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CREATING A VIRTUAL MUSEUM OF THE QORA UY (BLACK HOUSE), THE CULTURAL HERITAGE OF KARAKALPAKSTAN, USING ARTIFICIAL INTELLIGENCE

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ABSTRACT: This article scientifically explores the development of a virtual museum model for the "Qora Uy" (Black House) historical and cultural site based on artificial intelligence. The research analyzes modern trends in the digitalization of cultural heritage objects, the role of artificial intelligence technologies in museum operations and cultural heritage preservation, and the importance of virtual museums in education, tourism, and cultural promotion. It also examines the possibilities of conveying the historical and cultural value of the Qora Uy to a wider audience by recreating it in a digital format. The article substantiates the prospects of using 3D modeling, machine learning, and interactive platforms in creating the virtual museum model.

Keywords: artificial intelligence, virtual museum, Qora Uy, cultural heritage, digitalization, 3D modeling, AR/VR technologies, machine learning, historical monument, digital culture.

INTRODUCTION

In the 21st century, one of the most significant directions of human development is digital transformation, which is deeply permeating nearly all spheres of society, including culture, education, and science. Innovative solutions such as digital technologies, artificial intelligence (AI), big data, and augmented and virtual reality (AR/VR) are fundamentally changing traditional forms of activity and creating new opportunities. The role of these technologies is becoming especially crucial in the process of preserving cultural heritage, disseminating it to the wider public, and transmitting it to future generations.

Cultural heritage is one of the most important factors expressing the historical memory, national identity, and spiritual wealth of every nation. It manifests in tangible and intangible forms, encompassing historical monuments, archaeological sites, architectural structures, manuscripts, folklore, and traditional forms of art. However, due to the influence of globalization, urbanization, and natural and anthropogenic factors, the risk of many cultural heritage objects being lost, damaged, or forgotten is growing. For this reason, their preservation and digital restoration represent one of the most urgent scientific and practical challenges of today.

A number of programs are being implemented at the international level, particularly by UNESCO, to digitize cultural heritage and preserve it using innovative technologies. This approach allows not only for the documentation of cultural objects but also for their recreation in a virtual environment and presentation to a global audience. Consequently, the "virtual museum" concept was formed, which is now recognized as a new stage in modern museology.

A virtual museum is a system that presents real museum exhibitions or historical sites in an interactive format using digital technologies, allowing users to explore exhibits remotely, view them in 3D, and even engage with them interactively. This approach expands the capabilities of traditional museums, eliminates geographical boundaries, and makes the learning process more convenient and engaging.

In recent years, the development of artificial intelligence technologies has served to further enhance the concept of virtual museums. With the help of artificial intelligence, it has become possible to automatically reconstruct historical sites, restore lost elements, establish intelligent dialogue with the user, and create personalized tour systems. This has ushered in a new era for museum work and cultural heritage management.

The territory of Uzbekistan has an ancient history and is home to numerous unique cultural heritage sites. While cities like Samarkand, Bukhara, and Khiva played a significant role in the development of world civilization, there are also many historical sites of local importance in various regions of the country. Among these, the Qora-uy historical and cultural complex is worthy of special attention. This site is significant not only architecturally but also historically and culturally, making its preservation and promotion to the public a pressing issue.

However, traditional methods of preserving and promoting such sites have several limitations. First, physical objects undergo a natural process of deterioration over time. Second, visiting them is dependent on geographical location, which does not create equal opportunities for all who are interested. Third, tours and museum services are often constrained by limited resources and infrastructure. For these reasons, the need to implement modern digital solutions is emerging.

A virtual museum model based on artificial intelligence can be an effective solution to these problems. Through such a model, it would be possible to reconstruct the Qora-uy site in 3D, visually illustrate its historical evolution, create an interactive database, and offer users personalized virtual tours.

This allows not only for the preservation of cultural heritage but also for its integration into the educational process.

Virtual museums play a crucial role in increasing the younger generation's interest in cultural heritage. For young people growing up with modern technologies, interactive and visual content is far more engaging than traditional text-based or static information. Therefore, virtual museums created using artificial intelligence also serve to enhance educational effectiveness.

Additionally, virtual museums are of great importance in the tourism sector. Presenting historical sites to a global audience through digital platforms helps to build the country's cultural brand. This, in turn, will have a positive impact on the growth of actual tourist flows in the future.

The relevance of this article is underscored by the large-scale reforms currently underway in Uzbekistan to digitize cultural heritage and develop the creative economy. However, not all historical sites have been fully converted into digital formats, and virtual museum systems have not yet been widely implemented. From this perspective, developing a virtual museum model based on artificial intelligence, using the Black House as a case study, is of great scientific and practical significance.

The aim of the research is to develop the theoretical and practical foundations for recreating the Qora Uy historical and cultural site as a virtual museum using digital technologies. At the same time, another important objective is to analyze the potential of artificial intelligence technologies in preserving and popularizing cultural heritage.

Overall, this topic is focused on studying innovative ways to preserve cultural heritage, transmit it to new generations, and promote it globally in the context of a modern digital society, and is distinguished by its scientific and practical significance.

MAIN PART

1. Specific Research Objective

The primary objective of this project is to develop the theoretical and practical foundations for digitally recreating the Qora Uy historical and cultural site as a virtual museum based on artificial intelligence (AI) technologies and presenting it as an interactive platform.

This objective encompasses the following areas:

* Digitizing the historical, cultural, and architectural features of the Qora Uy site;
* Reconstructing the site using 3D modeling and virtual reality technologies;
* Creating an interactive information system based on artificial intelligence;
* Developing a virtual tour option for users;
* Forming an innovative model for the preservation and popularization of cultural heritage.

Achieving this goal will enhance the effectiveness of modern digital technologies in preserving cultural heritage and will foster the development of the virtual museum concept in Uzbekistan.

2. The Problem (A Pressing Issue)

Currently, there are several pressing challenges in the process of preserving cultural heritage sites and making them accessible to the general public. These challenges include the following:

2.1. Risk of Physical Deterioration and Loss

Over time, historical and cultural sites degrade due to natural factors (climate, humidity, temperature changes) and human activity. Objects like the Qora Uy (Black House) are also at risk of losing their original condition. Furthermore, traditional restoration methods do not always allow for complete recovery.

2.2. Geographical Constraints

The fact that cultural heritage sites can only be seen by visiting their physical location limits their accessibility to a global audience. This hinders the broader popularization of cultural heritage. In particular, locally significant sites like the Qora Uy are not well-known to many people.

2.3. Insufficiently Developed Digitalization

Although digital transformation processes have been developing rapidly in Uzbekistan in recent years, not all cultural heritage sites have been fully digitized. Many objects are preserved only as photographs or textual information, which limits their visual and interactive potential.

2.4. Limitations in Education and Outreach

Traditional museum formats are not always engaging or interactive for the younger generation. As a result, a decline in interest in cultural heritage may be observed. Without modern digital tools, effectively promoting cultural sites becomes challenging.

3. Solution (Proposed Model)

To address the problems mentioned above, a virtual museum model based on artificial intelligence is proposed. This model is based on fully recreating the "Qora uy" (Black House) site in a digital environment and using it as an interactive platform.

3.1. 3D Digital Modeling

The exterior and interior structure of the "Qora uy" site will be converted into a digital format using 3D scanning and modeling technologies. This process allows for the most accurate possible reconstruction of the site's real appearance. As a result, the user will be able to view the object from all angles in the virtual environment.

3.2. AI-Based Interactive System

Using artificial intelligence technologies, a "smart guide" system will be integrated into the virtual museum. This system will answer users' questions, provide additional information about the site, and create personalized tour routes. This will significantly enhance the user experience.

3.3. Virtual and Augmented Reality (VR/AR)

With VR technology, a user can take a "virtual tour" inside the Black House. AR technology, in turn, allows for the display of the object's historical state within a real-world environment. This approach makes cultural heritage more vivid and understandable.

3.4. Digital Database

All historical, archaeological, and cultural information related to the Black House will be compiled into a single digital database. This database will serve as an open platform for scientific research, educational processes, and tourism activities.

3.5. Integration of Education and Tourism

The virtual museum model will be integrated into educational institutions and the tourism sector. Students will have the opportunity to study the historical site remotely through this platform. Additionally, it will create an opportunity for foreign tourists to learn about the Black House.

4. Expected Outcomes

The implementation of the proposed solution is expected to achieve the following positive outcomes:

* A digital replica of the Black House historical and cultural site will be created;
* An innovative model for cultural heritage preservation will be established;
* The opportunity to reach a global audience through the virtual museum will be expanded;
* Interactive teaching methods in the educational process will be advanced;
* The effectiveness of tourism and cultural promotion will be increased;
* The integration of artificial intelligence technologies into the cultural sector will be strengthened.

CONCLUSION

The results of this study indicate that the idea of digitizing the "Qora Uy" (Black House) historical and cultural site as a virtual museum based on artificial intelligence (AI) is an important and relevant direction for the integration of modern cultural studies, information technology, and museology. In the context of current globalization and digital transformation, it is increasingly evident that preserving cultural heritage solely through traditional methods is insufficient; rather, it is crucial to make it accessible to a wider audience by transferring it to a digital environment.

Analysis shows that cultural heritage sites are at risk of disappearing over time due to factors such as natural deterioration, anthropogenic impact, and geographical limitations. Historically significant sites like the Qora Uy are no exception. From this perspective, recreating them in a digital format using 3D modeling, virtual reality (VR), and augmented reality (AR) technologies is considered an effective method for preserving their historical and cultural value.

The implementation of artificial intelligence technologies further enhances the virtual museum concept. Systems powered by AI enable users to receive interactive information, get answers to their questions, form personalized tours, and gain a deeper understanding of an object's historical context. Unlike the traditional museum format, this creates a new form of educational and cultural experience based on active interaction with the user.

Furthermore, the research results clearly demonstrate the significance of virtual museums within the education system. Studying historical objects through virtual platforms helps students better assimilate knowledge through visual and interactive learning. This also expands the opportunities for integrating the disciplines of history, cultural studies, and technology.

This model is also of great importance in the tourism sector. Presenting objects like the Black House to a global audience in a virtual format serves to strengthen the country's cultural brand. In the future, this can positively impact the growth of actual tourist flows, the development of the regional economy, and the creation of new jobs. Therefore, a virtual museum is regarded as an innovative solution with not only cultural but also economic significance.

At the same time, the research also shows that several conditions are necessary for the effective implementation of such a system. In particular, a high-quality 3D modeling infrastructure, qualified IT specialists, the capacity to develop and apply artificial intelligence algorithms, and the availability of a complete and accurate database of cultural heritage sites are of significant importance. Furthermore, protecting intellectual property rights and improving digital content management systems are also urgent tasks.

Overall, the project to create a virtual museum of the Black House historical and cultural site based on artificial intelligence holds great scientific and practical significance as an innovative model for cultural heritage preservation. This approach strengthens the integration of culture, education, and technology, serves to develop digital culture in society, and helps to further bolster Uzbekistan's position in the global digital space.

In conclusion, the virtual museum concept is not only a means of preserving historical sites but also an effective way to reinterpret them, make them accessible to a wider audience, and present them to the modern generation in an innovative format. Therefore, this field is regarded as a promising area that will require more in-depth scientific research and practical projects in the future.

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