

# Virtual Reality Based Technology Potala Palace Digital Museum Design

Shiman Yu

School of Dongguan City College, Guangdong, China

## Abstract

With the development of science and technology, virtual reality technology is gradually applied in various fields, its virtual, immersive and interactive characteristics, a good solution to the epidemic of the current difficult travel problems, but also for the development of traditional museums and transformation and upgrading to provide a new direction. This paper proposes the application of virtual technology in digital museums from the perspective of cultural resistance and the advantages of digital museums, and extracts interactive content design by digging deeper into the culture of Potala Palace. The combination of virtual reality and culture injects new vitality into the development of Potala Palace culture and has important value to the inheritance of culture.

## Keywords

Virtual Reality Technology; Potala Palace; Digital Museum; World Cultural Heritage.

## 1. Development of VR Technology and the Current Situation of Tourism in the Potala Palace

### 1.1. Development Prospect of VR Technology

VR is Virtual Reality (hereinafter referred to as VR) in Chinese, which means virtual reality. It is a combination of various information technologies, VR technology to build a simulation of reality of three-dimensional virtual scenes, through visual, auditory, haptic and other ways to immerse in the virtual scene, to achieve the immersive experience. As the VR industry continues to expand in the field of application, the industry chain continues to improve, virtual reality technology will become an indispensable part of the B-side customers. In turn, culture, technology and economy will be more closely integrated to promote the innovation of domestic tourism and open up a new era of Chinese cultural heritage.

VR technology is increasingly being used in various industries and fields. In the 2019 Beijing World Expo, the first real-time VR live broadcast by drones was used. Through 5G + VR live broadcast, the beautiful scenery of the World Park is transmitted to the 5G pavilion in real time, and the audience can watch the whole World Park in real time through VR glasses. That is, it saves time for the audience and brings an unprecedented visual experience. The World Park under God's vision: flowers and birds, lush greenery, the towering Yongning Pavilion, the highly aesthetic China Pavilion, as if it were at hand, and you can even count every tile on the pavilion clearly, the crowded queue outside the pavilion type bird's eye view of the World Park, attracting countless visitors. This new type of exhibition spreads culture while also protecting the Beijing World Garden well.

On June 11, 2021, the 12th Hubei (Qianjiang) Lobster Festival and the fifth Shrimp - Rice Industry International Expo main event opened. The Expo is a combination of offline and online, offline organization of 100 high-quality enterprises on-site exhibition, which invited 14 cities in the Han River basin to participate in the display of special agricultural products; online build "3D digital exhibition hall" "VR cloud tasting" "AI wisdom contract" and other three major

network display platform, so that more enterprises through online participation in the display and marketing, brand promotion, negotiation and cooperation, so that the people of the country without going home "to see live, shopping exhibition".

On January 12, 2022, the State Council issued a notice on the "14th Five-Year Plan" for the development of the digital economy, proposing to deepen the integration of AI/VR and other technologies, expand the application of public life scenarios, and improve the digital level of public services. In 2019, the Central Organization Department, the National Development and Reform Commission, the Ministry of Culture and Tourism and other nine departments jointly issued the "Action Plan for the Development of Basic Electronic Components Industry (2021-2023)", which stated to promote intelligent design, guide domestic software enterprises to develop various types of electronic components simulation design software, encourage the use of virtual reality, digital twin and other advanced technologies to carry out industrial design, and improve the level of enterprise design. In 2019, the Central Organization Department, the National Development and Reform Commission, the Ministry of Culture and Tourism and other nine departments jointly issued the "Implementation Opinions on Improving the Travel Environment for Tourism Consumption on Holidays", which requires the vigorous development of "intelligent scenic spots" and focuses on improving the cultural connotation and technological content of tourism products. With these policy backgrounds, it is timely to promote the development of the tourism industry of the Potala Palace through VR technology.

## 1.2. The Current Situation of Tourism in the Potala Palace

The Potala Palace, known as the "Pearl on the Roof of the World", is located on the Red Mountain in the northwest of Lhasa, Tibet, and is a museum of architectural art and Buddhist art, as well as a political and religious center of the local rulers of Tibet, and a grand and imposing palace fortress-style complex. In 1961, the Potala Palace was announced by the State Council of the People's Republic of China as one of the first national key units of protection, and in 1994, the Potala Palace was listed as a World Heritage Site.

As a representative tourist attraction in Tibet, the Potala Palace attracts a large number of visitors every year. Tourism, as the first of the six characteristic pillar industries in Tibet, is an important engine to pull the economic development of Tibet. With the great outbreak of the new crown epidemic in 2020, the tourism industry almost came to a halt and the scale of the tourism economy was nearly cut off due to the mobility and aggregation of people in the tourism industry, which coincided with the strong contagious and mutable characteristics of the new crown pneumonia epidemic. Global economic, social, and, in the case of China's A-class tourist attractions, their economic losses in 2020 were as high as 65% and more concentrated in the first quarter of the year. 2020 saw 2.879 billion domestic tourist arrivals, down 52.1% from the same period the previous year; domestic tourism revenue was 2.23 trillion yuan, down 61.1% year-on-year. Tibetan tourism, a pillar of economic development, is also facing the huge impact of scenic spot closure, plummeting travelers and low consumption, and it is imperative to find new development opportunities.

The easy spread, incubation period and high risk to life of the new crown epidemic make tourism a very risky act. Local policies on epidemic prevention and control, as well as the need for a negative 24-hour nucleic acid test, have a direct impact on the willingness of residents to travel. However, the potential demand for tourism as a "spiritual product" still exists, and technology-based tourism products and services such as "online exhibitions" and "cloud tourism" will usher in new development opportunities. The digital museum can make the experience of the Potala Palace feel the splendor of the Potala Palace from touch, sight and sound and experience the story of the Potala Palace brick by brick through technology.

## 2. The Cultural Value of the Potala Palace and the Importance of Communication

### 2.1. The Cultural Value of the Potala Palace

From the perspective of historical relics, the Potala Palace collects and preserves many cultural relics reflecting Tibetan political and religious activities and folk activities of various nationalities, including murals, objects, buildings, inscriptions and so on. The Potala Palace, as an ancient architectural complex condensed with the blood and wisdom of various ethnic groups, embodies both the traditional Tibetan architectural style and also absorbs the techniques and characteristics of the Chinese architecture such as beam arch, golden roof and algae well. The frescoes inside the palace, while concentrating on reflecting the major events such as the exchange of Tang and Tibetan envoys, the marriage of Tang princesses, the reception of local Tibetans and princes by the emperors of Yuan, Ming and Qing dynasties, and the reincarnation of living Buddhas, also record a large number of scenes of interaction between the people of various ethnic groups. It mainly includes historical events, biographies, religious rituals, customs, folk legends and mythological stories, as well as the activities of tribes such as the Kharka and Erut Mongolian, and the people of Sichuan, Qing, Gan and Yunnan regions to boil tea and worship Buddha in Tibet. In the Potala Palace, there are abundant cultural relics reflecting the in-depth cultural exchanges among various ethnic groups, two of which are particularly typical: the first is the Beijing version of the Great Tibetan Sutra "Ganjur" treasured in the Hall of the Three Worlds, a representative work of cultural exchanges and interactions between Tibet and other regions; the second is the colorful and realistic tapestry of the "Human Immortals Crossing the Sea" in the Hall of the Western Sunlight, which shows that the Chinese Taoist myth originated from the story of "eight immortals crossing the sea, each showing their abilities" is also widely circulated in Tibetan folklore. These treasures are rich in connotation and carry the profound history of exchanges and blends among various ethnic groups.

From the perspective of historical and religious significance, the Potala Palace used to be the ruling center of the unity of church and state, and had very important relationships with important figures in Tibetan history such as Songtsen Gampo, Princess Wencheng, Princess Chizun and successive generations of Dalai Lamas, thus having great historical and religious significance.

From the perspective of architectural art, Potala Palace is one of the world's top ten civil architecture, the most outstanding representative of thousands of Tibetan Buddhist temples and palaces combined with the type of architecture, which is the only example in China and even in the world.

### 2.2. The Significance of Cultural Dissemination of Potala Palace

General Secretary Xi Jinping pointed out at the Seventh Symposium on Tibetan Work of the Central Government: "We should excavate, collate and publicize the historical facts of the interaction and intermingling of various ethnic groups in Tibet since the white ancient times, guide the people of all ethnic groups to see the direction and future of the nation, deeply realize that the Chinese nation is a community of destiny, and promote interaction and intermingling of various ethnic groups.

Chinese culture is a great integration of the cultures of various ethnic groups, and our splendid culture is the common creation of all ethnic groups. As the treasure of Chinese culture, the Potala Palace is the "museum of Tibetan history" and the essence of Chinese ancient architecture, it has a long history and profound connotation, and contains great value of the times. Through the dissemination of culture, more people can understand the historical changes in the development of Tibet, and more precious ancient documents can be brought to

life and enter the public's view. Therefore, as the symbol of Chinese culture and the image of Chinese nation shared by all nationalities in China, we should further excavate, interpret and publicize the historical and cultural connotation of the Potala Palace, so that it can become a carrier for casting a firm sense of Chinese national community and a platform for displaying Chinese culture and the image of Chinese nation.

### **3. The Potala Palace Cultural Dissemination Resistance**

Museum is an important place to spread and popularize culture and spread culture out through displaying collections, which have long been displayed in a static way. Artifacts exhibits directly displayed, with text pictures video description, apparently are too monotonous. The boring exhibition hall mode makes visitors unable to be in it, and the long-term enthusiasm and attention of visitors will be greatly affected, which is very unfavorable to the spread of culture. First of all, the traditional way of exhibition is to place the physical relics in a special space based on some specific principles, and then with the text and video explanation, can give people a very clear and intuitive perception. However, the interaction between the audience and the collection is not strong, and it is difficult to observe the cultural relics carefully when there is a large flow of people, which also leads to the visitors to the cultural relics are mostly walking around, half-understanding. And exhibits are laid out in accordance with certain rules, visitors can only visit in accordance with the arrangement of the display, the autonomy of visitors has a great limit. Secondly, some exhibits cannot be put into the exhibition hall due to their excessive size, height or width.

Secondly, the limitations of the display space, resulting in the display of cultural relics to be displayed in the form of different time break rotation on the new display on display, each display can only show a small part of the display collection of cultural relics, most of the cultural relics are placed in the warehouse, which allows many exquisite exhibits can not meet with visitors at one time. Visitors have to choose their visit according to the time, and if they miss it, they have to wait for the next exhibition. The epidemic of the past few years has increased the risk of travel. The various factors have largely increased the cost of travel and dampened the interest of visitors.

In addition, traditional museums have time and space constraints and geographical barriers, and the epidemic outbreak in the past two years has made travel even more difficult. Under the influence of various factors, it takes a lot of time and effort for visitors to visit museums around the world.

Finally, since the opening of the Potala Palace, the excessive number of visitors has not only caused potential damage to the civil architecture class of cultural heritage proper architecture, but also increased the fire hazards, although the Potala Palace and other cultural heritage management departments have introduced some regulations to limit the number of visitors, but also only to control the number of visitors during the time period, the total number of tourists annual visits is still long, according to statistics: in 2015 the Potala Palace According to statistics, the Potala Palace received more than 900,000 visitors in 2015. This is very unfavorable to the protection of the Potala Palace, which is a cultural heritage.

### **4. The Potala Palace Digital Museum to Adopt the Advantages of VR Technology**

Museum digitalization is an important trend in the development of museums in recent years, the application of virtual reality technology in the construction of digital museums is one of its future development direction, has a broad development prospects, the arrival of digital

museums is also a good solution to the problems of traditional museums, the following is the Potala Palace as an example, the advantages of digital museums.

First, virtual reality technology creates a three-dimensional virtual environment, allowing the experience to be invested in a virtual environment to swim in. This technology allows viewers to browse a variety of digital exhibits more comprehensively and also allows them to explore the museum selectively and deeply online, making up for the monotony of traditional displays. The digital museum is divided into categories, so that visitors can clearly understand the museum's full range of exhibits and information through the guide, which enhances the viewer's autonomy and selectivity, allowing them to better choose the exhibits they are interested in visiting. The intelligent system of digital technology can intelligently plan the route or recommend the route according to the audience's preference, which is more flexible than the traditional museum's single route design. Through virtual technology, cultural relics are not limited to the display case, the audience can be directly in front of the cultural relics, zero distance to feel the charm of cultural relics, but also through interaction with cultural relics, so that the audience stand in the first perspective of the ancient people to understand the story behind the relics. This display mode is a good solution to the traditional museum's singularity and tediousness. It allows the audience to get a deeper understanding of the story behind the artifacts, and also increases the fun of independent exploration.

Second, through digital technology, the limited space of the museum will be transformed into an "infinite space" online. Exhibits are no longer restricted by museum space, and some works that cannot be displayed due to space constraints can be met online through virtual technology. With the help of digital technology, the audience can have a glimpse of the cultural relics, solving the problem of traditional museums because of the limitations of time and space, unable to carefully observe the whole picture, but also to allow more cultural relics to meet with the world.

Third, the digital virtual exhibition hall can provide fascinating or shocking virtual scenes, vivid and interesting experience, allowing visitors to visit the Potala Palace in a comprehensive and multi-perspective. Through the way of online visit, it can well relieve the pressure of carrying visitors to the museum and reduce the harm to the heritage of the main building. In addition, visitors can have access to more diverse cultural relics and experience electronic culture in this way. Visitors can look around the Physical Museum at any time.

## **5. Design and Realization of the Potala Palace VR Digital Museum**

Using computer virtual reality technology, the virtual three-dimensional model of the Potala Palace VR digital museum is established to digitally store the cultural relics of the Potala Palace realistically and completely into the database and realize three-dimensional digital archiving, so that everyone can share and use the cultural resources of the Potala Palace to the maximum extent. This paper focuses on the design and system development of the integration of the history and culture of the Potala Palace with the digital media virtual reality technology, and the following virtual environment constructed with the Potala Palace as an example.

### **5.1. Data Collation and Collection**

Data collection is the basis of the virtual reality system and is the main basis of 3D modeling. Data collection mainly consists of architecture, cultural relics and history starting from. The Potala Palace formed a huge palace fortress building covering an area of 400,000 square meters, with a construction area of 130,000 square meters, the main building of the Red Palace is 115.703 meters high, with many functions such as palace, lingtha hall, main hall, Buddha hall, sutra hall, office of important functions, Tsangguan school, dormitory, courtyard and cloister. These architectural data are presented through a combination of panoramic camera technology

and mapping maps. The mapping maps are provided by the Potala Palace Administration and the Chinese Cultural Heritage Research Institute in cooperation. Currently the Potala Palace in the register of Chinese, Tibetan, Manchu, Mongolian, Sanskrit and other multi-language precious ancient documents have nearly 40,000 letters, from 1988 to 2004, the Potala Palace was identified precious cultural relics reached as many as 60,000 pieces. Faced with the data of numerous historical relics, research experts of Tibetan culture were first consulted to select and classify the historical culture and relics for the key display. Then use the use of three-dimensional scanning technology or photography technology for multiple angles of multi-directional high precision photography of cultural relics, to obtain high-precision three-dimensional information.

## 5.2. Three-dimensional Modeling

Three-dimensional modeling is an important step in the virtual reality of the Potala Palace, the current commonly used method is mainly the use of existing mature modeling software such as SketchUp, 3DSMAX, Maya , Soft , Image, Alias, Flame, etc., through interactive modeling of the target, modeling accuracy can meet the requirements of practical applications. The main use of 3DMAX to create models, in a well-categorized database, to filter out the required information on cultural relics and historical context, through 3D modeling software for modeling and texture mapping.

Each IP has to be created under following the historical facts and finding the corresponding literature reference for its costume and character and other characteristics. Next, the overall shape and color of the IP is first set using Photoshop, and then the movement expressions during the character's performance are captured by means of dynamic behavior modeling, and multiple moving parts are analyzed by using 3dmax for movement relationship, so as to complete a variety of predetermined actions.

## 5.3. Interaction Design

At present, the virtual software platform is diversified, such as Virtools, Nibiru, Quest3D, converse3D, Unity3D, VR-Platform (VRP), among which we mainly use Unity3D engine for system development. The interaction design content inside the Potala Palace Digital Museum is mainly designed through the historical background.

### 5.3.1. AR into the Ancient Potala Palace

Historical background: The Potala Palace was built by Songtsen Gampo of the Tubo dynasty to welcome Princess Shaktsun and Princess Wencheng. The Potala Palace is an outstanding representative of Tibetan-style ancient architecture, the essence of Chinese ancient architecture, and is the scenic design on the back of the fifth set of RMB 50 yuan notes. It is a sacred place of Tibetan Buddhism and a landmark of the ancient city of Lhasa, guarding the rise and fall of Lhasa for thousands of years. The Potala Palace is the heart of Lhasa, leading the rhythm of Lhasa's prosperity, and is also the window and business card of Tibet to the outside world, a must-see place for tourists.

Production content: After scanning the 50 RMB coin through the customized app, the multi-faceted and multi-angle display of the site will appear. The combination of cosmic space and scenic spots brings a visually stunning experience. In addition, we have provided a narration for everyone, combining 3D story scenes and realistic scenes to make the narration more immersive.

### 5.3.2. Princess Wencheng Entering Tibet to Complete the Marriage

Historical background: The first floor of the Potala Palace is themed "Entering Tibet", and the fresco "Princess Wencheng Entering Tibet" in the foyer of the east gate vividly depicts the spectacular scene of Princess Wencheng entering Tibet. This is a picture depicting the evidence of promoting cultural exchange between Han Chinese and ethnic minorities, demonstrating the

majestic spirit of national unity of the great Chinese nation. The figures are vividly modeled, elegant in tone, and the lines are organized with rhythm.

Production content: The work will be "revitalized" by VR technology "Princess Wencheng into Tibet", around which the key figures (such as: Princess Wencheng, Songtsen Gampo) VR interactive animation design, matching the corresponding custom hardware equipment to display experience, but also to achieve the wedding of Princess Wencheng and Songtsen Gampo, vivid image It is also possible to observe the wedding of Princess Wencheng and Songtsen Gampo, talk with Princess Wencheng, toast with Songtsen Gampo, and experience pot throwing and archery.

### **5.3.3. Song and Dance Toasting**

Historical background: The east side of the White Palace of Potala Palace is themed with "singing and dancing to toast". In 1994, the first phase of the Potala Palace maintenance project was completed here.

Production content: the work will be VR technology Tibetan people hot dance, performing Tibetan opera, held a grand dance - tantric black hat, through the dynamic platform hardware equipment to match the corresponding physical design, to create an immersive leap experience, allowing visitors to immerse themselves in the song and dance with Princess Wencheng, toast to Princess Wencheng.

### **5.3.4. VR Golden Vase**

Historical background: The Golden Vase of the Best Sign for the Tibetan people to identify the highest Tibetan Buddhist reincarnation of the Great Living Buddha, according to the last Karmapa's will to identify the Tibetan system of rigorous and significant rituals, to have the Golden Vase of the Best Sign method and procedures to find the "spirit child", showing the effective system of the reincarnation of the Living Buddha system.

Production content: The work "VR Golden Vase Signing" uses VR technology to create an immersive travel experience, choosing the "Golden Vase Signing" method to find the "spirit child", setting up the interactive fun of the spirit child search, allowing the experience to feel immersive dialogue with the spirit child until The experience of being chosen as a spiritual child.

### **5.3.5. Treasure Hunt of the Secret Palace**

Historical background: The sixth floor of the White House is used for living and working, and has many rooms. For the time being, it is not open to travelers, so we designed the theme of this floor as treasure hunting, based on the rest of the levels of the building to design an immersive experience at the same time, with surreal technical means to meet the regrets of travelers in reality. Virtual Reality - Potala Palace as the core of the Tibetan culture purveyor.

Production content: The work is designed to restore the room on the sixth floor of the White House with VR technology, and to conduct a multiplayer interactive experience by searching for 13 treasures, including a pastel-colored floral-draped Domu pot, a pink and blue glazed open-piece amphora, and a Qianlong pastel-colored gourd bottle. The game is complemented by cultural inculcation, using an old-fashioned projector to watch stories related to Princess Wencheng in a blurred projection. The surreal high-tech and old-fashioned nostalgia overlap with each other, bursting out unique sparks, allowing visitors to immerse themselves in it at will.

## **5.4. Virtual Roaming Platform**

The virtual roaming system realizes VR roaming in three ways: computer-based (Htc Vive), mobile terminal-based (Storm Magic Mirror) and VR all-in-one machine. After the construction of the overall virtual world, there are two options of automatic roaming and manual roaming. In the virtual environment, the entire project of the Potala Palace Digital Museum interacts with people through the stories behind the artifacts with interactive devices, and visitors can

experience the charm and stories behind the artifacts through the first perspective of the ancients, interacting with the artifacts and observing them in all directions. Visitors have a 360° view of any scenes and artifacts, and can independently choose between automatic or manual touring mode.

## 6. Conclusion

In summary, virtual reality technology, as an important direction of science and technology development in the 21st century, provides new technologies and ideas for the development of traditional museums. Inject new vitality into the development of Potala Palace culture, use this advanced technology to inherit and develop Potala Palace culture, let the traditional culture and cultural relics live and live in the present, present in front of our eyes in a zero-distance way, let every piece of dusty history return to people face to face. The combination of virtual reality technology and culture will open a new chapter of traditional culture transmission and dissemination, which has important value for social development and cultural inheritance.

## References

- [1] Zou Shunhong. Integration of virtual reality technology and culture -- Reflections on digital Museum [J]. International public relations, 2022 (6) : 121-123. The DOI: 10.16645 / j.carol carroll nki cn11-5281 / c. 2022.06.025.
- [2] Wang Guangjun, Wang Penglin, Jia Minqing, Yang Xiaoxiao, Chen Xiaohui. Huangmei opera based on virtual reality technology digital museum design [J]. Journal of anqing normal university (social science edition), 2021, 40 (4) : 98-103. The DOI: 10.13757 / j.carol carroll nki cn34-1329 / c. 2021. 04. 016.
- [3] Pang Haihuan. Brief Analysis of the influence of visual Communication design on cultural Communication [J]. Tomorrow Fashion,2018(05):32-33.
- [4] Zhan Xiaofang. Cultural Inheritance in Visual Communication Design [J]. Exam Weekly, 2010 (27): 39-40.
- [5] GUO C. Enlightenment of virtual reality in the inheritance and protection of intangible cultural heritage -- Taking Kunqu Opera as an example. Art Appreciation,2021(30):141-142.
- [6] Xiong Nokawa. Research on modern inheritance and practice of White Deer Cave Academy Culture based on UE4 virtual reality technology [J]. Mechanical and electronic information, 2020 (23) : 76-77. The DOI: 10.19514 / j.carol carroll nki cn32-1628 / tm. 2020.23.040.
- [7] Zou Hong, Li Bo. Virtual reality technology in the application of heilongjiang regional culture heritage and development research [J]. Computer knowledge and technology, 2019 (19) : 221-222 + 241. DOI: 10.14004 / j.carol carroll nki CKT. 2019.2516.
- [8] Shen Ting, CAO Siqu. Application of VR technology in digital inheritance of Grand Canal Culture [J]. Electronic Technology and Software Engineering,2021(06):132-133.