



Research on Digital Exhibition Design of Local Museums Based on Augmented Reality Technology

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Abstract. With the development and popularization of technologies such as computers and augmented reality, the digitalization of museums has become the mainstream development trend of museums. However, limited by objective conditions such as funds and technology, the exhibition design of local museums has defects such as single information expression, poor interaction, and poor user experience. This paper takes Shaanxi Baoji Bronze Ware Museum as the research object, and based on augmented reality technology, the digital interactive exhibition system design is carried out from the aspects of digital exhibition design process, core technology, and application difficulties. This research aims to provide solutions for digital exhibitions of local museums.

Keywords: Augmented reality technology · digital exhibition · smart museum

1 Introduction

Museums are non-profit, provide services to the society, and provide places for the public to provide knowledge, education and cultural appreciation. With the development and popularization of various information technologies such as multimedia, big data, and artificial intelligence, the digitalization of museums has become the mainstream development trend. Augmented reality technology (AR) can closely connect the real environment, objects and virtual environment, bring a strong sense of presence and participation to the experiencer, and bring new ideas and opportunities to the digital exhibition design of the museum. An important technical support to make museum cultural relics “live”.

As of the end of 2022, the number of museums in my country has exceeded 6,000, with a collection of more than 58 million cultural relics. China has formed a museum system with a reasonable structure, that is, with first-, second-, and third-level museums and key industry museums as the backbone, state-owned museums as the main body, and private museums as supplements. Limited by the scale and development status of museums at different levels, the application effect of AR technology in museums in different regions is uneven. The AR applications of most local museums are still

relatively basic, and their effect is still to increase the fun of the exhibition experience, lack of system design for the overall tour link, and there are problems such as rough interactive content and unsmooth interactive experience [1].

Based on this background, this study takes the Baoji Bronze Museum in Shaanxi, the first bronze museum in my country, as the object, and conducts digital interactive exhibition system design from the aspects of digital exhibition design process, core technology, and application difficulties.

2 Application Status of Augmented Reality Technology and Museum Digital Exhibition

2.1 What is Augmented Reality Technology

AR (Augmented Reality), that is, augmented reality technology, also known as mixed reality and augmented reality, is an emerging technology developed on the basis of virtual reality (VR). It can superimpose computer virtual information on the real scene, and through the display device, users can see the fusion of virtual information and real scene at the same time, providing users with an experience based on reality and beyond reality.

2.2 Specific Scenes of Augmented Reality Technology Applied to Museum Exhibitions

AR technology has shown wide application potential in many fields, and has also brought profound changes to museums. The “Horizon Report” issued by the International New Media Consortium has repeatedly called on museums to pay attention to AR technology.

At present, in China, the application of AR technology in the field of tourism is still in the initial stage of development, and the 31 first-level museums in China have not yet achieved full coverage [2]. Generally speaking, the application of AR technology in museums is mainly reflected in the display of cultural relics, information interaction and the development of derivatives, etc.:

- **Dynamic display of exhibits:** Such applications can digitally restore cultural relics through AR database information and device motion capture functions, and can also scan outdoor ruins to watch the restored ruins on mobile devices.
- **Application of Digital Restoration of Exhibits:** Such applications can digitally restore cultural relics through AR database information and device motion capture functions, and can also scan outdoor ruins to watch the restored ruins on mobile devices.
- **AR interaction with large screen:** AR large-screen interaction is a multimedia product that integrates 3D somatosensory cameras, somatosensory interactive software, and 3D digital content. It uses body movements to interact in space or finger touch interaction to interact with the content on the screen.
- **Simple navigation function application:** This application involves the dynamic UI tracking technology of AR. Through the tracking and matching of the real scene through the camera of the mobile terminal or the head-mounted device, the geographical coordinate information shared by GPS or Beidou satellite is generated, and the corresponding UI instructions are generated in real time.

- Souvenir Making or Virtual Exhibit Presentation: Through AR technology, visitors can use mobile phones to scan ticket stubs and souvenirs and generate three-dimensional virtual exhibits or even the museum itself on mobile phones or other mobile devices. For example, AR cards of Banpo Museum, AR cards of Terracotta Warriors and Horses, AR cards of Yuanmingyuan, etc., visitors can “take home” cultural relics, collect them by themselves or show them to friends, and observe and study cultural relics up close.

3 Examples of Digital Transformation of Displays in Local Museums—Taking Shaanxi Baoji Bronze Museum as an Example

3.1 Analysis on Exhibition Design of Baoji Bronze Ware Museum

Baoji Bronze Ware Museum is the first special bronze wares museum in my country. The building area of the museum is 34,800 square meters, the cultural relic warehouse area is 5,000 square meters, the exhibition hall area is 11,000 square meters, and there are more than 480,000 cultural relics, including 3,245 precious cultural relics. The museum is determined to create a cultural brand of Baoji as the birthplace of Zhou and Qin civilization and the “hometown of bronzes”.

During our research, we found that whether it is a concentrated display of a large number of unearthed cultural relics or a unit narrative as the logic, most of the cultural relics exhibits are simply introduced by placing cards. Due to the limited space of the exhibition hall, it is difficult for some visitors to understand the details of the exhibits. Detailed information limits the role of popular science education; in addition, the bronze ware unit in the exhibition hall is not comprehensive enough to display key exhibits, and the interactive effect of the electronic screen in the fourth exhibition hall “Light of Wisdom” is single, causing visitors to actively visit and use digital Not enough enthusiasm for interactive devices.

3.1.1 Reconstruction of Museum Digital Exhibition Based on Augmented Reality Technology

3.1.2 Transformation Process Design

In order to respect the original design logic of its exhibition hall, we followed the idea of “preliminary research - sorting out the existing exhibition narrative - digital interaction design system transformation”, and carried out the smooth movement of the exhibition hall under the premise of following the original unit narrative logic. At the same time, the multi-device AR gameplay design is integrated into the whole browsing process of visitors to achieve a more attractive and holistic digital interactive exhibition solution (Fig. 1).

3.1.3 Main Implementation Technology

We divide the augmented reality technology it uses into three major sections, video capture module, tracking registration module and virtual-real superimposition module. We collect video capture images in the real environment, obtain the location of mobile

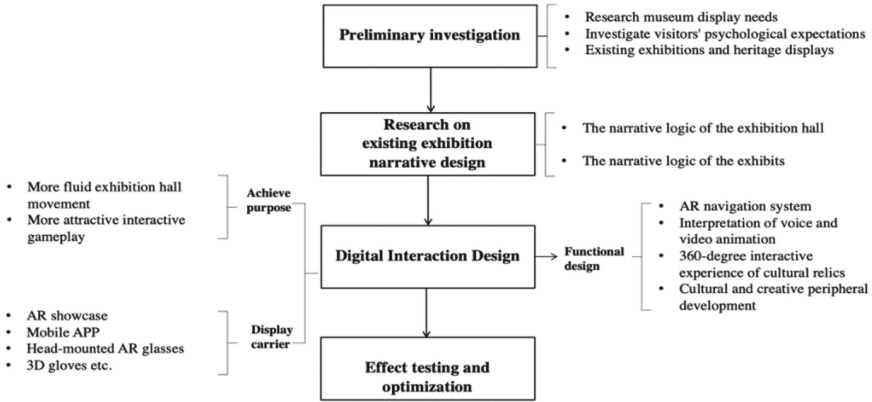


Fig. 1. Improvement process of museum digital exhibition design

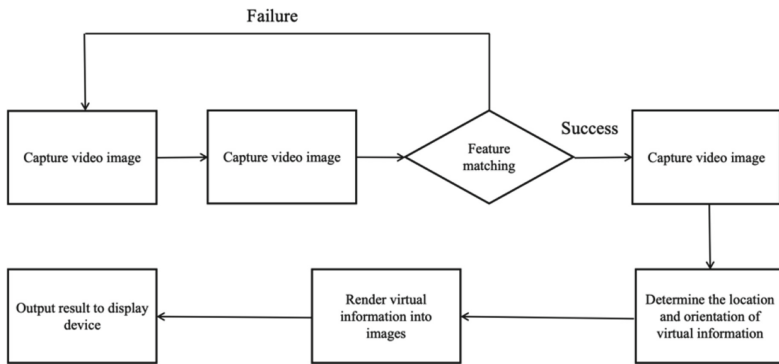


Fig. 2. AR technology tracking registration operation process.

devices through wireless WI-FI positioning technology, collect various landmarks in the museum in real time, track and register based on computer vision, complete virtual-real matching, and then complete virtual-real superposition [3]. The mobile terminal receives the wireless signal to locate the location area of the mobile terminal. In the vicinity of specific markers, through computer vision-based tracking and registration technology, according to the pattern recognition matching algorithm, the marked image is compared and matched with the template marked image in the marked library to judge whether the marked is a legal mark. After tracking and registration, the scene captured by the camera and the virtual cultural relic information in the computer are rendered on the screen, so that visitors can see the exhibit information superimposed on virtual and real (Fig. 2).

3.1.4 Augmented Reality Production Process for Key Collections

The Baoji Bronze Ware Museum collects more than 1,500 bronze wares from the Shang and Zhou dynasties unearthed in the Baoji area, including more than 100 national treasures such as He Zun, Du Pan, and Qin Gongpan. In order to better realize the purpose

of “making cultural relics come alive”, the author follows the following steps to carry out the digital display and restoration of key collections. The hardware mainly relies on smartphones and AR glasses, and the software part mainly relies on Maya2019, UNITY3D and UNREAL ENGINE4.0 for implementation.

- Step 1. Production of 3D models of exhibits

Since AR itself is a superposition of virtual and reality, the 3D model is the most important factor in solving its virtual part. In the stage of 3D model making, we mainly use the more popular polygonal modeling methods and subdivision modeling methods to make models. Due to the large amount of model data in some collections, low-precision models are made through retopology technology, and high-precision model information is loaded onto low-precision models through normal baking technology to reduce the amount of graphics calculations on the computer.

- Step 2. Production of 3D animation and special effects

After the static model is generated, we need to produce the 3D animation and special effects presented by AR. The production process is the same as that of the traditional 3D animation and special effects, except that the assets need to be stored in FBX format files.

- Step 3. Implemented on the engine platform

In the current AR production process, most game engine technology is used to test and realize the final AR effect. The engine platforms we mainly use are UNITY3D and UNREAL ENGINE4.0. In the process, AR related network protocols and plug-ins can be loaded to realize the simulation of AR lens in PC.

- Step 4. Packaging testing and post-optimization

After the AR function is tested in UNITY3D, the program can be packaged and tested using mobile devices, and iteratively optimized based on user feedback in the actual experience.

3.2 Digital Exhibition System Design of Baoji Bronze Ware Museum

3.2.1 Design of Museum Guide System Based on AR Augmented Reality Technology

As shown in the Fig. 3, the tour app obtains the real-time location of the visitor through the GPS positioning system. The visitor is abstracted as a blue direction sign, and the route is generated or changed in real time. In a moving environment, the audience can compare the relative positional relationship between objects, determine their own position and the position of the object they need to visit, and let the visitor predict the object they want to visit and their own position. Thus forming very vivid guidance information. The path navigation function can calculate and plan the route according to the personal preferences of the visitors. However, if tourists do not have specified goals, the system can also customize several goals to form multiple guiding routes for tourists to choose, so as to ensure the sightseeing needs of different groups of people [4].



Fig. 3. Route navigation based on wearing AR glasses



Fig. 4. Key exhibits - He Zun AR projection related instructions

3.2.2 Browsing and Explanation Function Based on AR Augmented Reality Technology

The explaining function of the AR intelligent guide is quite different from the traditional explaining function. It gives full play to the information superposition characteristics of the augmented reality technology, can provide comprehensive supplementary explanations for the real objects, and enhance the interest of the audience in the experience process [5]. For example, in Fig. 4, with the help of a smartphone with a camera or wearing glasses, visitors will directly see the superimposed relevant marks on the key exhibit He Zun, and browse the animation video of the exhibit.

4 Conclusion

This article takes Baoji Bronze Ware Museum in Shaanxi Province as a sample, and uses AR technology to change the one-way display mode of the museum, which can further enhance the interaction of cultural relics display, and enhance the authenticity and atmosphere of the exhibition. If AR technology wants to be better integrated into museum exhibition construction, it needs to continue to develop and create more connotative and interesting experience projects. The author believes that in the metaverse era, museums will bring people greater surprises and more room for imagination, and create new social and cultural values.

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