VIRTUALIZATION OF THE CULTURAL HERITAGE

OF THE SOLOVETSKY MONASTERY

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Abstract

The article details the experience of designing an information-cum-multimedia resource that presents a unique historical site, the architectural ensemble of the Solovetsky Monastery. The final product is a complex entity, consisting of an information and research internet portal, a 3D virtual reconstruction Ensemble of the Solovetsky Monastery in the Period of Its Highest Prosperity (XVI-XVII Centuries), as well as an interactive 4D tour of the Solovetsky Monastery based on Video 360 technology.

The project is being realized by an interdisciplinary team, joining the efforts of research staff of Solovetsky National Historic and Architectural Museum and Natural Reserve, ITMO University and Saint Petersburg State University.

1 INTRODUCTION

There's a large number of unique historic religious sacred sites within the Russian Federation, that are still being used for the initial purpose and attract special attention of pilgrims, tourists, researchers etc. One of such sacred sites is definitely the Solovetsky Monastery, listed as a Highly Valuable Object of Cultural Heritage of the Peoples of the Russian Federation [Solovky].

The Solovetsky Monastery (Fig. 1) is a vast architectural entity, it is on the UNESCO World Heritage list. It has always played a prominent part in the Russian history and culture, for it was highly instrumental in the advancement of the Russians into the White Sea region, the subesquent exploration of the Arctic Ocean by the Russian mariners and the emergence of Russia as a great Arctic power.
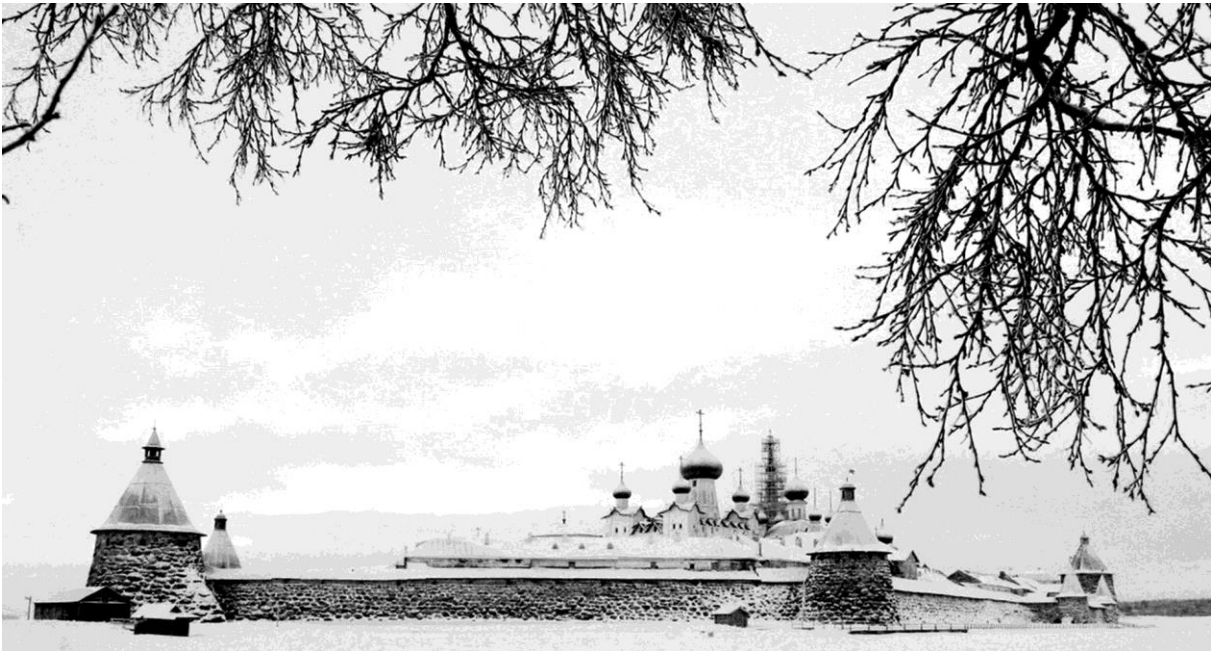

Fig. 1: Solovetsky monastery

The Solovetsky Monastery was founded in the first half of the XVth century, in 1436, when St. Zosima of Solovki had arrived to the archipelago.

Solovetsky Islands are a unique historic, cultural and natural site, since their preserved ecclesiastic structures, residential buildings, household structures, fortifications, waterworks, roads etc. are unparalleled. The architectural complex took shape between early XVIIth and early XXth cent. The highlight of the Solovetsky Monastery as a historic and cultural site is the

main ensemble that includes the fort, the church complex, residential and household structures, waterworks, operational buildings and units.

An impressive number of unique historic relics and artifacts has been preserved on the grounds of the Solovetsky Monastery (Fig. 2): a collection of icons, cult objects, pieces of applied arts, manuscript books and incunabula, Mediaeval manuscripts etc.

Fig. 2: The Stone Cross of St. Zosima of Solovki

1.1   Using Information Technologies in Cultural Heritage Preservation and Tourism

Virtualization of the objects of non-material cultural heritage pursues the following goals:

1) Virtual reconstruction of the object, to show what it looked like in the past. For this purpose, it is essential to have the adequate amount of content, i. e. blueprints, archival images, engravings etc.

2) Virtual conservation of the object in its current state, in order to preserve its digital image for the future generations. The principal technologies used for the purpose are 3D scanning and photogrammetry.

3) Introduction of various interactive products, using various virtual and augmented reality technologies.

The three abovementioned approaches can be combined in various modifications, in order to meet the goal of actualization of a certain cultural heritage site.

The obtained results can be used in a number of ways, depending on the goal; one of the options is to design an information source that features structured site-specific historic and research information. With the use of GIS and the augmented reality technologies for smart

phones, tour applications can be designed that would enhance the visit to the cultural heritage site in question, offering a more comprehensive educational experience.

One of the successful examples of virtualization of a cultural heritage site with the use of 3D scanning technologies and the technologies of augmented reality is the digitalization of a whaling station in the Kerguelen Islands.

In December 2010, Eurl Pérazio team performed the 3D scanning of a whaling station in the Kerguelen Islands; they did over 46 hours on a site across 6 hectares with the help of 3 laser scanners: 2 HDS 6000 and 1 C 10 by Leica® (Fig. 3) on a tripod [Boris16].

Fig. 3: Leica Pegasus Backpack

The result is a textured model. The simulation of the site as a whole was carried out with Blender program. After that, ITMO University team, in collaboration with Eurl Pérazio team, have designed a virtual interactive walk through a recreated site in Oculus Rift DK2 virtual reality helmet (Fig. 4).

Fig. 4: 4D reconstruction of the whaling station in the Kerguelen Islands

1.2 Multimedia information system «Architectural ensemble of the Solovetsky monastery in the period of its highest prosperity (XVI-XVII centuries)»

With the support of Grant 16-01-12022 (2016-2017) of the Russian Humanitarian Research Foundation, ITMO University and Saint Petersburg State University, in cooperation with Solovetsky National Historic and Architectural Museum and Natural Reserve, designed a multimedia information system Architectural Ensemble of Solovetsky Monastery in the Period of its Highest Prosperity (XVI-XVII centuries) [Solovky.IFMO] that encompass the following features:

1) Authentic virtual 3D reconstruction of the Solovetsky Monastery (XVI-XVII centuries) with the option of viewing it through the virtual reality headsets;

2) Quality information base featuring various data on the history of the site;

3) Virtual interactive 4D tour of the Solovetsky Monastery in various multimedia formats.

What adds urgency to the creation of this particular information system is the major renovation and reconstruction program that is currently under way in the church complex, which will definitely affect its authenticity. There's a multimedia exhibition on the grounds of the Solovetsky Monastery, that can use new multimedia products. Besides, there's a web site of Solovetsky National Historic and Architectural Museum [Solovky]; it seems essential to enhance it with a complementary interactive internet resource.

Using a vast number of sources (iconography of the Solovetsky Monastery, photographs, archeological records, restoration projects, historic descriptions, inventory lists of the Monastery, accounting and donation books etc.) we managed to create the authentic virtual 3D reconstruction of the Solovetsky Monastery (Fig. 5).
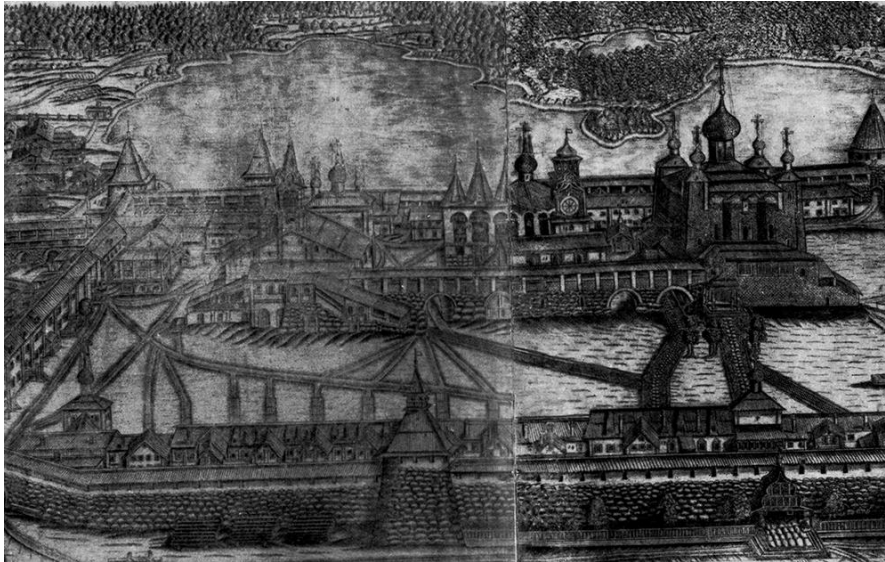

Fig. 5: An old engraving featuring the Solovetsky Monastery

Autodesk 3D Studio Max program was used for designing the virtual 3D reconstruction of the Solovetsky Fortress.

One of the main challenges was to render the unique masonry work of the structures. The stonework of each curtain wall in unique, featuring boulders of a different size; in each case it depends on the type of the structure and the technological preferences of the period.

To ensure the authentic rendition of these objects, we resorted to photogrammetry and generation of bump maps and normal maps, based on the photographs.

Using the photogrammetry technology, we created 3D maps of high verisimilitude, both as far as the geometry and texture maps go, to obtain the information on the shape of the real objects and to transfer it on the reference models (Fig. 6).
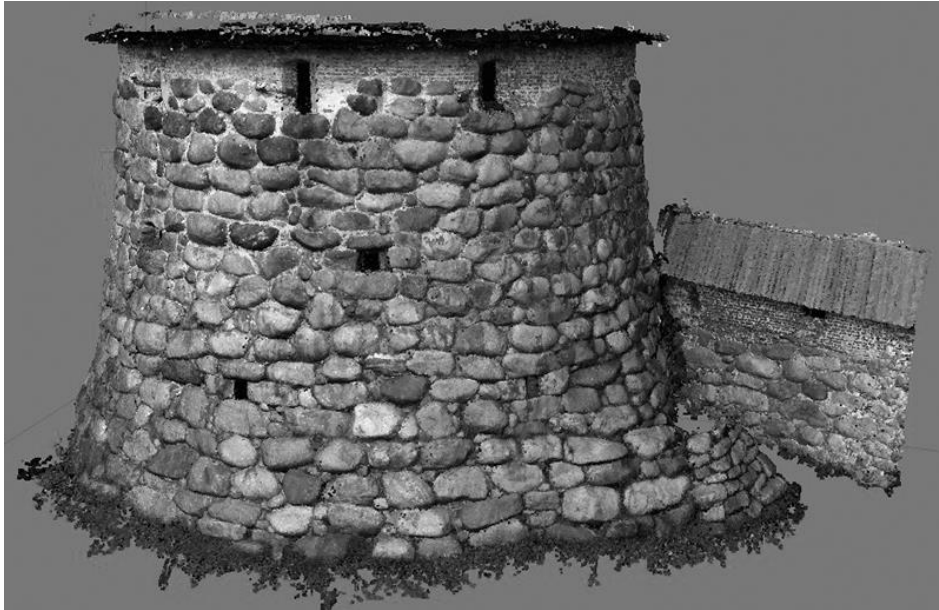
Fig. 6: Korozhnaya Tower, photogrammetry results

For some of the objects, high-resolution texture maps (ca. 35,000 pixels for the long sides of the curtain walls) were assembled manually, to be used as the textures for the models. To optimize the process, we created reduced copies of the textures (16К, 8К, 4К) to be used at the distances that do not require very high resolution. To prevent the objects made of the boulders from looking flat, customized software was used to generate, on the basis of the resulting images, the height map and the normal map; they were superimposed on the reference models that were based on the blueprints.

Fig. 7 presents the result of the virtual 3D reconstruction of the architectural ensemble of the Solovetsky Monastery.

The virtual interactive 4D tour is structured as a map of the Solovetsky Monastery, that is divided into sections. In each section the user can select one of the following viewing formats:

1) A tour in 360 format - our times;

2) A tour in 3D 360 format - 16-17th centuries;

3) Textual illustrated information at each sector.

This virtual interactive tour gives the user a chance to experience an in-depth personified immersion into the virtual space of the Solovetsky Monastery.

The video tour in Video 360 format was filmed in cooperation with Video360production [Video360] project, using a custom-designed two-camera system and Entaniya Fisheye lenses.

Fig. 7: Virtual reconstruction of the architectural Ensemble of Solovetsky Monastery

Fig. 8: Selection menu for the interactive map of the Solovki

The result of this project is the information and multimedia portal that incorporates a number of multimedia elements (3D reconstruction, Video 360, interactive map etc.), as well as educational content on the history of the emergence and evolution of the Solovetsky Monastery.

Multimedia information system Architectural Ensemble of Solovetsky Monastery in the Period of its Highest Prosperity (XVI-XVII Centuries) is available online at: http://solovky.ifmo.ru/.

Literature

[Solovky]   URL: http://www.solovky.ru/

[Boris16]   Borisov N., Smolin A., Chambaud L., Couesnon P., Jacquot E., Mielcarek F., Peral J., Perazio G., Rebiere J., Trushin V., Valcke S. Digitalisation of a whaling station in the Kerguelen islands (southern french and antarctic lands) // EVA 2016 SAINT PETERSBURG. Electronic Imaging & the Visual Arts INTERNATIONAL CONFERENCE, St. PETERSBURG, JUNE 23th–24th, 2016 Conference Proceedings. – SPb ITMO University, 2016. – P. 79-84

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