

Research on Digital Exhibition Hall Design Based on VR Experience — Taking Qiong Kiln as an Example

Guiping Pu, Jiawei Wu, Chengming Wei, Yufeng Li

Geely University of China, Chengdu 641419, Sichuan, China

DOI: 10.32629/asc.v5i3.2433

Abstract: Based on the VR experience method, this paper analyzes the characteristics and development status of the current exhibition hall with Qiong Kiln in Sichuan Province as the design object. The design uses digital interaction technology, AI 3D generation, 3D software processing models, and UE5 engine to develop and produce a digital exhibition hall, and display related cultural relics in the exhibition hall. Through the construction of blueprints, users can interact with cultural relics and understand the cultural relics more intuitively. At the same time, we designed cultural and creative peripherals about Qiong Kiln to promote consumption and bring a better experience to users.

Keywords: virtual reality, digital exhibition hall, user experience, cultural and creative design

1. Introduction

1.1 Current status of VR technology

Digital museums are an important trend in museum development in recent years (Wang R G, et al.,2014). Virtual Reality (VR) has been regarded as a highly effective technology that enables people to gain enjoyable and immersive information about museum collections (Lee H, et al.,2020). Since people can no longer satisfy the two-dimensional visual experience, virtual reality technology is used to present physical objects as three-dimensional images to enhance the user's visual experience and achieve the effect of human-computer interaction. The user experience of VR-based museum exhibitions is gradually receiving more attention (Zou N, et al.,2021). At the same time, VR's well-documented educational value (Zouboula N, et al.,2008).

During the practice of digital exhibition halls, virtual scenes are constructed to allow users to accurately locate and have "close" contact with collections. At the same time, attention is paid to the rendering of collection details to increase the user's sense of presence. It can also simulate historical scenes, cultural sites and other non-replicable objects. Scenes, immersing yourself in the cultural charm to achieve the effect of augmented reality. Compared with traditional exhibition methods, VR technology has greatly improved users' knowledge, understanding and learning effect of cultural relics, reduced the time and geographical constraints of physical exhibition halls, and realized the concept of digital exhibition halls.

1.2 Analysis of the dilemma of traditional exhibition halls

With the development of science and technology, people have entered the era of information flood, and the forms of entertainment are constantly increasing. However, traditional exhibition halls still use the inherent static display method, which allows tourists to only view the exhibits from a distance, but cannot get close contact or interaction, which reduces the interaction of tourists. Experience, the analysis of the characteristics of traditional exhibition halls is shown in Table 1. At the same time, contemporary exhibition halls are limited by physical space, and are subject to certain constraints in terms of quantity, type, and layout of collections. This also results in the inability to display larger exhibits, making it difficult to choose from a wide variety of collections due to insufficient space. For suitable collections, the display effect between collections cannot be highlighted.

Exhibitions in exhibition halls usually have a cycle, and collections on temporary display only exist for a short period of time. Visitors may miss the exhibitions they are interested in, or they may not be able to fully appreciate the exhibits due to time constraints, resulting in a poor playing experience. In addition, the exhibition hall also has deficiencies in exhibition design and content planning. Most of the descriptions are in the form of simple text, which lacks the innovation and attraction of the design. The form of interactive experience is single, and there is a lack of activities and projects to attract tourists. It can only be described in the form of simple words. Observing from a static perspective cannot be immersive. There is a lack of opportunities for interaction and communication during the visit, making tourists lack a sense of participation.

Table 1. Analysis of characteristics of traditional exhibition halls

spatially	The space is fixed and the exhibit volume is restricted.
experience	No interaction.
Exhibition method	Static display, single-sided presentation.

1.3 Advantages of integrating VR technology into exhibition halls

The digital exhibition hall uses digital technology to completely present the functions of the physical exhibition hall on the Internet in a digital way. On the one hand, the application of VR technology can break the time and space limitations of traditional exhibition halls, allowing tourists to visit the exhibition halls anytime and anywhere. On the other hand, through virtual reality technology, visitors can immerse themselves in the virtual space of the exhibition hall and interact with the exhibits, and the collections can be arranged in front of them in a three-dimensional form, People are able to obtain enjoyable and immersive information about museum collections (Lee H, et al., 2020). This immersive experience allows visitors to have a deeper understanding of the historical background, cultural connotation and production technology of the exhibits, continuously enhances visitors' visual experience, and achieves an immersive effect. (Parker E& Saker M, 2020) The study explores whether the incorporation of virtual reality might lead to a radically different experience of an art museum as a shared social space.

Users can interact with exhibits through VR equipment, such as touching, rotating, zooming in and other operations. The detailed features of the collection are presented in a concrete form, which can promote visitors' in-depth understanding of the collection. At the same time, it combines elements such as sound, light and shadow to render the collection. The vividness brings a more realistic visiting experience to tourists.

2. Research on Qiong Kiln Exhibition Hall Design

2.1 Analysis of the current situation of Qiong Kiln

The Qiong Kiln ruins are located in Qionglai City, Chengdu City, Sichuan Province. Qiong Kiln, one of the oldest folk kilns in China, is the birthplace of Chinese painted porcelain. It was founded in the Eastern Jin Dynasty, matured in the Southern Dynasties, and flourished in the Tang Dynasty. It is a famous ancient Chinese ceramic kiln spanning more than eight centuries. The ruins are located in Shifang Village, Qionglai City. Now the Qiong Kiln ruins have been developed into the Qiong Kiln National Archaeological Site Park. The park is being constructed with the Qiong Kiln ruins as the center, retaining the earthen ruins - the kiln package itself and building the Qiong Kiln temporary exhibition hall.

The current status quo has the following problems: (1) Most of the ruins are earthen ruins, which have problems of poor viewing quality, insufficient textual explanations and lack of dedicated guides. It gives tourists weak visualization and difficulty in understanding the structure of the ruins, making it difficult for tourists to fully understand the ruins. The historical value and cultural inheritance contained in Qiong Kiln. (2) The Qiong Kiln Exhibition Hall occupies a small area. Due to space limitations, more collections cannot be displayed in the exhibition hall. As a result, the content of the collections displayed in the exhibition hall is not rich and in-depth enough, and it also causes tourists to be confused during the tour guide. During the process, it is impossible to fully understand the historical and artistic value of Qiong Kiln ceramics and the inherent cultural connotations contained therein, making it difficult for tourists to form a deep memory and coherent experience when visiting. (3) There is a lack of innovation in exhibition methods. The current exhibition hall uses the traditional showcase exhibition method to display collections. The traditional exhibition method may not be able to meet the needs of current tourists. It is only displayed through static exhibition methods and simple text explanations. The way the Qiong Kiln collections are collected may not attract tourists' attention and interest in understanding the Qiong Kiln culture. (4) Not well-known in publicity, there is a lack of audience interaction and experience in the entire temporary exhibition hall. Qiong Kiln cultural and creative products on the official website are mainly ceramic crafts and embroidery products, and there is a lack of cultural and creative products that are unique to Qiong Kiln. IP and related derivatives and cultural and creative peripherals, without unique commemorative peripherals, prevent tourists from retaining the memory and feelings of Qiong Kiln culture for a long time and stimulate the emotional resonance of tourists, nor can they promote the growth of economic benefits.

2.2 Analysis of demand points and pain points in digital exhibition hall design

This design uses a user journey map (see Figure 1) to analyze the current demand points and pain points of the Qiong Kiln Exhibition Hall. The expectations of the current exhibition hall for tourists are far from one-way information transmis-

sion. Users hope You can go deep into the exhibition hall and interact with the exhibits. This interaction is not limited to hand-made, live performances, etc., but also includes some digital applications to enhance visitors' sense of participation. The digital experience not only brings entertainment fun, but also meets tourists' needs for knowledge and culture related to Qiong Kiln. At the same time, it is no longer limited to the problem that the physical exhibition hall is small and the collection cannot be placed. Digital display, artificial intelligence guide, and virtual reality experience can bring users a unique and novel visiting experience and enhance their happiness when visiting. It can enhance the attractiveness and communication power of the exhibition.

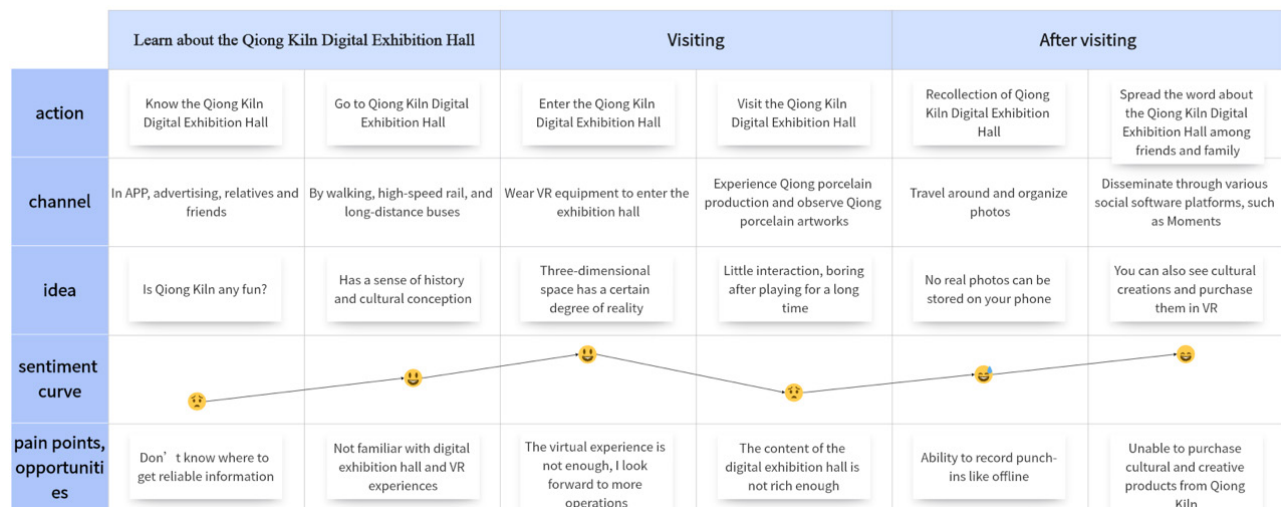


Figure 1. Qiong Kiln Tour User Journey Map

2.3 Digital exhibition hall design strategy

Nowadays, with the development of virtual technology, artificial intelligence and Internet technology, digital exhibition halls need to achieve a high degree of intelligence. Utilize virtual technology, 3D modeling technology, and Internet technology to realize interconnection between devices to improve user participation and immersive experience. In this study, the digital exhibition hall design strategy was built through the service design blueprint, as shown in Figure 2. The backend of the digital exhibition hall supports the operation and display of the entire exhibition hall. The backend needs to establish a file management database to allow administrators to upload, edit, and rearrange the digital content in the exhibition hall. The administrator can change the layout and display of the collection according to specific circumstances. Customize the style and theme of the hotel.

Offline experience enables users to gain an immersive experience in the virtual digital exhibition hall through backend computing and the interconnection between virtual technology and equipment, as if they are in a real three-dimensional space, achieving the feeling of reality in a virtual environment. Seamless connection, thus deeply participating in the exhibition. Online, it is necessary to establish a reasonable spatial layout and color matching to highlight the characteristics and attractiveness of the collection. In terms of content display, fun interactive games can be used to improve visitors' knowledge and understanding of the collections.

Online experience uses background data support to enrich the content and form of online experience through pictures, videos, audios, and animations to enhance user experience. Use responsive design to ensure that the online exhibition hall can adapt to different devices and screen sizes, provide users with a consistent experience, and design a simple and intuitive interface to help users operate more conveniently during the search and browsing process. Provide guidance to help users quickly find the collections they need to view, ensuring that users can browse and understand the collections and cultural points contained in them in a logical order. Design online Q&A, interactive games and other interactive methods to increase user participation, social interaction and word-of-mouth communication.

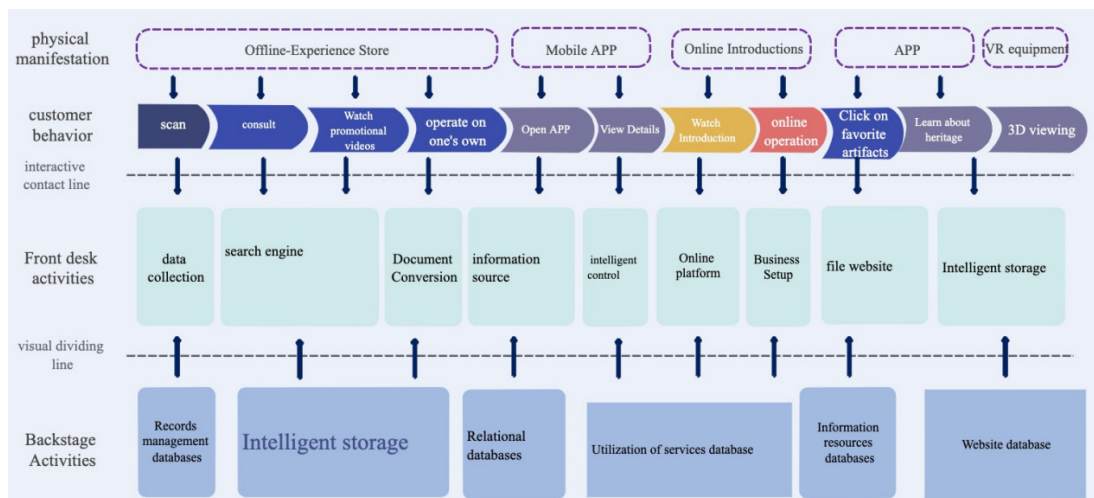


Figure 2. Design Blueprint

3. Qiong Kiln Digital Exhibition Hall Design Practice

3.1 Digital exhibition area design

The digital exhibition hall pays special attention to the stories and cultural connotations behind each cultural relic. These cultural relics are not only witnesses of history, but also carriers of culture. Therefore, it is necessary to deeply explore the historical background, production technology and artistic value of each cultural relic and integrate it into the design of the virtual exhibition hall. Through the careful presentation of cultural relics, it aims to allow tourists to feel the unique charm of Qiong Kiln culture in the virtual space, see Figure 3. Through accurate measurement and modeling of the real pavilion, the full view of the physical pavilion can be reproduced in the virtual space. This design takes into account factors such as users' visiting habits, points of interest, and fatigue level to ensure that tourists can get the best visiting experience in the virtual exhibition hall, making it easier for tourists to visit all cultural relics.



Figure 3. Qiong Kiln Digital Exhibition Hall Plan

(Figure 4) is a cross-sectional view of the main exhibition hall as a whole, which can effectively see the frame structure and display situation of the main exhibition hall. The overall cross-section at the entrance is equipped with a cultural wall that can display historical pictures, etc. It also has a virtual place for tourists to check in and take photos to simulate the need for offline photos to commemorate.



Figure 4. Sectional view of the exhibition area

3.2 Exhibition items and interaction methods



Figure 5. Exhibition cultural relics

The exhibition items are combined with AI technology and 3D software to present a complete 3D model of the exhibits, as shown in Figure 5. In the subsequent design of the virtual exhibition hall, there will be a shopping area to provide visitors with an area for selling souvenirs and cultural and creative products, and where they can also visually see the products. This area displays a variety of souvenirs and cultural and creative products related to the theme of the exhibition hall, such as peripherals, artworks, etc. These products not only have ornamental value, but also contain rich cultural connotations and historical significance. Visitors can choose their favorite souvenirs and cultural and creative products here as souvenirs and mementos of their visit to the exhibition hall.

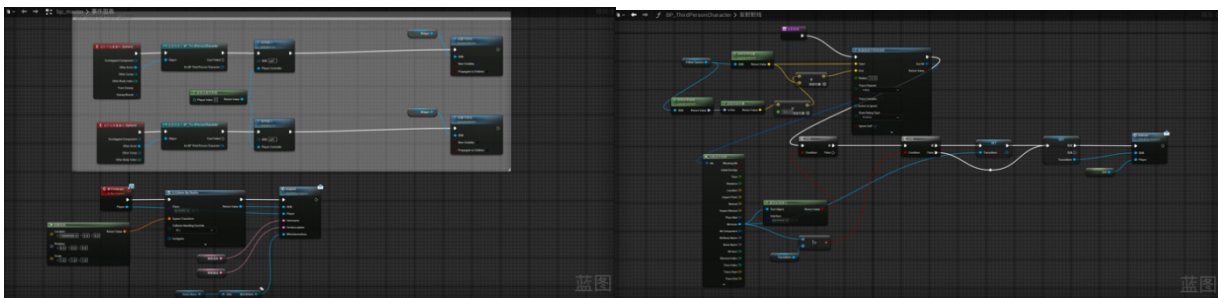


Figure 6. UE5 blueprint

The interaction is built through UE5. The blueprint is shown in Figure 6. BP_studio displays the rotating object on the screen. The BP_master scene can see the physical objects that can be interacted with. W_notice is the user control that displays prompts when walking next to the object. Winspect is displayed as The interactive object displays the name and item introduction, and the blueprint interface is used to transmit information between two blueprints. By obtaining the start and end positions of the character camera, when the rays of the camera hit the object, the hit results are scattered and the object actor information is obtained. Before obtaining the object actor information, it is necessary to determine whether the character camera rays hit the interface of the object. , and then determine whether the interface is implemented. BP_master uses the object collision component overlap start and component overlap end methods to determine the distance between the object and the character in the interactive object. When the character passes by the object, the UI interface of the user control is displayed, which can prompt the user how to interact.

3.3 Cultural creativity increases sustainable development

In the context of the new era, in addition to shouldering its own social functions, exhibition halls should also develop and design cultural and creative products in conjunction with the trend of the times and current market needs to enhance the driving force for the development of the exhibition hall business and make the cultural and creative industries truly become exhibition halls. An important part of the industry to achieve efficient dissemination of the high-quality traditional cultural connotation of the exhibition hall.

In the design of cultural and creative derivatives, more references are made to the external appearance of the object itself for cultural and creative design. By extracting the elements of each cultural relic, we can create our own cultural and creative products. From the porcelain figurine of a ball-playing girl from the Song Dynasty (Figure 7), the shapes and costumes of female porcelain figurines are extracted, and more attention is paid to the color matching of costumes in the Song Dynasty.

Red is the main color, combined with bright colors such as modern aesthetic colors, to form a contrasting visual effect. On the basis of retaining the original form of the porcelain figurine of a ball-playing girl from the Song Dynasty, modern design elements are incorporated to make it conform to modern aesthetics without losing the traditional charm.

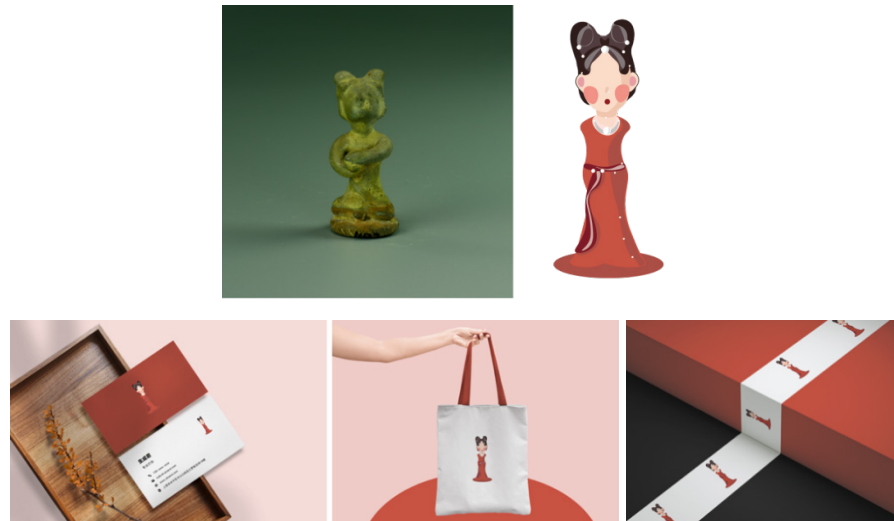


Figure 7. Derivative design of porcelain figurines of women playing ball in the Song Dynasty

The following is a three-color carved porcelain basin from the Tang Dynasty (Figure 8). We retain the basic shape of the three-color carved porcelain basin from the Tang Dynasty, that is, the rounded basin body and elegant basin mouth. At the same time, according to modern aesthetic trends, the proportions and lines of the basin body are fine-tuned to make it more in line with modern aesthetic standards. The main colors are yellow and green, which were commonly used in tri-color porcelain in the Tang Dynasty, creating a contrasting visual effect. Through the clever combination of colors, cultural and creative products are more eye-catching, and at the same time reflect the diversity and tolerance of Tang Dynasty culture. Through the promotion and application of cultural and creative products, more people can understand the ceramic art and culture of the Tang Dynasty, and promote the inheritance and promotion of China's excellent traditional culture. It also enhances the stickiness of user experience.



Figure 8. Design of derivatives of Tang Dynasty carved three-color porcelain basins

4. Conclusion

After an in-depth discussion of the application of VR technology in digital exhibition halls, it is not difficult to find that this technology not only brings revolutionary changes to the display method of the exhibition hall, but also brings an unprecedented visiting experience to the audience. This experience is unprecedented and cannot be completely replicated by a physical exhibition hall. It opens up a new path for cultural inheritance and knowledge popularization. This immersive

experience allows the audience to immerse themselves in the long river of history, feel the charm of culture, stimulate the desire for knowledge, and also give more people the opportunity to come into contact with the exhibition content of the pavilion. However, there are still limitations in this design research. The design used AI technology, 3D technology and UE5 engine to build a virtual exhibition hall space, and expanded the design of cultural and creative products based on the existing exhibition hall problems. Due to the lack of VR equipment, It cannot be truly experienced in VR.

However, we have completed the construction of the interactive and virtual space, which also confirms that the future development direction of digital exhibition halls can be realized through VR technology and can have more interactive experiences. We also hope to provide valuable reference for subsequent research.

Acknowledgments

This work was supported by the Demonstration Course of Innovation, Entrepreneurship and Creativity Education of Geely University (project code: JLCSFK2024Y4).

References

- [1] Lee H, Jung T H, tom Dieck M C, et al. Experiencing immersive virtual reality in museums[J]. *Information & Management*, 2020, 57(5): 103229.
- [2] Parker E, Saker M. Art museums and the incorporation of virtual reality: Examining the impact of VR on spatial and social norms[J]. *Convergence*, 2020, 26(5-6): 1159-1173.
- [3] Wang R G, Dong H L, Wu M W, et al. Research and design of digital museum based on virtual reality[J]. *Advanced Materials Research*, 2014, 926: 2516-2520.
- [4] Zou N, Gong Q, Zhou J, et al. Value-based model of user interaction design for virtual museum[J]. *CCF Transactions on Pervasive Computing and Interaction*, 2021, 3(2): 112-128.
- [5] Zouboula N, Fakides M, Tsolakidis C. Educational uses of virtual reality: Constructing a VR museum[C]//*International conference on interactive collaborative learning proceedings*. 2008: 24-26.