Research on Interactive Design Thinking of Museum Digital Exhibition Space

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Keywords: Digital exhibition space; Information sequence; Interactive design

Abstract. Digital exhibition space of museum becomes an important part of museum construction and development. According to the design and use of the existing museum digital exhibition space, the paper classifies the information sequence structure of the museum digital exhibition spaces as follow: linear sequence, axial radial sequence and scattered sequence. In addition, in line with different information sequence structure, the digital interactive model of digital exhibition space in the museum is proposed, which provides theoretical and practical basis of the interactive design of digital exhibition space of museum.

1 Introduction
With the continuous development of information exchange technology, more and more museums take digital exhibition equipment to provide better viewing experience for the audience. The effective use of digital exhibition equipment in the museums interweaves the digital information that the audience and the museum want to convey, pressing a state of intertwining and interdependence. The connection between museum digital information and audience will take the digital exhibition equipment and mobile Internet, which could create an interactive museum digital exhibition space and present a network of winding multi-threaded information transfer mode.

2 The Present Situation of Digital Exhibition Space in Museum
As everyone knows, Museums are specially designed to preserve artistic creation, including different kinds of collections[1]. Museum exhibition is a group of exhibits which, in a certain space, are based on cultural relics specimens, combined with appropriate auxiliary exhibits, and according to a certain theme, sequence and art form to provide intuitive education, scientific and technological information and aesthetic appreciation. The essence of today’s museum research is to pay attention to the social changes, analyze the visual culture, psychological culture and aesthetics of human beings, what is more important is to establish an “interaction field” with the visual and psychological culture[2]. With the rapid development of information exchange technology and Internet, digital exhibition becomes an important direction of museum construction.

Digital exhibition space is open to the public, wear and rub in the physical exhibition environment, or set in a specific separate area, guided by specific information and knowledge communication demands, in a limited space or area, through comprehensive means such as sound, light, electricity, image, sensor device, etc., to create a new business and cultural experience for the audience. With the extensive application of advanced technologies such as sensors, big data, virtual reality, augmented reality and hybrid reality, the new generation digital exhibition space has the characteristics of integration, perception and community[3]. Digital exhibition is one of the important trends of modern exhibition design, with strong comprehensiveness, high intelligence, the most advanced technology and strongest sense of experience, it is also one of the exhibition scenes that are easy to interact with the visitor and produce memory resonance. Digital exhibition mode, with traditional physical exhibition space, provides better viewing experience for the audience, which is an important development direction in the future museum development.
3 Information Sequence Structure of Museum Digital Space

The physical space of the museum is composed of different cultural relics exhibits, exhibition cabinets and related public facilities. At present, most of the known and completed contents of the museum are related to the collection, recording and dissemination of information [4], the invisible digital cultural relics information is covered in various digital facilities of the museum. The audience’s own mobile Internet equipment is also one of the important sources of information. The information sequences structure of museum digital space is divided into three categories: linear sequence, scattered sequence and discrete sequence. It should be emphasized that considering the information sequence structure in the museum digital exhibition space does not mean that achievement of the museum is only measured by more income or visitors, otherwise the museum will find itself regards as “living fossil” [5] everywhere.

3.1 Linear Sequence.

At present, the information sequence of linear sequence is the most important form of most museums. At the beginning of design, the museum is planned a tour route for visitors, showing a process of visiting museums. As the name implies, the linear sequence of museum digital exhibition space refers to the part of exhibition hall or exhibition area in the museum, there is only one established single visit route, just like a line, from one end. Take the Henan Geological Museum as an example, as shown in figure 1.

![Evacuation Route of Henan Geological Museum](image1.png)

Figure 1. Evacuation Route of Henan Geological Museum.  

The first floor and the second floor is basically the same visiting path, an arc-shaped linear corridor, with conventional display cabinets on both sides for exhibition display, and with color printed text explanation and publicity. A few small devices with convex lens are convenient for the visitors to observe the texture and pattern of digestive food unearthed. Apart from a few LCD screens, there are few other digital display devices, which is to be attribute to the shortcomings of linear sequence display space, simplicity and non-expandability, which need to leave enough space for visitors to pass through. In the corridor from the first floor to the second floor of the Henan Geological Museum, there is a “Miller Experiment” device, due to the light and color of the device are in the darkness, it is not easy to be found by visitors, and the color of the physical keys is not obvious as the same time. Once a large-scale group visitors enter into the museum, it is easy to gather and crowd in the corridor, which greatly affects the quality and experience of visitors, as shown in Figure 2. In addition, as the corridor is very close to the entrance of the museum, the evacuation function for visitors is very limited, it may bring potential safety problems.

3.2 Scattered Sequence

The scattered sequence is reflected in the museum, that is, each exhibition hall or exhibition area is in a complete and relatively independent state, distributed in the form of scattered points, and connected by corridors or rest areas. The whole visit process is simple and bright, with a certain function of personnel diversion and exhibits zoning.
In the exhibition hall of Ancient China in the National Museum of China, there are heavy culture relics of various historical dynasties on display, attracting a large number of visitors. Based on the historical events, a relatively independent and interdependent tour route has been established according to the development order of the dynasties. Visitors can follow the designed best tour route according to the guide tips, or they can choose to jump out of the original tour route and enter another relatively independent exhibition hall.

The query machine at the entrance of the exhibition hall has done a good job in cutting and splicing the scattered information of the map. Before visiting, the audience can quickly understand the structure of the exhibition hall and reasonably arrange their own visitor routes and times, as shown in figure 3. Before getting the map information, it can be imagined that the visitor can only follow the commentator or the crowd to visit the exhibition hall roughly once. If the visitor is interested in a certain dynasty, they can quickly get the map of Xia, Shang and Western Zhou Dynasties and representative cultural relics thumbnails in the map, see Figure 4, to find the location and cultural relics information they need just like a dictionary, and save a lot of time for sightseeing and information search on the Internet. In this exhibition hall, due to its relative independence, it is not the only way to go on the tour line. There is no unnecessary crowd and noise, so the visitor can fully enjoy the tour process. At the same time, this kind of scattered sequence also helps the museum to effectively guide and divert the visitor, relieve the pressure of people flow on the main exhibition areas, and it is also one of the ways to fully protect cultural relics as well.

### 3.3 Discrete Sequence.

Discrete is a concept originated from mathematics, which studies the structure of discrete quantity and its relationship with each other. The embodiment of the discrete sequence in this subject is to construct the exhibition area in which has no function, to form the useful information for the visitors, and then to express the extended information around the museum theme. Taking the platform of the Palace Museum as an example, due to its large range of exhibitions, tens of thousands of visitors come to visit every day. From January 2012 to June 2018, the Palace Museum received 100 million visitors. Since 2015, the policy of restricting the flow of 80000 people per day has been implemented. Since 2019, the Palace Museum takes time interval tickets, tickets are still sold out in the peak season an hour or two before opening.
Large quantity visitors enter the Palace Museum at the same time, if they visit along the central axis of the Palace Museum at the same time, they will not get a good experience. When the Palace Museum is built, each relatively courtyard is built on both sides of the central axis, which provides excellent convenience for the optimization and opening of the Palace Museum. As shown in the plan of the existing open area, the central axis is also the center. The surrounding courtyards are relatively independent to form satellite points to provide information for the visitor. The well-known Treasure Hall and Clock Hall are evenly distributed in the Palace Museum, which are used for 80000 visitors to arrange their own tour every day.

4 The Digital Interactive Model of Digital Exhibition Space in the Museum

As we know, in part of daily work, museums rely on external information for temporary exhibition work, education core activities, etc. this process can be refined interaction of information exchange and information sharing between museums and visitors based on the Internet. Many museums have many problems in exhibition design, such as incoherence of exhibition system, single exhibition content and function, homogeneity and stylization of exhibition content, and entertainment of exhibition, supremacy of vision and sense of exhibition form[6]. In addition to the exhibitions in the permanent exhibition hall, museum exhibitions are often related to the practicality of the theme, such as anniversary exhibitions, itinerant exchange exhibitions, etc., which are basically carried out by experts in the theme field in combination with the staff of the museum. In the later stage of exhibition arrangement, the museum competes display, publicity and exhibition management, and finally, in the process of visiting, the commentator delivers relevant information.

Besides, museum research also should focuses on the basic elements of “things”, “people”, “information” and its information transmission model[7]. Based on the above three sequence of museum digital exhibition space, which include linear sequence, scattered sequence and discrete sequence. No matter what kind of information sequence the museum visits, the intertwining between the museum’s digital exhibition space and the visitor still exists. Furthermore, with the development of digital exhibition technology and interactive technology, the deep application in museums, and the detailed division of work in museums, the interactive entanglement between the information delivered by museum digital equipment and the visitor will become more and more close.
As the carrier of information and space for information exchange, digital exhibition enhances the interaction between the visitors and the museum, and also increases the opportunities for communication among visitors. This paper proposes a user perception model of digital exhibition in Museum, as shown in Figure 7. First of all, ensure the ease of use of digital exhibition, because the digital exhibition equipment in the museum faces different visitor groups. Through interactive participation, the visitor can perceive the virtual image in the real museum, as well as the real visual and auditory feeling in the virtual image during the visit, and generate immersive experience, enjoy state, curious psychology, and promote deeper participation in the exchange with museums and other visitors, self-learning and entertainment are finally achieved.

5 Conclusion

Throughout the development of the museum for thousands of years, the progress of human science and technology has brought a leap forward development trend to the museum itself. As an important container of human civilization, the museum provides information service and cultural memory for every visitor. The application of interactive digital exhibition technology in museums brings about the effective combination of digital exhibition space and traditional physical exhibition space, which is a double-edged sword for the improvement of museum information service quality. Designers need to select the appropriate information sequence structure for museums of different sizes and themes, and design the digital exhibition space effectively, from perspective of designer, visitor as well as museum constructor. There is no doubt that, museums will go further and further in the direction of digitalization in the future, the exhibition space carrying human civilization will be more and more diversified, and the integration of physical space and digital space will be more integrated.

Acknowledgements

This thesis would not have been possible without the consistent and valuable reference materials that I received from my supervisor Prof. Fang, whose insightful guidance and enthusiastic encouragement in the course of my shaping this thesis definitely gain my deepest gratitude. Furthermore, my sincere appreciation also goes to the former Museum researchers and builders, who provide important theoretical and practical basis for the formation of this paper.
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