Virtual reconstruction of the lost listed buildings in the case of the Altai mission churches

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Abstract. The issue of computer modelling of the lost and partially lost architectural religious heritage sites is discussed in the article. The methods of virtual reconstruction of the architectural projects, the computer-based software for three-dimensional modelling, as well as the technology of the computer compilation, which allows deciding the issue of the easy access to viewing a model are analysed using the multidisciplinary approach. The modelling issues in the terms of preservation, monitoring the current state of the cultural and historical heritage sites, ensuring the cultural landscape have been defined. The procedure of virtual recreating the look of the lost religious buildings and complexes has been suggested. It has been emphasized, that the creation of three-dimensional panoramas, electronic catalogues could mitigate the effects of the church property restitution and retains the free access to at least the virtual models of the heritage sites.
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Introduction

Over the last years the 3D-graphics has become more common in various fields of the human activity, a large number of the architectural and design works are executed in the three-dimensional space. Three-dimensionality enriches the computer technologies with the elements of the realistic style, changes the nature of the interaction between a person and a computer. The technologies of building the three-dimensional computer models have been already developed for several decades. However, only today these technologies have become available for the general computer users. Two major factors have made a contribution to it. At the turn of the XX and XXI centuries the sufficiently powerful (large memory capacity, response time) personal computers appeared. Modelling has become available for a large number of the specialists, architects, designers, restorers. Then, at the end of the first decade of the XXI century the high-speed networks, which allowed transmitting the significant information scope between the remote users appeared. This significantly expands the audience, which uses the modelling results. Now this information could be available not only for the technical specialists, but also the art critics, museologists. Moreover, the three-dimensional models could be transmitted through the Internet, i.e. to the workplace in any institution. The significant expansion of the usership has resulted in the significant progress in developing the shell programs, which allow building 3D-models, improving and "reviving" it, simulating a high degree of vividness of the virtual space.

Methods of Research

The historical, descriptive and analytical research methods are used in the article.

Main Part

In a view of developing the modern computer technologies the art history and the history of architecture have had the opportunity to enhance the traditional research methods. This opinion has been repeatedly expressed by E.Y. Kalnitskaya [1], D.Y. Dragomirov [2] and others. The application of the computer technologies has a variety of advantages. The computer technologies allow more clearly imagining the dimensional and spatial, as well as planning structure of the architectural project, the decoration of building elevations, and, what is the most important and the commensurability of the environment. In case of the elaborated model the walling technique, the material and decoration of the building could be determined. Not in all cases it is possible to reach the high accuracy of the model, which directly depends on the completeness of the initial historical, archive and other data on the lost site.

At the present stage the objectives of the three-dimensional modelling are as follows:

1) recreating the look of the lost buildings upon the unique photographic documents and graphic materials in a form of the three-dimensional models;

2) modelling "the cultural landscape" by means of the computer technologies and the reconstruction of its changes on the basis of the archaeological, as well as archive and historical data;

3) virtual preservation and monitoring the current state of cultural and historical heritage sites;

4) implementing the concept of the virtual computer modelling the landmarks of architecture, history and culture in education, culture and art;

5) development of the electronic educational tourism.

Two approaches, which ensure building the three-dimensional models of the architecture and urban development projects, should be drawn up. The first one is to create a cyclorama of the existing sites (a pseudo-three-dimensional model). The illusion of three-dimensionality is peculiar to the models, but they are not actually three-dimensional, as the observer is not able not move in the chosen direction. The specified panoramas are built using circular photographing followed by further photo stitching in the special programs. Such panoramic views have become more popular in the Internet. The field of its most active application - is the interactive catalogues, presentations, encyclopaedias and educational programs. In the field of the art history this technology is convenient to use for representing the interiors of the preserved historical and architectural landmarks. For the purpose of building the pseudo-three-dimensional model the highly specialized applications, such as Easypano Modelweaver, 3D Photo Builder Professional, 360 Degrees Of Freedom 360.3D are often used. The automation function is specified in these software packages. Implementation of this technology is relatively time-consuming, therefore, in our view; it will be more widely spread in future.

There are some graphical packages, which give the possibility to simulate the spatial effect (a drop shadow, a perspective). However, the drop shadows or the lines simulating a perspective - are just the illusion of depth; the model does not actually have depth. When using these three-dimensional programs the perspective becomes dynamic and real. The second approach of building the three-dimensional special models lies in the use of the computer programs of the complete three-dimensional modelling. A large number of the cultural and architectural heritage sites require the implementation of different methods of the computer modelling optimization. The most important stage - is the model visualization, the process is very time-consuming [3]. The intended man-hours of the modelling final stage should comply with the required degree of detailing the recreated 3D-model of the site.

It is necessary to compile a computer model into the machine codes in order to apply the three-dimensional virtual reconstruction of an architectural project, carried out in one of the graphical packages (3D Studio MAX, ArchiCAD, AutoCAD, etc.), as the local (within the subject exhibition) or major (Internet projects) presentations. The latter allows solving some important technical problems of presentation: 1) an access to viewing a virtual 3D-model without installing the special expensive graphical packages; 2) the presence of the individual interface, which reflects the specifics of the art study for exploring a 3D-model; 3) reducing the response time and increasing the speed of work with the 3D-model of a site; 4) decreasing the used computer memory capacity without the picture quality degradation. An alternative to the CAD-technologies is the recently released software packages, which implement the so-called BIM-technology. In the estimation of some experts, such as V.V. Talapov, this technology is more user-friendly and advanced for landmarks modelling and building design. It could greatly ease the problem of arrangement and integration of various building elements and systems. The BIM - technology is implemented, for example, in the Autodesk software programs (the Rivet Architecture, Rivet Structure packages, etc.) [4].

Nowadays the following technologies of the computer compilation have been the most widely spread. The programmer-friendly multiplatform tool Unity3D. Although this development has been initially intended to creating the virtual three-dimensional computer game framework, the integrated program features allow quickly enough modelling the landscapes of varying complexity by a limited number of the specialists, and working with light and shades, reaching a high degree of vividness. The other approach requires the participation of a large number of programmers, as it provides the possibility to process the graphical 3D-model by means of the low-level programming languages (in particular, C++). For this purpose the OGRE technology could be applied. When using this technology as high as possible degree of the landscape and site vividness could be reached, but it will require much more time and financial expenses.

Due to the changes in the legislation on the relations between the Church and the State the problem of recovering the church buildings, church ware, icons and other spiritual heritage sites has arisen. Most of the extant church property is under the supervision of the public cultural institutions. Moreover, the church buildings themselves - the churches - have been often turned into a museum, what to a certain extent, has prevented its total loss. As noted by V.G. Bondarchuk, "The history of preserving the domestic religious buildings - is a complicated, complex, touchy and still insufficiently studied issue" [5]. Recovering the church buildings and other property, restoring the public worship will undoubtedly restrict the art critics', restorers' and non-specialists' access to the ancient church buildings. The creation of three-dimensional panoramas, electronic catalogues could mitigate the effects of the restitution and retain the free access to at least the

virtual models of the heritage sites. It is obvious that the model could not fully catch the exhibit image, as well as the virtual technologies could not simulate all the experiences of the direct contact with the work of art [6].

Because of the virtual reality and virtual world's concept development on the basis of the computer-based information and communication technologies the prerequisites for forming the virtual public cultural space, which could propel the domestic culture and art to a higher level of the public interest, have appeared. However, virtual presentations will contribute to the promotion of the actual historical and cultural landmarks, increasing the tourist and investment attractiveness. It is primarily subject to the large cultural centres of Moscow, St. Petersburg and other cities, where because of the cooperative efforts of the state authorities and cultural institutions the implementation of the large-scale projects is possible.

The geographic information systems, including the less stringent models, than those during the restoring process are established in order to complete the conservation tasks. In the context of this study, the GIS visualization in the test mode has been carried out on the basis of Google Earth, which provides the open access to the three-dimensional terrain model upon the satellite images. The 3D site plotting was carried out by the GPS-coordinates of the sites, obtained by the author during the field studies. According to the electronic cartographic materials the final visualization allows determing the site location, as well as evaluating the pattern of the landscape surrounding the landmark. In the same system referencing the simplified site model to the terrain could be carried out as a matter of the landscape composition analysis while implementing the urban conservation or environmental activities [7]. Applying the three-dimensional models obviates the need for executing the time-consuming physical modelling of the site or the terrain.

According to the practice, the stages of developing the 3D-models of landmarks and landscapes have its own specifics depending on the tasks to be solved and the chosen software. However, the key elements of the procedure are common to different modelling objects. When setting the modelling task, it is necessary to determine the required level of detailing and the degree of vividness (visualization) of the final product. During the operation, in addition to the orthogonal projections, it is necessary to determine the image of the building elevations and interiors, as well as the model terrain textures. The naturalness of perceiving the modelled computer environment and the possibility of the contact (interactive) on-line interaction with the virtual environment are required for reaching a high degree of vividness of the computer (virtual) model [8].

Conclusion

Subject to as aforesaid the author's integrated procedure of virtual reconstructing the completely or partially lost church missionary architecture assets of the South of Western Siberia is as follows.

1. *Archive and Historical Surveys*. Determing a list of the church buildings upon the archive data and identification of the archive architectural graphics.

2. *Field Studies*. Detecting and coordinating the location, photo fixation and measurements of the church buildings. In some cases - using the methods of archaeological clearing. The collection of the old residents' memories of the church exterior and interior, church ware and other religious items.

3. *Implementation of the Geographic Information System*, Reflecting the Sacral Topology of the Research Region. The 3D satellite site plotting.

4. *Preparation of the 2D-profiles of the Recreated Sites*, Drawing in Floor and Elevation Plans, Coordination of the Archive, Bibliographic and Field Data.

5. *Deriving "the "Wire" Site Frame* upon the Two-Dimensional Profiles of the Floor and Elevation Plans or through the Computer Processing of the Historical Photos. For complexes - detection and identification of the geodetic building parameters.

6. *Generating the 3D-Model of a Site and the Surrounding Landscape* on the Basis of the Three-Dimensional Graphics and Exclusive GIS.

7. *Model Visualization*. Development of the optimal lighting layout, arrangement of the virtual spotlights, set-up and "installation" of toning and terrain textures of the architectural projects.

8. *Presenting the 3D-Model of a Site.*

8.1. Compiling a Computer Model into the Machine Codes.

8.2. Designing an Individual Shell Program Which Interactively Creates the User's Access to a Model.

8.3. Generating a Video Sequence of the Comprehensive Inspection ("a Fly-By" in the Given Path) of the Historical and Architectural Landmark with an Information Audio Sequence.

9. *Project Implementation.*

9.1. Recording a Video Sequence on DVD from the Menu, Which Allows Viewing Each Site.

9.2. Allocating the Separate Three-Dimensional Models in the Internet.

9.3. Creating a Virtual Museum Exhibition.

Implementation of the aforesaid procedure involves the work of a variety of the specialists - the architects, programmers, computer designers. However, the major role is reserved by an art critic. Neither a programmer nor a designer himself could fully feel and render the 3-D composite and colour score of a landmark. The modelling experience has shown that the steady development of the computer technologies will enhance the prospects of implementing not only virtual, but also actual projects.

The aforesaid modern computer technologies allow recreating not only the particular models of objects or its complexes. The geographic information systems along with three-dimensional modelling could recreate the large-scale scenes, including the entire look of the environment, which is a model of "the cultural landscape" as a form of describing the cultural and natural heritage sites. If there is a sufficient amount of the historical data and documents, the model could be extended by the additional chronological layers, reflecting the state of the landmark in various times. For example, we have recreated the look of the first missionary church of Chemal, which was renewed several times, while changing its exterior and location. A multilayered model includes drawing in a landmark prior to 1890 and then, when it was reconstructed. In general, the procedure of three-dimensional modelling of the church missionary buildings has been evaluated while developing the computer models of 15 buildings of the Ulalinsky missionary camp (the first prayer house of two types, the Vladimir Memorial Church, the chapels of Our Saviour and St. Panteleimon, the Cemetery Church of Assumption, the house of the mission's chief with a family chapel, the boys' and girls' missionary schools, the Konshins shelter, the Metropolitan Macarius school, an old college house, a missionary hospital, an obelisk, a preaching house), 13 buildings of the Chemalsky community shelter and missionary camp (the first prayer house of two types, the All Who Sorrow Church, the St. Nicholas Church, two cell buildings, a sanatorium, the one-class and second-class schools, a refectory, a cross-house, a cell-hut, an old bathhouse, a household building), three buildings of the Ongudai missionary camp (the churches of St. Innocent and Assumption, the preaching house of missionaries the Sokolovs), two buildings of the Ulalinsky Nunnery (the Church of Anna the Prophetess and the St. Nicholas Stone Cathedral) and the St. Nicholas Church in Ust-Kan. A total number of the computer 3D-models developed during the study is 34 items, including two sets. Modelling the partially preserved buildings have been based on the design drawings of the pre-Soviet times, the author's measurements of the historical structures and building elevations, the typical forms of roofs, window openings and decorative elements, which are typical for the regional building types under consideration. During the computer model compilation the additional processing is necessary to reach the required level of vividness of the 3D visualization. In addition, correct matching of the virtual camera parameters, which is carried out empirically is crucial for eliminating the "optical" distortion of the model cubage's. The list of the modelled objects reflects the range of all the most classical and important architectural heritage sites of the Russian Orthodox Church in the traditionally missionary territory in the South of Western Siberia [9].

Results

The new promising ways to preserve (including the virtual preservation), to account and to protect the unique historical and cultural heritage of the region lie in the application of the information technologies. Propelling these work types to the level of the modern technologies will to a large extent contribute to renewing and retaining the historical memory of the Russian people. This research trend has become more urgent. The cultural and religious heritage becomes the study object of various subjects in both higher and secondary education institutions [10]. The process of restoring the lost church architecture assets has been intensified. The need for the skilled personnel in the field of the architecture, construction and applied arts has increased. The aforesaid computer technologies have become not only an actual tool for the design and presentation works, a method of the scientific communication for the general researchers of different specialties, but also the possibility to amplify the subject of the art historical and architectural studies.

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