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Visualization of Architectural Cultural Heritage Model Based on VR Virtual Reality Technology

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In the field of culture and art, virtual reality (VR) can restore cultural relics and historical sites through digital means, providing people with a more convenient means of exhibiting and curating cultural relics, sculptures, and three-dimensional painting. By roaming through 3D virtual ancient buildings, the researcher analyzed the structure of the buildings and obtained sample data. Using this data, preliminary modeling was conducted using 3D Studio Max (often referred to as 3D Max or 3ds MAX). In this article, 3DS Max used surface segmentation technology to simplify the process of model establishment. The researcher constructed the application software framework of the system, and imported it into the initial model, mapped and optimized the initial model, and achieved the 3D roaming control through the 3D virtual ancient building roaming system. When establishing the model, both the required positions and surface parameters in the model were saved, as well as the relevant information in the model. The visualization of the architectural cultural heritage model is achieved through the system interface. The rating for the dissemination method of virtual architectural cultural heritage models was 93, while the rating for physical architectural cultural heritage was 84. VR technology plays an immeasurable role in protecting architectural cultural heritage and inheriting traditional culture.

Keywords: virtual reality technology, architectural cultural heritage models, model visualization, ancient architecture roaming

1. INTRODUCTION

In recent years, with the development of the global economy and the acceleration of urbanization, the preservation and inheritance of architectural cultural heritage have become particularly important. However, existing conservation methods and traditional display techniques have become inadequate to meet the contemporary demand for understanding and experiencing architectural cultural heritage. Traditional approaches to the preservation of architectural cultural heritage often rely on text, images, or simple models, which cannot authentically reproduce the historical appearance and cultural significance of buildings, nor provide sufficiently immersive experiences. This leads to a lack of public interest and awareness in architectural cultural heritage.

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The aim of this study was to collect and organize examples of local architectural (tangible) cultural heritage, and combine these with internet and VR technology to create a virtual reality experience of architectural cultural heritage. Virtual reality is an advanced digital technology, and its application in the cultural heritage domain is significant. By means of VR, architectural heritage culture can be showcased, allowing people to better understand and appreciate the architecture created by their ancestors. At the same time, as well as protecting and disseminating the cultural heritage, planners can also draw inspiration from the design concepts and methods used in the past. Apart from ensuring that traditional cultural heritage is passed on to future generations, VR technology and various virtual design concepts can give people a better understanding of their country's architectural culture. Moreover, new technologies should be utilized to promote high-quality and effective dissemination of architectural cultural heritage.

The unique digital advantage of VR is that it facilitates the dynamic transformation of previously static artworks and the dynamic and intuitive display of virtual ideas created by designers in virtual spaces. This greatly improves the expressive ability of the exhibition and enhances the user's power of imagination. In this study, the characteristics of ancient Chinese architecture are analyzed, and the feasibility of using virtual reality technology to reproduce and preserve ancient buildings is explored. With the help of modern technology, ancient buildings can be classified and described, providing an efficient model for the virtual construction of ancient buildings. The technology can fully leverage the advantages of 3 DMAX and OpenGL (Open Graphics Library), and explore new methods for joint modeling of the two. Based on existing model construction methods, this study conducts in-depth research on optimization methods for model construction.

2. RELATED WORK

Virtual restoration of cultural relics based on VR technology is a learning method that combines education and entertainment, offering users easy access to information related to ancient buildings. Tolibjonovich's article covers the lives, scientific activities, and sociopolitical perspectives of great thinkers and politicians living in the Eastern Renaissance. They believe that China's cultural heritage urgently needs better means of inheritance [1]. Attenni believed that the modeling of building information is the most effective way to understand existing architectural structures. His research analyzed some important issues in building information modeling: the relationship between semantic modeling and surface continuity of architectural heritage [2]. Koo applied innovative virtual visualization methods to provide a more immersive and interactive experience for the historical, cultural, and architectural details of heritage sites [3]. Paladini believed that reachability plays a major role in promoting the protection of all aspects of cultural heritage. She believed that information and communication technology has led to the rapid development of augmented reality and virtual reality experiences [4]. The purpose of Borri's research was to address the protection of Italian architectural heritage. They also discussed architectural guidelines for Italian cultural heritage interventions, pointing out several limitations and highlighting important developments [5]. However, the research did not involve the visualization of buildings.

In a virtual museum, the building components are arranged in order, and users use 'handles' to pick them up and build them layer by layer from bottom to top, experiencing the construction process of ancient architecture. Arinto believed that protecting cultural heritage is an obligation, so that future generations can still enjoy the cultural wealth created by previous generations [6]. Barrile believed that three-dimensional modeling of archaeological and historical buildings is a new frontier in the field of conservation science, aiming to restore ancient villages located in the Greek region of southern Italy [7]. Kharitonov believed that the main elements of "green buildings" in the historical part of mega cities require scientific and practical proof. Due to the limitations of historical architecture in terms of efficient and 'green' land use, he proposed the development of "green buildings" in response to the cold climatic conditions of St. Petersburg [8]. Ulvi believed that cultural heritage is the most important link between the past and the future, and that the importance of recording and protecting cultural heritage is becoming increasingly evident [9]. Farhan focused on the dramatic transformation of the historical city and architectural features of the city of Najaf in Iraq, and considered new ways to protect and revitalize the city's historical center [10]. Perry believed that the importance of cultural heritage in sustainable urban development has been increasingly recognized in policy frameworks at multiple levels [11], while Heras believed that fields such as anthropology, history, or architecture can all help determine the value of heritage. Semi-structured interviews and cultural graphs are examples of qualitative and participatory methods that have been applied in the field of conservation. However, there is currently no framework for evaluating the effectiveness of these methods [12]. Their research does not consider the application of virtual reality technology.

3. METHODS FOR VISUALIZATION OF ARCHITECTURAL CULTURAL HERITAGE MODELS

3.1 Using VR Technology to Display the Advantages of Architectural Cultural Heritage

(1) High level of interactivity accelerates two-way communication of information

Through VR interactive displays, visitors can enjoy and experience an exhibition more fully, rather than just looking at exhibits and reading the information. This new VR method offers tourists a greater understanding of an exhibition and enhances their experience. In interactive displays, visitors need to become active participants in the learning process, rather than passive recipients.

(2) Protecting cultural relics and maximizing audience participation

The key to protecting cultural relics and historical sites is not to change their original state. Simply put, the main task of site protection is to maintain the original appearance of the site. Historical sites are mostly ancient tombs and buildings, with most of the latter requiring restoration. If the site reconstruction project is carried out recklessly, it not only may harm the original structure, but excessive intervention also affects the cultural and value orientation of the site, violating the principles of site protection [13–14]. It is often difficult to provide temporary visitors and tourists with a comprehensive understanding of a cultural site. The main reason is the state of the ruins and the lack of contextual clues about the functions of various spatial elements and the significance of their architectural features. All this makes it difficult for tourists to explore these ruins and understand their

relevance and significance. In this regard, VR displays can be of assistance as the technology can be used to label real scenes and perform virtual reconstructions of restored buildings on a computer. Tourists can view the reconstructed scene of the ruins through VR devices in the scenic area.

3.2 Construction of Architectural Cultural Heritage Models

The strongest capability of 3D Studio Max is the establishment of 3D models, which is one of the main reasons that this software can be applied to virtual reality systems. The main features in terms of modeling include the 3 DSMax surface tool and improved NURBS (Non-Uniform Rational B-Splines) technology. The use of surface tools to generate very complex patch models is an important modeling method. 3 DS Max adopts subdivision surface technology, making the modeling process simpler and achieving good results. Flexible selection techniques can locally select different vertices, making the transformed vertices softer and smoother. It is particularly suitable for modeling ancient architecture.

This study focuses on the polygonal modeling technology of 3DS Max. The polygon modeling method is a very direct modeling technology used for architectural models. It is also the basis of curve modeling and subdivision surface modeling. Although there are advanced modeling methods such as nurbs surface modeling and subdivision surface modeling, polygon modeling technology is still the main technical means of building architectural models. In regard to building features, multi-layer geometric modeling technology is widely used to establish building models with complex structural relationships. This method takes a small surface as the foundation, builds an object surface based on lines, and establishes a model. These small surfaces can be triangles, rectangles, or other polygons. When building a polygon model, the first step is to establish a basic geometric figure and then use modifiers to adjust the shape of the object, or use surface patches to model, and combine the object, so as to build a virtual ancient architectural model. Polygonal modeling technology is suitable for constructing objects with regular shapes, and it is relatively more suitable for modeling buildings. Furthermore, the parameters of the constructed model can be adjusted according to the requirements of the virtual reality system. This can result in models with different resolutions, meeting the real-time display needs of virtual scenes. When building a virtual architectural model, a relatively simple model should be used as much as possible, and the goal should be established in a parametric way to achieve the desired visual effect. In order to facilitate manipulation and research in a virtual environment, the model can be divided into different parts, each of which is established separately. 3DS Max provides a series of graphic editing tools including editing and mapping, among other functions. Polygons consist of elements such as vertices, edges, faces, normals, etc.

In VR displays, the creation of VR identification cards aims to restore the original appearance of cultural sites. Therefore, historical accuracy must be maintained. If the recognition map of VR identification cards allows designers to have a larger creative space in terms of visual aesthetics, then enhanced 3D virtual objects cannot afford designers a larger creative space, and these enhanced 3D virtual objects must be able to reflect historical facts. When creating VR identification cards, the key is to ensure the original appearance of cultural sites is restored, which implies strict adherence to historical facts during the design process. However, for enhanced 3D virtual objects, designers' creative space may be constrained as they must accurately reflect historical facts rather than engaging in free imagination or artistic manipulation. Hence, a balance must be struck between maintaining historical accuracy and visual aesthetics during the design process to ensure the final VR display is both accurate and captivating.

In the process of 3D modeling for architectural cultural heritage, creating and exporting UV maps is a crucial step. Creating UV maps involves unfolding the surface of the model onto a 2D plane, using letters U, V, and W to represent directions, enabling accurate mapping in subsequent texture mapping processes. Additionally, map drawing is indispensable, requiring the import of UV maps into drawing software such as Photoshop to accurately depict texture details. When drawing maps, it is essential to clarify the area being drawn to ensure the final texture maps perfectly match the model.

Create and export UV: On the coordinates of the map, the letters U, V, and W can be used to represent the orientation, corresponding to the traditional X, Y, and Z axes. Because most objects are irregular, it is necessary to unfold the normals on their surfaces in order for the mapper to better draw the corresponding two-dimensional shapes. In general, to judge the quality of a model's UV display, one needs to assign a checkerboard material to the model and see if each face of the checkerboard in the model is a square. If the square exhibits significant distortion, this indicates that the UVs have not yet fully unfolded and need to continue to do so. Every part of the 3D model of architecture is relatively regular, so UV is also easy to operate and surface segmentation is easier.

Map drawing: Generally, a machine would have several maps. It can save the previous UV map and import it into Photoshop for drawing. When drawing, it is important to clarify which area is being drawn.

(1) Key Technologies for 3D Virtual Ancient Architecture Roaming

The most crucial aspect of the audience's experience of a VR display is interactivity. In general, the interaction occurs between users and virtual humans or objects, during which the audience would provide corresponding feedback in terms of perception. Throughout the entire VR-human interaction, the visual experience of the audience is very significant, but at the same time, the audience themselves would also experience and improve psychologically, which is sensory imagination.

The most important issue in virtual roaming is how to provide users with a real-time interactive 3D scene. When interactively controlling the system, control information can be input from the outside, such as the amplitude of model control, changes in scene parameters, etc. Any externally-collected data is stored in real time for observation and analysis of future experimental data. Model transformation is used to manipulate the model and specific objects in the model, and

Figure 1 Interface presentation of a 3D virtual ancient architecture roaming system.

the final appearance of the scene and objects depends mainly on object movement and rotation. The building is described using a transformation matrix:

$$T_{A\to B} = \begin{pmatrix} M_L & N_P \\ 0 & 1 \end{pmatrix} \tag{1}$$

In 3DS Max software, rotate the 3D building points (x, y, z) around the x-axis to generate new points (x', y', z'):

$$\begin{bmatrix} x' & y' & z' & 1 \end{bmatrix} = \gamma \begin{bmatrix} x & y & z & 1 \end{bmatrix} \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix} \tag{2}$$

θ represents the angle of rotation.

Transforming the coordinates of ancient buildings along the y-axis yields:

$$\begin{bmatrix} x'' & y'' & z'' & 1 \end{bmatrix} = \gamma \begin{bmatrix} x & y & z & 1 \end{bmatrix} \begin{bmatrix} -\sin\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix} \tag{3}$$

(2) Implementation of a 3D virtual ancient architecture roaming system

This system uses 3D max software to establish a 3D model of ancient buildings, and outputs and saves it as a document. Afterwards, the program can be used to analyze the model file, input the model data into the computer's memory, and then use OpenGL to draw on the model data. This can obtain the three-dimensional geometric shape described by the model. 3DS is a public format that has good support. In addition, the 3DS includes complete normal vectors and common information such as lighting and animation. During the modeling process, it not only preserves parameters such as position and surface, but also retains information related to animation.

The system implementation process involves, firstly, an analysis of the building structure and the collection of sampling data which is used to establish a preliminary model on the 3DSMAx platform. It then establishes a system application framework, imports the original model, optimizes the model through mapping and, finally, implements 3D roaming control. The interface of the 3D virtual ancient architecture roaming system is shown in Figure 1.

Virtual roaming refers to users being able to browse freely within an exhibition hall while wearing glasses and hand-held devices, and using menu keys or logos. It can also be combined with the conflict detection algorithm, which can move teleportation to avoid encountering obstacles, and can also prevent "going through the wall". The human-computer interaction function refers to the viewers' ability to visit by clicking on images or text while roaming. It has the functions of zooming in, zooming out, and moving, and can also help the viewer to fully understand architectural culture by clicking and playing videos. In addition, it there is an interactive exhibition booth where visitors can have an interactive experience of recognizing and writing architectural fonts. These design points can enable users to truly integrate into the intangible cultural heritage museum of the building, achieving the purpose of experience, interaction, and dissemination. The data management function stores and manages the resources of the entire exhibition hall.

The distance between the architectural cultural heritage model and interactive objects is [15]:

$$\mathrm{d} = \mathrm{m}\tan\theta + \sqrt{x^2 + y^2} \tag{4}$$

In the architectural cultural heritage model, the tangent D_A and normal F_A of the same vertex satisfy the vertical condition:

$$D_A = a_0 + \sum_{n=1}^{\infty} \left(F_A \cos\frac{n\pi x}{L} + M_A \sin\frac{n\pi x}{L} \right) \tag{5}$$

$$M_A = M_T + G_N \tag{6}$$

4. VISUALIZATION EXPLORATION RESULTS OF ARCHITECTURAL CULTURAL HERITAGE MODELS

There are dozens of endangered cultural heritage sites in the world, so how to effectively protect and manage cultural heritage has become an urgent task. Cultural inheritance is an accumulation of human history and also the foundation and source of inspiration for further development of modern civilization. With the development of human

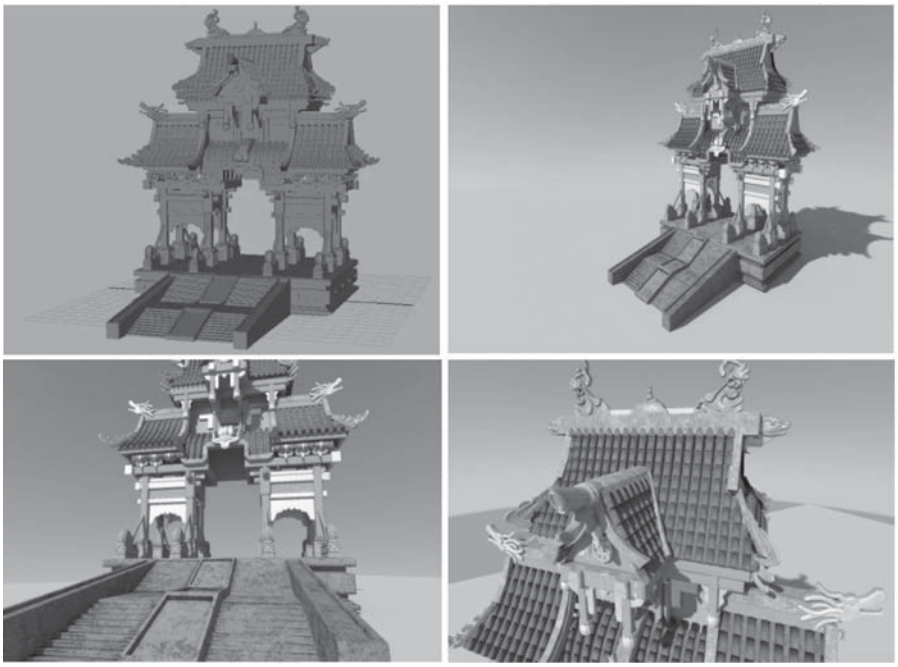


Figure 2 VR effect display of Hanyuan hall.

society and economy and the progress of civilization, the requirements for the protection of cultural heritage are also constantly increasing [16–17]. From a technical perspective, traditional cultural relic protection science is increasingly being integrated with other related disciplines, utilizing its latest research results to protect and develop cultural relics, resulting in interdisciplinary fields such as digital cultural relics.

Throughout its long history, humanity has created countless glorious historical and cultural works that constitute architectural heritage. China has thousands of years of history featuring its architectural history as well. It not only reflects a certain level of development in terms of social productivity, but also indicates the progress of of science and technology, and the human creativity evident in a certain social environment. It also reflects the cultural and artistic level, aesthetic and spiritual civilization of the people of a certain era, and has both cultural and artistic value. Cultural heritage refers to things that have cultural, historical, aesthetic, archaeological, ethnological, anthropological, and other value for a society or group or individual.

To date, the achievements have been that after scanning and identification, the hall inside the Hanyuan Hall appears, and the mobile phone can be rotated for observation from multiple angles, with good results. The VR demonstration leaves the user very satisfied. The VR display of Hanyuan Hall is shown in Figure 2.

Although in a conscious state of attention, the audience's level of consciousness is higher than that of unconscious attention and can maintain it for a longer period of time, due to their constantly high nervous state, people are also more likely to experience tiredness. In museums, people are usually in a state of unconscious attention for a long time, and only when paying attention to exhibits will they consciously become attentive. Inevitably, tourists' attention will alternate between intentional and unintentional. The audience's attention tends to be attracted by new displays offering more sensory experiences. The average participation rate of the interactive virtual reality architectural cultural heritage model visualization experience proposed in this article is about 20.7%, and some viewers did not participate due to long waiting times. Overall, there are more exhibition participants who have a higher level of interaction and feel more. The number of individuals participating in augmented reality, mixed reality and extended reality experiences is relatively low as shown in Figure 3.

A virtual reality display attracts people's attention, isolates the individual from the external environment, and maximizes the effectiveness of popular science learning. When the content of an exhibition aligns with the interests of the audience, it is possible to maintain audience participation without external incentives. In a virtual reality environment, viewers can turn their attention into deliberate attention, and due to the closed nature of the virtual environment, they can concentrate more easily. Self-consciousness gradually disappears and is replaced by enjoyment.

In the architectural cultural heritage model, to showcase the charm of a building and a great project, it is necessary to express the inherent meaning of a single building, because just the appearance of a building is far from enough. Only by presenting building materials, colors, light and shadow in a "realistic" way can the digital functionality of the building be maximized. In the architectural visualization design proposed in this study, it is often necessary to present large, complex structures and a large number of textures, which not only exhibit beauty but also combine with light and shadow. With the existing computing power and network bandwidth, it is difficult to achieve real-time rendering of high-quality 3D scenes. If real-time masking and environmental imaging are added, it would significantly increase the computational load

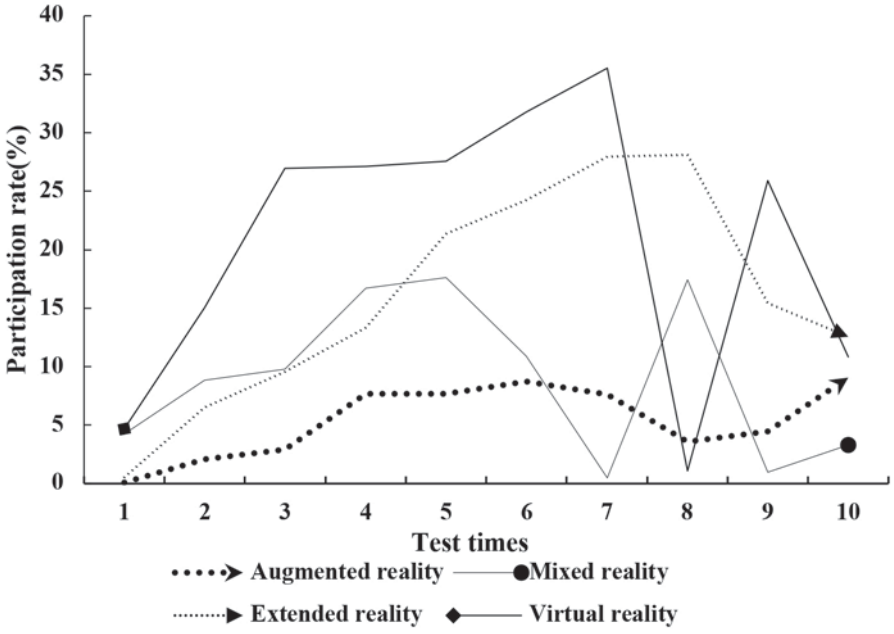


Figure 3 Audience participation rate in virtual reality, augmented reality, mixed reality, and extended reality modes.

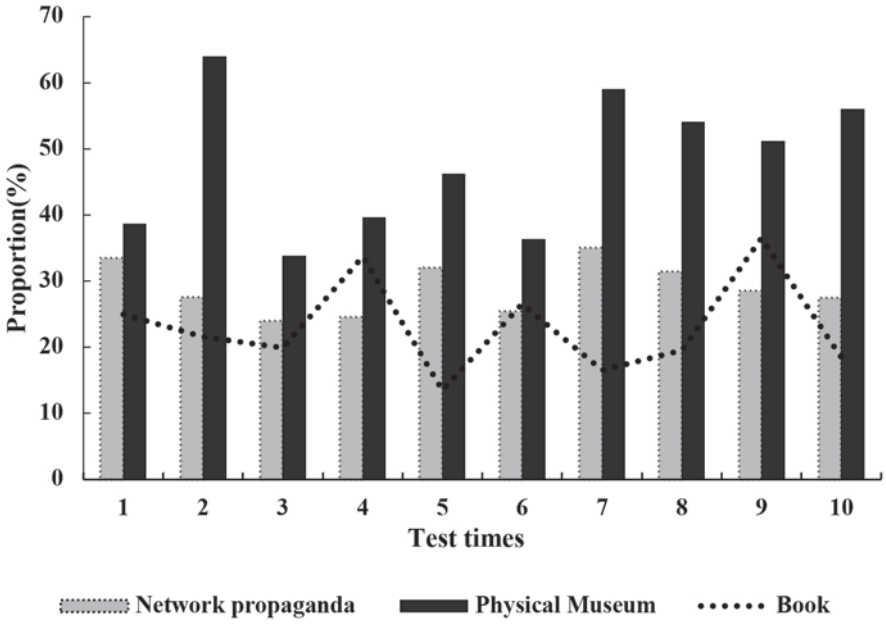


Figure 4 Statistics on the ways of understanding architectural cultural heritage.

of the computer. VR technology presents the realistic effects of light, shadow, and color as a texture, and applies this texture to the scene. In the user's final browser, the drawing tool only needs to process the texture map, without the need for real-time rendering of light and shadow. This technology not only can display true light, shadow, and color, but also has low requirements for browsers.

The statistics regarding the ways to learn about and understand architectural cultural heritage are given in Figure 4 which shows that 29.00% of people learned about it via online promotions, while 47.88% learned by visiting physical museums.

VR technology is a technological advancement that addresses people's increasing demand for entertainment by means of internet technology. At the same time, VR technology is a relatively new technology signaling the development of the times. The greatest value of VR technology is its ability to elevate both visual and auditory abilities to another level. However, currently, the virtual reality technology in the world is mainly focused on glasses and helmets, while the development of virtual reality technology in China is relatively slow.

With the increasing emphasis on openness and participation in virtual reality design, in addition to using media devices and virtual interaction technology to increase the audience's experience, it is also necessary to stimulate users' participation awareness and improve the interaction between users and display devices. During sightseeing and viewing, users can

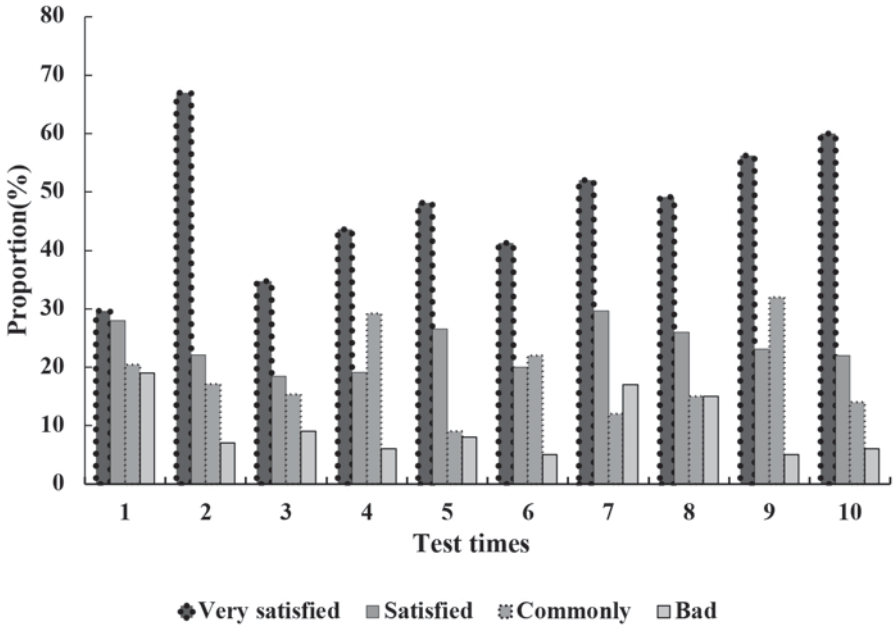


Figure 5 Experience statistics of the 3D virtual ancient architecture roaming system in this article.

use devices such as keyboards and mice. When an individual participates in the interactive experience, a flashing logo appears which can be used to identify the character that appears virtually. Some exhibitions provide certain historical background information. When users click on this exhibition, its background information and story content is presented to users, allowing them to quickly and conveniently understand the relevant information about the exhibits. With the continuous improvement of people's living standards and spiritual pursuits, users' demands for virtual reality displays are no longer just about roaming interactions and the acquisition of information; users want to be able to personally experience the content of virtual reality. Nowadays, the development of digital virtual reality technology has led to a change in people's understanding of the world. Therefore, interactivity has become more important, and people's demands for quality experiences are also increasing. The designs of virtual reality displays are diverse, which can arouse people's curiosity and encourage their participation, thereby attracting more audiences. Therefore, in-depth analysis and research should be conducted on the theme or content displayed. With the support of digital technology and virtual devices, updated virtual reality display design concepts can be explored, integrated with content, and attractive interaction methods and behaviors can be achieved.

Although current technology cannot achieve a fully realistic experience, and some virtual reality displays still have limitations in terms of information, the three-dimensional visual perception experience generated by virtual reality has surpassed any existing media, and its audience appeal is unprecedented. The experience statistics of the 3D virtual ancient building roaming system in this article are shown in Figure 5. The number of very satisfied people reached 48.18%, with only 9.70% rating the experience as poor. Virtual reality has endless spatial expansion capabilities, especially in terms of vision, allowing viewers to endlessly expand their exploration space, thus providing more possibilities for display.

The more realistic the picture, the more immersive is the audience. In the design process, in addition to establishing fine models, textures, lighting, and rendering, consideration should also be given to the position of the lens and the scaling of objects. This is different from computer screens and mobile phone screens where there are clear boundaries that allow users to switch between unit coordinates at any time without confusion. In the virtual world, endless displays can blur this boundary, making it particularly important to create realistic scenes.

The human perception system can effectively integrate the functions of five senses, including visual and auditory senses, in order to comprehensively and richly understand the environment. The transmission of this natural message can be continuously and effectively experienced by people. For example, feedback on the current state of the system can be provided through sound effects, ambient sound, etc. When the user engages in the correct interactive behavior, natural changes in the environment can be used to tell the user whether the current behavior is effective. In the VR mode of the system proposed in this article, there is always an anchor point in the center of the user's field of view, while on the ground, there is an arrow representing the path. When the user looks up, this arrow would not appear. This can enhance the user's sense of immersion, and when the user lowers his head, this arrow would gradually appear and change as the user's gaze changes. When the user's visual anchor stays on this arrow for 1–2 seconds, the scene changes, and the previously gray scene also appears in color. The scene of the 3D virtual ancient building roaming system changes when the user lowers his head is shown in Figure 6.

Generally speaking, 3DSMAx has the highest resolution compared to the other two VR tools. The faster the refresh speed, the larger the field of view angle, and the more realistic

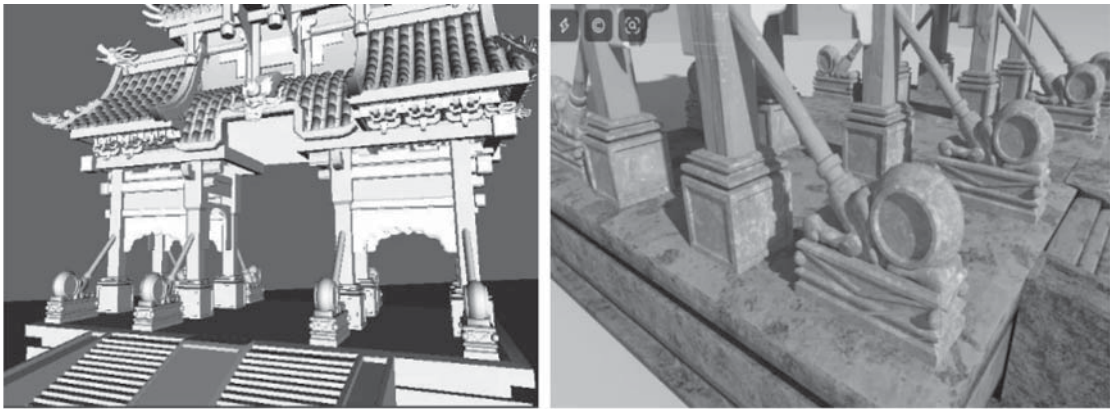
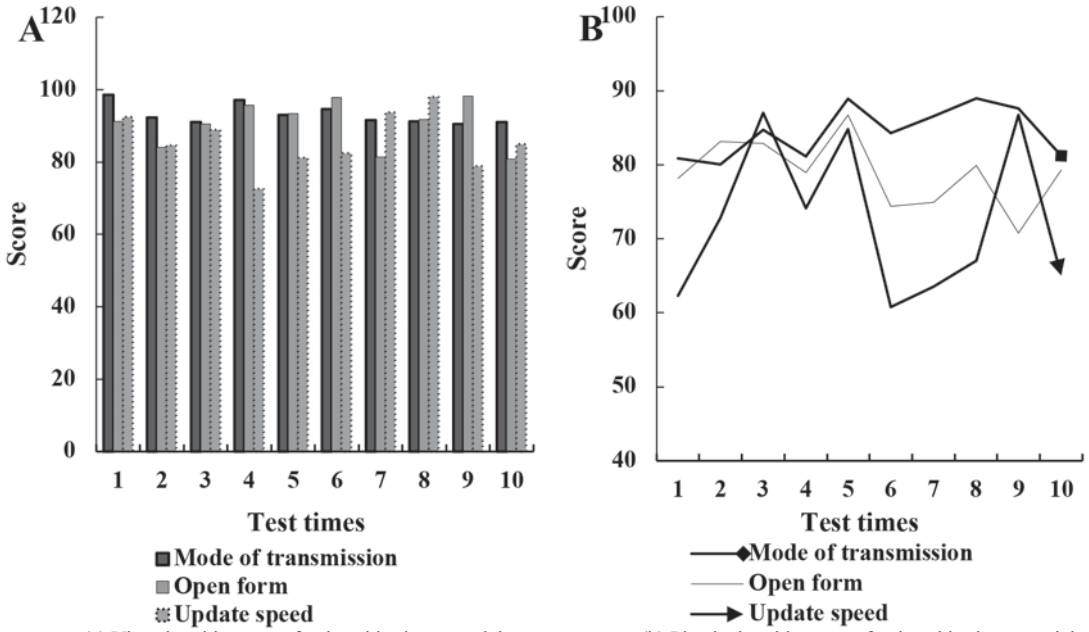


Figure 6 The scene change of the 3D virtual ancient building roaming system when users lower their heads.

Table 1 Comparison of 3DSMAx and other VR tools.

Serial Number	Project	3DSMax	PlayStation VR	Oculus Rift
1	Field of view angle	120°	100°	90°
2	Refresh rate	80HZ	100HZ	95HZ
3	Weight	400g	500g	370g
4	Moving range	100m	20m	10m



(a) Virtual architecture of cultural heritage model (b) Physical architecture of cultural heritage model

Figure 7 Comparison of relevant ratings between physical and virtual architectural cultural heritage models.

is the user experience. It has great advantages in terms of mobile distance and can provide users with a rewarding immersive experience. The method proposed in this article requires users to be in a virtual environment and be able to freely walk within a certain spatial range. Therefore, 3DSMAx was chosen as the research object of virtual reality technology in virtual museums, with a mobility range of up to 100m. The comparison between 3DSMAx and other VR tools is shown in Table 1.

The virtual architectural cultural heritage model is an important means of protecting and passing on traditional Chinese culture, which has continued to thrive in recent years. The virtual architectural cultural heritage model utilizes modern technologies such as virtual simulation, 3D imaging, image synthesis, and computer image processing to construct realistic 3D scenes. These technologies can create a three-dimensional model of ancient architecture and design a web interface that is consistent with standards, allowing visitors to achieve an interactive experience between people and objects while browsing the web. The comparison of relevant scores between physical architectural cultural heritage and virtual architectural cultural heritage models is shown in Figure 7(A) for the virtual architectural cultural heritage model. The physical architectural cultural heritage model is shown in

Figure 7 (B). Compared with the latter, virtual architectural cultural heritage models can utilize networks to store digital resources, allowing users to see cultural relics anytime and anywhere. At the same time, visualization technology not only gives users close access to cultural relics, but also allows users to exercise full autonomy, continuously enhancing the penetration, dissemination, and influence of Chinese culture. The rating for the dissemination method of the virtual architectural cultural heritage model was 93, while the rating for the physical architectural cultural heritage was 84.

5. CONCLUSIONS

With the continuous development of VR technology, its unique interactivity has attracted more and more scholars' interest in its immersive research. However, VR technology and its visualization have become better known only in recent years, and the many complex computer vision concepts and related knowledge these involve require broader and more in-depth research. The current research on virtual reality technology for the visualization of ancient buildings focuses on examples of these, which are by no means comprehensive, and provides detailed explanations of the key knowledge points. This article started with the characteristics of VR ancient building visualization projects and provided a detailed description of the relevant rules for such visualizations, combining them with the characteristics of VR ancient building visualization. This provided principled guidance for the development of future VR ancient building visualization projects, making the querying of VR ancient building visualization possible. In terms of interactive experience, designers can focus their attention on the interactive experience of VR display design, using meaningful interactive forms to enhance the tourist experience.

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