Application Research of Virtual Reality Technology in the Protection of Chongqing Celebrities' Former Dwellings during the Second Sino-Japanese War

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Abstract: At present, the protection of Chongqing Celebrities' Former Dwellings during the Second Sino-Japanese War is mainly based on the restoration of buildings. There are some problems such as single protection method and lack of protection of architectural space environment. In order to make the Chongqing Celebrities' Former Dwellings fully present their historical environment during the Second Sino-Japanese War, this paper creatively applied virtual reality technology to the protection of them. The study takes Soong Tse-ven's Residence (Yi Yuan) as the object, based on detailed information data and historical data, using virtual reality technology and 3D real-life technology, through the "visitor guide" and "architectural protection guide" two design practice samples, to realize the all-round interactive display of the virtual environment and the real environment inside and outside the building, and achieve the purpose of "virtual restoration" of the building space and the indoor and outdoor environment. This paper explores a new method for digital protection of Chongqing's anti-Japanese celebrities' old residences, and explores a feasible path for the protection of historical buildings across multiple fields of architecture, art and technology. Taking the case of Soong Tse-ven's Residence (Yi Yuan) as the "catalyst", it promotes the dissemination of chongqing's Anti-Japanese War culture by improving the degree of visitors' participation and experience, which has strong academic and practical significance.

1. Introduction

1.1 Research Background

As the "wartime capital" of China during the Second Sino-Japanese War, Chongqing preserved a large number of Celebrities' Former Dwellings. As an important cultural heritage left to Chongqing by history, how to reproduce the historical glory of Chongqing Celebrities' Former Dwellings During the Second Sino-Japanese War, further play the role of promoting patriotism, enhance national cultural self-confidence, and consolidate national strength has always been a hot spot of concern to all sectors of society.

In the context of the digital age, scholars at home and abroad are exploring the preservation and display of historical architectural buildings while combining the latest digital technologies with traditional architectural protection to achieve "multidisciplinary science and technology protection"[2]. build a historical building information database based on virtual reality system.

At the same time, many of Chongqing Celebrities' Former Dwellings During the Second Sino-Japanese War are open to the public as well-known attractions and patriotic cultural and educational bases, and bear the important responsibility of carrying forward the revolutionary traditional culture and patriotism. As visitors become more aware of the historical, cultural and

architectural background of celebrities' Former Dwellings, how to make historical information more complete and intuitive to visitors, enrich the experience and interactivity of visitors, and promote the actual use of celebrities and tourism development must be solved.

1.2 Research Status

Through the CNKI database search, it is found that the protection research of Chongqing Celebrities' Former Dwellings During the Second Sino-Japanese War is mainly concentrated on the protection and repair of physical buildings. The existing research results are mainly based on case studies, architectural styles and historical values [2]-[5], and has achieved certain research results in historical building protection, architectural interior display, cultural relics protection, etc. [6]-[12]. However, most of them focus on art majors. From the perspective of architecture, there are few studies combining interdisciplinary fields, and this study can have a lot of space to explore and explore.

Based on historical background research, literature collection and field research, this paper digitally constructs and interacts with the representative building of Chongqing Celebrities' Former Dwellings During the Second Sino-Japanese War, Soong Tse-ven's Residence (Yiyuan), using virtual reality technology to establish architectural protection guides and tourists, Guide two samples to achieve "virtual repair" [1] of the building space and indoor and outdoor environments.

We hope to use this as a "catalyst" to explore new ways of digital protection and display of Chongqing Celebrities' Former Dwellings, and explore a feasible path for building historical buildings that span multiple fields of architecture, art and technology. By improving the participation and experience of visitors, this paper promotes the spread of Chongqing's anti-Japanese war culture and has strong academic and practical significance.


Fig. 1 Old photo of Yiyuan (photograph of Zhou Enlai and Marshall at the entrance of Yiyuan, (Image source: Chongqing Municipal Archives)

2. Basic Information Acquisition

Song Ziwen Guanyin (Yiyuan) is located at No. 19, Sixin Road, Shangqingsi Temple, Chongqing[2]. It was the residence of the Foreign Minister of the National Government and the Executive Director Soong Tse-ven during the Anti-Japanese War, and the former site of the "Chongqing Negotiation". At the end of 1945, General Marshall, the five-star general, as the US President Truman's special envoy, once lived here (Fig. 1) [13]
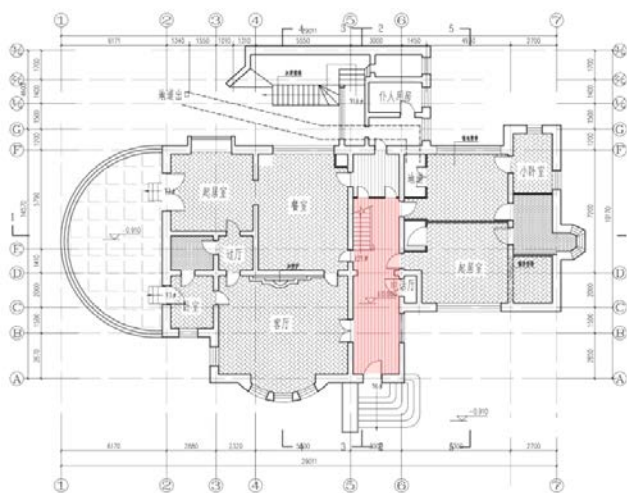
a. First floor plan mapping
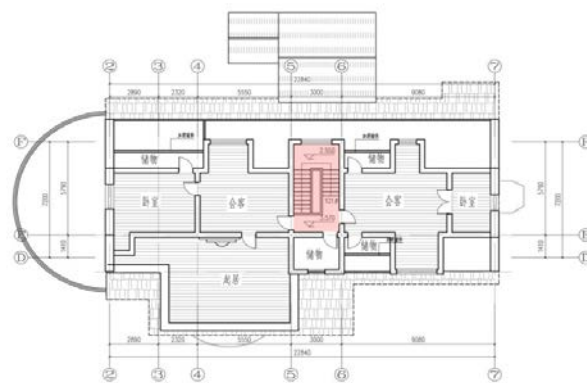
b. second floor plan mapping
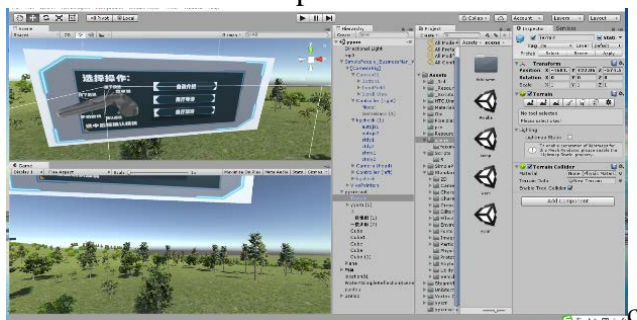
Fig. 2 Yiyuan floor plan

Image source: The results of the Yiyuan Surveying and Mapping Team of the School of Architecture and Urban Planning of Chongqing University (including authors)
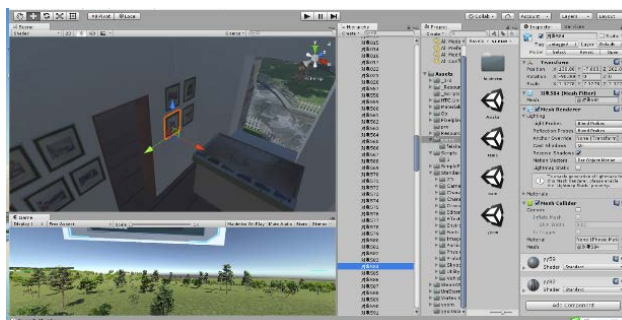

a. 3D panorama showing indoor and outdoor space③

b. 3D MAX model construction

c. Establish a real-time tour

d.360° virtual reality scene construction

Fig. 3 VR interaction model

Image source: Author self-painting

As a "National Key Cultural Relics Protection Unit" and a well-known tourist attraction, it is a representative case of Chongqing Celebrities' Former Dwellings During the Second Sino-Japanese War[14]. The building faces south and covers an area of 1529.8 square meters. The main building has 2 floors and a basement. The building base area is 415.7 square meters and the total construction area is 948.7 square meters. The building site is divided into front and rear yards, with a height difference of 3 meters inside and outside the courtyard (Fig. 2). Through surveying, photographing, video recording, historical data collection and other methods, the detailed construction survey of Song Ziwen's official residence was carried out, and the first-hand building information materials were collected to study the architectural modeling features, structural features and environmental landscape features.④

3. 3D Real Scene Production

Through the investigation and research of Soong Tse-ven's Residence and the classification and finishing of the photos on the spot, based on the PTgui software platform, it is made into a 3D panoramic display file, combined with the dubbing of important space nodes, to achieve a comprehensive view of the real scene of the indoor and outdoor space of Soong Tse-ven's Residence. Provides a foundation for 3DMAX modeling and real-time dynamic rendering via VR (Figure 3a).

4. 3D MAX Model Creation

Combine detailed architectural drawings, on-site pictures, and indoor display information, and use 3DMAX software to perform detailed architectural and indoor and outdoor environment modeling. The difficulty of this part is the depiction of architectural details, environmental essays and details of interior exhibits. Through the detailed modeling of each piece of furniture, each historical display, and each tree, a realistic depiction of the spatial environment of the historic building is achieved (Figure 3b).

5. Virtual Restoration Method Exploration

Restoration generally refers to the process of recovering from the state of destruction to the original state. There are many specific methods, such as the "repair of the old" and the "copying collage" of the photo editing[15]. The virtual restoration of the celebrity's former residence proposed in this paper emphasizes the establishment of a space restoration model, focusing on the restoration of architectural scenes (Fig.3c/3d).
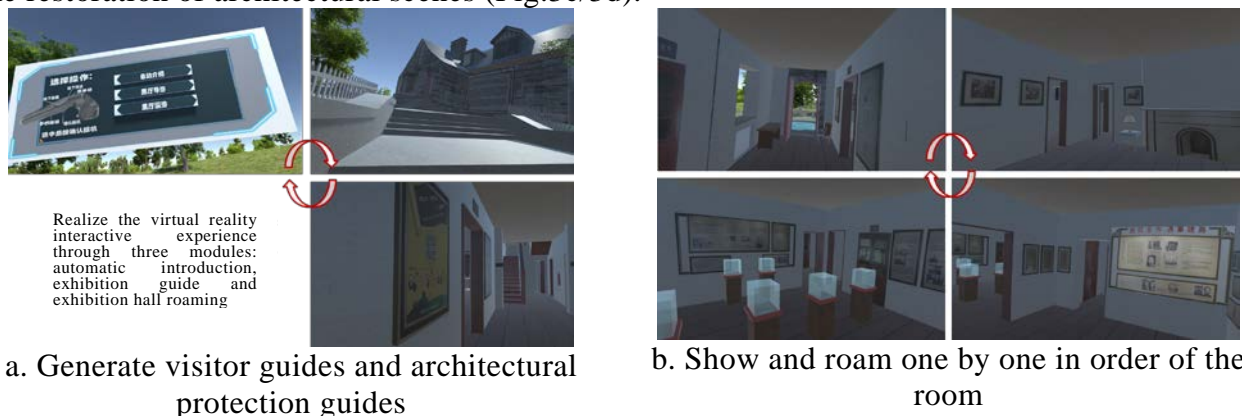

Realize the virtual reality interactive experience through three modules: automatic introduction, exhibition guide and exhibition hall roaming

a. Generate visitor guides and architectural protection guides

b. Show and roam one by one in order of the room

Fig. 4 Build a virtual space tour based on the story script

Image source: Author self-painting

5.1 Scene Recovery

By importing 3DMAX architecture and environment model into Unity2018.3, through VR real-time dynamic rendering and human-computer interaction function, combined with existing physical architecture, historical pictures and historical materials, in the construction of virtual information, try to restore the architectural style and the surrounding environment features of Soong Tse-ven's Residence. Using the immersive features of virtual reality technology, the historical environment scene is merged in the modern real-life environment, giving the experience a "crossing" situational experience between time and space, and on the basis of historical architecture, the surrounding (story) scene Recovery and reproduction. In addition, experience activities such as point reading and armistice agreement have been added to the entrance, foyer, living room, dining room and living room, which greatly enhanced the interaction with visitors, as shown in Figure 4.

5.2 Environmental Evidence

Environmental evidence is to verify the feasibility and operability of the construction of the research scenario by simulating environmental factors. This method is to construct the on-site environment under certain situation setting, and to detect the situational and interactive effects of the research results according to the surrounding environmental factors, in order to obtain relevant data and obtain the effect of "highly restored". By comparing the scenes in the VR model generated by the 3D real scene and Unity2018.3 one by one, the details of the model that are inconsistent with the real scene are found and corrected, thereby realizing the true restoration of the scene.

5.3 Story Thinking

Stylistic thinking is mainly used in the scripting of the story of the virtual space of Song Ziwen. For the venues with strong historical attributes such as the anti-Japanese celebrities' old residences, under the premise of following the research of its profound historical accumulation, based on its historical figures or historical background, combined with the factors of its place, the story is arranged. The study selected five important space nodes: entrance, foyer, living room, dining room, bedroom, and wrote stories for them. In combination with the sequential browsing of the model, according to tourists and cultural relics protection professionals to create guided tours and architectural protection tours, giving visitors a customized tour service (Figure 4).

6. Conclusion

Through cross-border combination of virtual reality technology field and protection research of Chongqing Celebrities' Former Dwellings, this paper constructs the relationship between virtual reality and traditional historical elements, and explores the relationship between historical memory and space. Through the digital construction and scene interaction of the Celebrities' Former Dwellings, the "virtual restoration" of the architectural space and the indoor and outdoor environment is realized. The study breaks the limitations of the previous protection of building entities, and restores the historical memory and indoor and outdoor space, environment, scenes, activities and other elements that cannot be repaired in reality.This paper is a successful exploration of establishing a historical building information database based on virtual reality technology, and also provides a reference method and method for the digital management of Celebrities' Former Dwellings.

Notes

① "Virtual Restoration" refers to the attitude of protecting historical contexts, using new restoration techniques to restore historical memory and indoor and outdoor spaces, scenes, and activity elements of historical buildings that cannot be repaired in reality (Yao Yuqiong, 2013). The use of virtual reality technology to virtualize Chongqing Celebrities' Former Dwellings means repairing the building space and indoor and outdoor environment through digital means, and enabling visitors to get an immersive experience without having to go to the building site, thus effectively breaking the time and space constraints. Promote cultural communication and reduce the damage to historical buildings during the visit.

② During the Second Sino-Japanese War, it was close to the Chengdu-Chongqing Highway and has convenient transportation. It is one of the main areas in the celebrity's new villas.

③ The file has been uploaded to the internet, link: https://720yun.com/t/5b6jusevkm5?scene_id=23490635

④ The current situation image was compiled by the author after many on-the-spot investigations. The basic information and drawings of the building were provided by the Soong Tse-ven's Residence protection project team of Chongqing University. The author participated in the research, mapping and protection of the project.

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