

Revive the Spirit of the Forbidden City by VR Technology

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Abstract. As the most famous heritage site of China, the Forbidden City not only represent masterpieces in the development imperial palace architecture, but also carry profound cultural information and evidence to the living traditions and the customs of Han and Manchu, which was considered as the spirit of the place.

But today the historic and cultural information of the Forbidden City has lost a lot due to the deteriorated environment. In recent years, the excessive tourism with approximately 10 million visitors per year has obviously threatened the historic buildings and the landscape too. In order to preserving the site, people have to be kept away from some buildings, thus the true spirit of the place could not be understood well.

This paper intent to introduce what we have done with virtual reality technology, discussing whether we could help people to access and understand the heritage sites much better by VR without any destruction.

1. What is the spirit of the Forbidden City?

1.1 THE SPIRIT COMES FROM THE NATURE

In ancient China, there was a momentous conception called the “Harmony between the Heaven and Human”. It showed respect to the nature. People thought everything should be done in the light of the “Rules” of the nature. Therefore the imperial palace also built according to some “Rules” of the nature, reflecting the theory of “Harmony between the Heaven and Human”.

The North Star was called the “Purple Numinous Star” in ancient China; people regarded it as the center of the heaven and believed the Emperor of Heaven was dwelling there in a palace called “Purple Numinous Palace”. Chinese emperors claimed they were heaven’s sons; therefore, the palace they lived in was named “Purple Palace” after the North Star. The plan of the palace was designed imitating the imaginative “Purple Numinous Palace”.

It was further believed that all things on earth resulted from the interaction of Five Aspects or Elements. They are wood, fire, metal,

water, and earth. The first four correspond to the four images in the sky representing the four directions. The central element is Earth, correlating with the Purple Numinous Star. They each corresponded to a color—green, red, white, black and yellow. All of these observations are reflected in the design of the Forbidden City.

TABLE 1. the Reflection of the “Five Elements” in the Forbidden City.

Element	Direction	Color	Reflection in the Forbidden City
Wood	East	Green	Princes were dwelling there in a group of buildings with green glazed tile roof.
Fire	South	Red	The paintings under the eave of the south gate used much red colour than others.
Metal(Gold)	West	White	Queen mother was living there, with a river called inner “Golden” river.
Water	North	Black	There was a building worshipping the Spirit of the North, with a lot of symbol of water.
Earth	Centre	Yellow	The most important three halls were built on a foundation in the shape of the Chinese character “tu” meaning earth.

1.2 THE SPIRIT COMES FROM THE SOCIETY

Besides the relationship between human and nature, the Forbidden City also reflected the connection between people and the society, between people and people. This was so-called “Ritual System” in ancient China, which still has deep influence on today’s society. In order to emphasis the stateliness of the emperor, when designed the buildings and the landscape, ancient people paid more attention to the social hierarchy. The style, scale, color and decoration of the buildings need to be distinguished clearly according to the ranks. That is to say, the intangible “Ritual System” was materialized in the plan and design of the Forbidden City. And at the same time, the tangible buildings also strengthened and expanded the influence of social rules and conception.

1.3 THE INFORMATION COMES FROM IT’S REAL UTILITY

In the real utilization, the Forbidden City was the imperial palace during the Ming(A.D.1368~1644) and Qing(A.D.1644~1921) dynasties. Twenty-four emperors lived and ruled from this palace during this 500-year span. The buildings here carried nearly all kinds of function such as ceremony, government affair, study, library, religion, worship of ancestor, living, garden, entertainment, storage and safeguard, etc. The various style of architecture and the furnishing in them record the historical information of the all the activities mentioned above. It is the important part of the spirit of the Forbidden City.

2. Could people get the spirit of the Forbidden City?

1.1 DETERIORATION FOR THE ENVIRONMENT

The Forbidden City is a huge wood structure museum exposing in the air. For influence come from ultraviolet radiation, acid rain, sandstorm, deleterious gas, bristletail, humidification of rainy season, and other kinds of deterioration of the environment, the wood structures and the furnishing indoors had been damaged in varying degree. The magnificent of the Forbidden City has been covered by historical dust. The aspect has been quite different from the original of hundreds years ago. People are visiting “TODAY’S” Forbidden City, not the place of the emperors’ time, how could they get the spirit of the emperors’ palace?

1.2 THREATS OF TOURISM



Figure 1: Watching inner space from the windows.

As one of the most famous area of tourism in Beijing and China, the visitor’s quantities have kept up growing. Especially since the “golden week for tourism” policy started in 1999. Last year, there were nearly 10 million people visit the Forbidden City, which ranked first among all the heritage sites in the world. As we all known, the damages caused by tourism are terrible.

First, visitors of such big amount have badly damage the buildings inescapability. For example, the bricks paving in both inner and outer space have been polished by steps, including the rare “Jin” bricks which was produced in Suzhou. The craft of these nice bricks has lost. Another example is the carbon dioxide people breathe do harm to the plaster on the wall and the paintings under the eave. Sometimes there is also directly damage by people, although they may be unconscious. To deal with these problems, some buildings with narrow spaces or holding fine arts collections have to be closed.

Second, numerous visitors affect the atmosphere of the place. Everyday, especially the holiday season, nearly each corner of the Forbidden City is crowded with tourists and their guide. It is quite difficult to feel the solemn, silent, spiritual emotion when emperors were living here. Maybe it can work if we limit the amount of visitors.

If people were prevent from the place, how could they get the spirit of it?

1.3 THE CONFLICTS BETWEEN HERITAGE SITE AND MUSEUM.

To most of the museums located in the heritage site, they have to face the same problems. On the one hand, in order to provide good exhibiting condition, some of the historic buildings have been changed into modern exhibition hall with constant temperature and humidity equipment. On the other hand, some collections which were placed in the historic buildings for some reason have been gathered and sorted according to the category such as paintings, china wares, jade articles, etc. Thus they can be protected well and people can enjoy them closer in the exhibition cabinet. Of course, act as a museum, one of the important goals is to show the collections to public and let people learn the knowledge of them. But, how could people get the real spirit from the buildings having been changed and collections displaying in rows?

3. Help people to understand the spirit by VR technology.

In order to solve these problems, the Palace Museum which is the authority of the Forbidden City made a series of research. Finally it decided to cooperate with TOPPAN PRINTING CO., LTD, a Japanese company. The company is experienced in digital technology. It has worked together with Sistine Chapel, Uffizi gallery (Italy), Toshodai temple (Japan), State Hermitage Museum (Russia), Maya Site of Copan (Honduras) and several other heritage sites.

In 2003, the Institute for Digitization of the Palace Museum Heritage was founded in the Forbidden City. Staff of the Palace Museum and TOPPAN is working together. One of their targets is trying to preserve and present culture assets of the Forbidden City by VR programs.

3.1 RESTORE OR REBUILT THE HISTORIC BUILDINGS

As we discussed above, the Forbidden City have been damaged by environment and tourism continuously. It's difficult for people to imagine the glory and resplendence of the emperors and the imperial families. But restoration in real world must be very carefully. Otherwise it will not only harm the historic buildings themselves, but also cause the historic information lost. And at the same time, the real restoration will take long time and high cost. But today we can do it much easier, cheaper and safer in the virtual world. Assisted by the graphics programs, we can rebuild the destroyed buildings; recover the color of the painting and the glaze-tiles, and fix the floor by 3D models of bricks.

3.1.1 Restore the Existent Buildings.

For example: the Hall of Supreme Harmony, the largest and most important building of the Forbidden City. In fact, it has been restored since 2006. The wood structure was carefully detected and mended. The glaze-tiles has been repaved, most of them are still original things. The paintings outside have been repainted, according to the original aspects and historic literatures. But the inner space is still kept the original state with limited cleaning. People could not get the whole image of the hall. So, we built the 3D model of the building and restore the real color by modifying textures. The texture pictures were shot before the real restoration project started and modified according to historic paintings which described the color of the hall in Qing dynasty. The true color materials also become important reference. We took photo of the blue, green, red and golden materials, and adjust the color display on computer screen by color management technology. Besides recover the color, we also emphasize the solemn tone in the hall by adjust the light and camera path, helping people to imagine the atmosphere when great ceremonies were holding here. So people can understand what kind of place it is.



Figure 2: Contrast of reality and virtual reality.

3.1.2 Rebuild the Buildings Disappeared.

Both in and after the time of the emperors, there were buildings demolished in the Imperial City. For example, Emperor Qianlong changed the five plain courtyard houses in the north-west corner of the Forbidden City into a magnificent palace and garden. The famous Tian An Men square was built on the site of the long and narrow corridor in front of the Forbidden City last century. In the first example, people can see the nice garden built in the Qing dynasty now, but can not know the original aspect when the Forbidden City was founded in the Ming dynasty. In the second instance, the corridor is out of the Forbidden City, but it's very important to emphasize the supreme status of the emperors. Ancient designers use the long and narrow way to contrast with the huge Tian An Gate. Both these two examples can not be rebuilt in real world, but fortunately we got

evidence to help us rebuilding them in virtual reality. The black and white pictures took from 1900 to 1922 did great help to our work. The five courtyards in north-east corner remain original state told us the true aspect of the Forbidden City in Ming dynasty. Now, people can get the designers' idea when they experience the virtual scene. Obviously, we can not reproduce a "real" Imperial City or Forbidden City, for it's impossible to describe the "past" in every detail. But by contrast the small plain courtyard houses surrounded the Forbidden City and the grand palace, we believe that people can understand the Forbidden City and the invisible "Ritual System" better.

3.2 SHOW THE BUILDINGS DO NOT OPEN TO PEOPLE

Today, the open area occupies about 1/2 of the whole Forbidden City. There are still a lot of well-keeping buildings with fine furnishing in the area people can not access. For example, the Yu Hua Pavilion, a beautiful religious building built under the reign of Emperor Qianlong. It imitated a temple's architecture style of Tibet. The furnishings in the pavilion have not been changed since 18th century. It carries the important evidence of religion and politics activities of the middle Qing dynasty and thus becomes a vital part of the Forbidden City and the history of Qing dynasty, anyone who interested in architecture, religion and history should not ignore this wonderful building. But the narrow wood stairs can not sustain a large number of visitors, the figures of Buddha placed everywhere may be easily damaged by people. So it's a pity the pavilion can not open to public. For those buildings are not suitable for open, the best way for people to access it is the VR program.

But even in the open area, there are also many problems. Buildings in open area are "open" to visitors, but people can just have a glance at the obscuration inner space through windows or the open doors. The reflection on the glass makes it quite difficult to see anything. So it's much more difficult for people to understand the spirit of the space. To solve these problems, we built the 3D buildings of each detail, such as the Hall of Mental Cultivation. Visitors can go

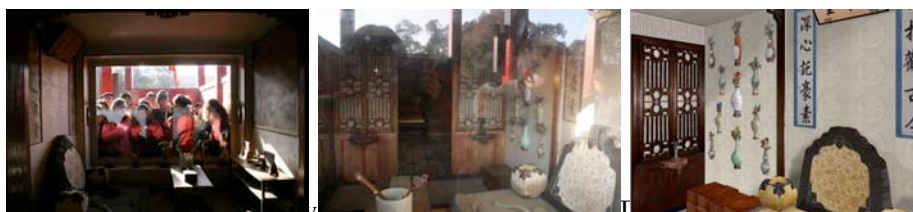


Figure 5. _1. Tourists are watching from the San Xin Tang's window. _2. It's difficult to see clearly for the reflection on the glass, the silk throne cover is faded. _3. These problems can be solved by VR.

deep into the buildings without any destruction. They can even “sit” on the throne. But this is not a vulgar item for tourism. We hope it will help people to understand the place. For example, people can see the inscribed board hung above the door, which they will never see from outside. When the emperors were sitting on the throne, they looked at the board everyday and were reminded of being diligence.

3.3 SOLVE THE PROBLEMS: EXHIBITION VS CONSERVATION

Both the heritage site and the museum intend to transmit knowledge and culture information to people, so they have the same target. So the conflict can be solved on this basic. And the new computer technology has provided a new way to us.

First, we try to “return” the collections to the buildings where they were placed in during the Ming or Qing dynasties. For example, there is a small room in the Hall of Mental Cultivation. Emperor Qianlong put three famous masterpieces of calligraphy in the room and changed its name into “San Xin Tang” (means a room with three rare treasures). In order to show his respect to the culture of the Confucian and the Han nationality, Emperor Qianlong decorated the room with calligraphies and paintings, and always enjoyed the three masterpieces here. But, for complex reasons, one of the collections is in the National Museum in Taipei today. The other two are well kept in the storeroom with constant temperature and humidity equipment. Sometimes they are exhibited to tourists, but will never be shown in “San Xin Tang”. In the latest VR program we made, we “put” the three calligraphy scrolls together in virtual scene of San Xin Tang. People can “spread” them by click buttons on controller and enjoy the collections as if they were sit in the small room.

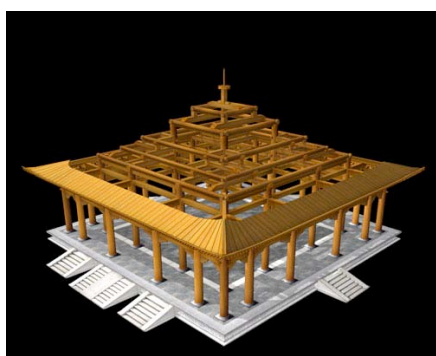


Figure4: Show the wood structure and working procedure of the buildings.

Second, we try to show the invisible scene by VR technology. For example, we show how the Chinese “tu” character change into the foundation of the three important halls, helping people to understand how the idea of “Five Elements” reflect in the Forbidden City. Another illustration is we show the procedure of wood structure and paintings by 3D animation, telling people how the great Forbidden City was built. Thus, we combine the education role of museum and conservation

role of heritage site together.

4. Conclusion

Now we have finished three VR programs with different style of presentation.

The spirit comes from the nature can be explained and showed by 3D animation. Second, the relationship between the design idea and the society rules can be emphasized by “virtual restoration”. Last, we let people get into the buildings and interact with the VR scenes, in order to make them understand better about the tradition and customs of ancient people.

The VR technology is just a tool for us. Obviously, it has a lot of limits. VR technology can not reserve all the information of the heritage site and reproduce the real scene of “past”. But it is true that many people has accessed the place and understand the spirit of the Forbidden City better by VR program. In addition, when we make VR programs, we're trying to find rapid and accurate way to record the data of heritage site. It is another important aim of our research work.