologies presented here one can understand their full potential in overcoming some of the most serious conservation and restoration problems. We can only hope that the economic crisis, which has also hit architecture and building industry will not diminish efforts and achievements made in this field. Regardless of problems, the State should always be open-minded towards quality and innovative projects and should try to help putting them in motion.

References

- Azuma R., A Survey of Augmented Reality", SIGGRAPH 95, Course Notes no. 9 (Developing Advanced Virtual Reality Applications),1995.
- Jovišić V., Rizvić S., Photorealistic Reconstruction And Multimedia Presentation Of The Medieval Fortress In Travnik, Review of the National Center for Digitization Issue 13, 2008, 65–73.
- Милошевић Г., Ротер-Благојевић М., Јадрешин-Милић Р., Николић М., Обнова и презентација утврђења Рам на Дунаву и његове околине у функцији културног туризма, Гласник 34, 2010, 89–94.
- Miljković I., Iskopine pikselima, Svet Kompjutera 4/2004, 2004, http://www.sk.rs/2004/04/skpr01.html
- Miljković I., Kalemegdan, 3D in Svet Kompjutera 5/2004, 2004
- Pajić V., Jovanović D., Govedarica M., Modeling City Hall's Facade Using Laser Scanning Technology, Review of the National Center for Digitization Issue 15, 2009, 59–63.
- Станојев Ј., Софтверска реконструкција тврђаве Бач процесом фотограметријског снимања, Гласник 34, 2010, 197-201.
- TASIĆ N., STEPANOVIĆ G., 3D Scanning at Vinča – a Solution for Conservation and Study of Cultural Heritage in Review of the National Center for Digitization Issue 16, 2010, 43–48. http://www.sk.rs/2004/05/sknl01.html
- Vlahakis V., Ioannidis N., Kirigiannis J., ARCHEOGUIDE: Challenges and Solutions of a Personalised Augmented Reality Guide for Archaeological sites. *Computer Graphics in Art, History and Archaeology, Special Issue of the IEEE Computer Graphics and Applications Magazine*, 22, 2002, 52–60.
- Vlahakis V., Kirigiannis J., Ioannidis N., Augmented Reality Touring of Archaeological Sites with the ARCHEOGUIDE System, 2003, http://www.cultivate-int.org/issue9/archeoguide/

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