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Geometrical classification of forms of cultural monuments and creation of a conceptual model of original parameter dimensions in a virtual museum

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ABSTRACT: The article presents the description of cultural heritage objects in geometric models of traditional information based on set theory, implemented in a computer environment. This organization of the spatial object allows us to talk about the geometric interpretation of the original appearance of the state of the object in question, since the same manifestation of the properties of the environment is observed virtually in all directions at each point, that is, the definition of variability provided with.

KEY WORDS: Objects of cultural heritage, museum, virtual museum, digital imaging, conceptual model.

I.INTRODUCTION

Over the past years, we have supported culture and art in our country, preserved and increased the national cultural and spiritual heritage, introduced our people to the best examples of national and world culture, improved the material and technical base and international cultural relations. Comprehensive strengthening measures were implemented. In particular, in the decision of the President of the Republic of Uzbekistan "On measures for the innovative development of culture and art in the Republic of Uzbekistan" PQ-3920 Development measures involving foreign researchers are presented.[1]

After the independence of the Republic of Uzbekistan, a lot of work is being done to promote the rich spiritual and cultural heritage of our nation to the world. In this regard, according to the decree of the President of the Republic of Uzbekistan "On the fundamental improvement and improvement of the activities of museums", through extensive exhibition activities in Uzbekistan and abroad, the rich history of our country, today's achievements will be introduced to the world public, and the unique exhibits stored in museums will be promoted on a global scale. tasks are presented. After all, the features that make a nation known to the world are its spirituality and culture. In the work of the first President of the Republic of Uzbekistan, I.A. Karimov, "High spirituality is an invincible power", the concept of spirituality is broadly defined: "spirituality is the spiritual purification of a person, which invites him to grow from the heart, the inner world of a person, strong will, "The incomparable power that completes his faith and awakens his conscience is the criterion of all his views".[2]

In recent years, further development of national culture in the Republic of Uzbekistan, creation of a new history of the new Uzbekistan, preservation and promotion of tangible and intangible cultural heritage masterpieces, popularization of folk art and amateur art, world cultural heritage of our country Systematic measures aimed at ensuring active integration into the space, innovative development of culture and art were implemented.

Every year, the use of computing systems is expanding. The decision PQ-357 of the President of the Republic of Uzbekistan "On measures to bring the field of information and communication technologies to a new stage in 2022-2023" defines the priority tasks for bringing the field of information and communication technologies to a new stage a number

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of tasks are presented for the purpose of implementation, including the issue of developing an interactive website and its mobile application, which includes 36 museums in the Republic.

II. LITERATURE SURVEY

The idea of three-dimensional description of objects of national-cultural heritage, museum collections and electronic documents is connected with the extremely rapid development of real and abstract structures based on the engineering geometry and computer graphics sciences of information technologies, leading to the field of digital modeling of objects. aims to solve issues such as virtual existence in museum work, historical monuments, archeology and even purely humanitarian and other fields.

A museum is a non-profit cultural institution created by the government to store, study and display museum objects and museum collections to the public, as well as to achieve other goals established by state laws.

Virtual museum is an interactive multimedia software product that displays museum collections and exhibits in electronic form.

The main criterion for including the software product in the concept of "Virtual Museum" is the implementation of the following known mechanisms of interaction between visitors and exhibitors:

- the mechanism of presentation of exposition; - the process of presenting the exhibition; - additional information provision structures; - increase the international index of the language and local exhibits; - indicator of the share of exhibition buildings displayed in the virtual museum format in the total number of museum exhibit buildings; - an indicator of the share of objects of the museum fund presented in the virtual museum format out of the total number of objects in the exhibition rooms displayed in the virtual museum format; - indicators of comfort for disabled, disabled and elderly people.

In addition to natural modeling in the researches of scientists such as W.Franz-Yerich, M.Reuter, N.Peinecke, computer (digital) modeling of objects includes not only the shape, that is, the geometry of nature, but also the quality characteristics of the object: the history of the original appearance, material, weight - that is, the description of the descriptive characteristics of a real object is studied. These descriptive (often called semantic) features are often stored as a set of "token" data organized in one or more tables.

III. METHODOLOGY

A conceptual model of creating objects of cultural monuments in a virtual museum was formed (Fig. 1). The description of cultural heritage objects (MMO) based on the above in traditional information data geometric models implemented in a computer environment and based on set theory can be formally expressed by the following set of attributes:

$$MMO(l_t) = \{O(n_1^t x_{l_i}, n_2^t y_{l_i}, n_2^t z_{l_i}), S(kol, PBR), T(d)\}, \quad (1)$$

here, the , $MMO(l_t)$ -cultural heritage project, that is, the record of the value unit of digital imaging in the database, the record is represented by the current time information; A set of data describing the spatial view (metrics and topology) of the $O(n_1^t x_{l_i}, n_2^t y_{l_i}, n_3^t z_{l_i})$-object; $l_i \in O$, forming a set of planes along each of the axes, is written by the equations on the rock:

$$A_t(x - x_{l_i}) + B_t(y - y_{l_i}) + C_t(z - z_{l_i}) = 0; \text{ or } A_t x + B_t y + C_t z + D_t = 0,$$

where $D_t = -(A_t x_{l_i}) + B_t y_{l_i} + C_t z_{l_i})$, where t is the position of the plane in the ith set at the current time; This organization of the spatial object allows us to talk about the geometric interpretation of the physical appearance of the state of the object in question, since the same manifestation of the properties of the environment is observed virtually in all directions at each point, that is, the definition of variability provided with. In this case, according to the principles of geometric modeling, the inclination and position of the t-th plane form a local function of the model for each point and are determined by the following four components of $\vec{n} = (n_1, n_2, n_3, n_4)$, normal to the t-th plane.

$$n_1 = \frac{A_t}{\sqrt{A_t^2 + B_t^2 + C_t^2 + D_t^2}}, n_2 = \frac{B_t}{\sqrt{A_t^2 + B_t^2 + C_t^2 + D_t^2}},$$

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$$n_3 = \frac{C_t}{\sqrt{A_t^2 + B_t^2 + C_t^2 + D_t^2}}, n_4 = \frac{D_t}{\sqrt{A_t^2 + B_t^2 + C_t^2 + D_t^2}},$$
$$n_1^t x + n_2^t y + n_3^t z + n_4^t = 0$$

- S(kol,PBR) a set of data describing the texture and colorimetry of the object surface; T(d) - as a rule, a set of text data representing the most detailed description (semantics) of the object; t is the time of obtaining the MMO or placing its digital model in the database.

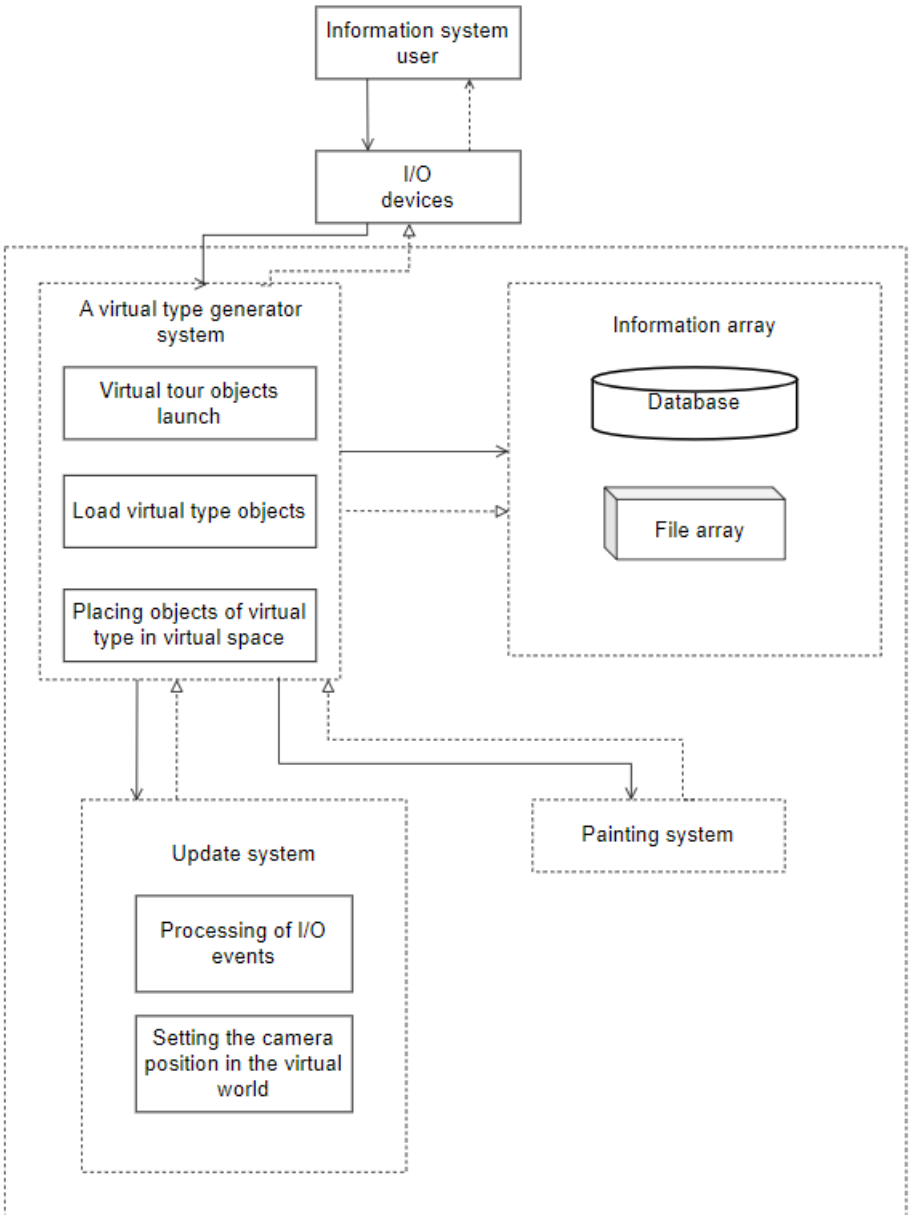

Figure 1. Conceptual model of creating a reflection of cultural monuments in a virtual museum.

The semantic part of this complex T(d) information resource has been comprehensively developed and implemented in many systems (registries, electronic catalogs, databases, etc.). Formally, the size of this type of data, as well as the information about the time of describing the object, are equal. In this process, our interest is focused on obtaining and storing the spatial (metric) and structural-colorimetric parameters of the MMO in storage, the storage of

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which is very widely discussed today, which significantly increases their dimensions and is necessary for creating the dimensions of the graphic component of the object model is a problem.

It seems that photographs in the form of drawings in the graphic form of the MMO model appeared together with the organization of museum collections. These are two-dimensional (2D) flat models of real objects. Some time later, they were joined by 2.5 and 3D models, representing (or simulating) the three-dimensional appearance of MMOs. In addition, it is still used in the form of 3D models and stereophotos. With the advent of innovative computer tools, modeling problems have risen to the next level, but, unfortunately, they have been separated from the most sought-after professional community.

Forming 3D models of classical images using modern computer technologies has become a common practice in the work of large museums. Less known are the works in the field of modeling with the increase in the size of the description of cultural heritage objects to the so-called 4D and 5D models. In such cases, it will be possible to save the image of the object in the model, taking into account the temporal parameters of its existence, taking into account the visualization and generalization of its properties during working with the model. Summarizing the options for describing, creating, presenting and working with the model, the following options are offered for the use of dimensions from 2D to 4D for documents on objects of museum account (in some areas it is customary as, for example, in the cadastre).

Incorporating scale into spatial datasets on MMOs allows for the separation of models in terms of partial or complete simultaneous coverage with a detailed description of the accuracy and characterization of MMOs in space. Currently, examples of the use of this option in existing IPV models are not widely known, and for now it is a kind of abstraction, but its use in the future cannot be ruled out.

In this case, the shape and visual attributes of the object model are created with the help of computer graphics, which today are represented by a large set of tools for reproduction of objects that are very complex in terms of shape, color and surface texture. Next, it is necessary to describe the features of building models of these dimensions in relation to the field of knowledge, where computer technologies have been actively used in recent decades. As mentioned above, attention is paid to the creation of multifaceted models of cultural heritage objects of museum collections, as well as to the use of modeling methods in the topographical support of archaeological works.

IV. CONCLUSION AND FUTURE WORK

In conclusion, the innovative model for creating virtual museum geometric shapes through segmented division, coupled with the algorithm of geometric intersection of objects, represents a significant advancement in the digitization and preservation of cultural and historical artifacts. This approach not only allows for a highly accurate and detailed representation of complex geometric forms but also enables dynamic interaction with these forms within a virtual museum setting. By leveraging the power of intersection algorithms, the model ensures that the virtual representations of these artifacts are not only visually appealing but also geometrically precise, providing an educational and immersive experience for users. Such technological progress in virtual museum exhibits promises to enhance accessibility, extend preservation efforts, and offer new dimensions for experiencing and studying the intricate beauty of geometric shapes in cultural artifacts.

For future work, there are several promising directions to explore based on the current model of the creation of virtual museum geometric shapes and the algorithm of geometric intersection of objects. Firstly, enhancing the algorithm's efficiency can enable real-time processing of complex intersections, allowing for seamless interaction within the virtual museum space.
Secondly, integrating advanced rendering techniques and exploring the use of virtual and augmented reality (VR/AR) technologies could significantly enrich the user experience, offering a more immersive and interactive way for visitors to engage with museum exhibits from anywhere in the world.

Another avenue for future research is the development of educational tools and interfaces that leverage this technology to educate users about geometry and its applications in art and history. These tools can include interactive tutorials, gamified learning experiences, and in-depth analytical features that allow users to dissect and understand the geometric properties of objects.

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Incorporating machine learning algorithms to predict and present related geometric shapes or artifacts to users based on their interactions can personalize and enhance the learning experience, providing a tailored educational journey through the virtual museum.

Lastly, further collaboration with historians, artists, and mathematicians to refine the accuracy of virtual representations and to expand the virtual museum's database of geometric shapes and artifacts can help to bridge the gap between art and science, making this educational resource more valuable and comprehensive.
Continued interdisciplinary research and development in these areas will undoubtedly solidify the foundation laid by the current model and expand its capabilities, making the virtual museum experience increasingly accessible, informative, and engaging for diverse audiences.

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