Research on Museum Prime Space Design and User Experience based on Virtual Reality Technology

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Abstract: Virtual reality technology as a widely used intelligent computer technology in various fields, its principle is to use different transmission ways to display the hd three-dimensional data edited in advance in front of users, and then bring users multi-angle, real visual experience. At the same time, as the probability of the universe, as the inheritance of human civilization and culture museum get new development opportunities, and with the help of virtual reality technology, build a special scene of virtual museum, so as to effectively improve the value of the museum, rich museum culture construction, and with good user experience feedback, reflect the benefits. Therefore, the design of the museum, firstly provides the theoretical basis for the study, highlights the design points of the study, and lists an interactive system based on the combination of virtual and real, to study the user experience.

Key words: virtual reality technology; museum yuan universe; user experience

1 Introduction

Virtual reality technology, as the most widely used and effective scientific technology, holds a very important position for the development of various fields. Then relevant researchers put forward the concept of "meta universe" through in-depth virtual reality technology, clearly pointing out that although the meta universe is still in its infancy, due to its progressiveness and pioneering nature, it will bring more diversified and traditional experience to visual design [1].At the same time, researchers have shown that the "metaverse", as a new type of virtual space, has already surpassed the traditional physical space and turned to a state of virtual and real coexistence. They have also summarized the bottlenecks faced by museum exhibition design in the context of the metaverse, and proposed directional suggestions for the development of the metaverse in museums[2].

Researchers have also discussed the emotional, commercial, and subcentric issues brought about by new developments in the metaverse era, proposing that museum exhibition design is a new connection between virtual and real symbiosis, digital twins, and people, objects, and fields through new technologies[3].In addition, in foreign research on the "metaverse", it has also been applied to the chemical field, studying how oxide technology has become a choice for ultra-high resolution due to its transparent properties [4].Furthermore, virtual technology has been applied to employment development, and a virtual reality interview training program (VR JIT) provided through the internet has been proven to be effective in increasing the employment of SMI adults [5].

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From this, it can be seen that the practical application fields of virtual reality technology are not only very broad, but also play a unique role. Combined with the probability of the "metaverse" derived from virtual reality technology, whether it is applied to the fields of technology research and development, education, etc., it can high-quality promote the development and construction of this field.

2 Characteristics of virtual reality technology

The characteristics of virtual reality technology are mainly reflected in four aspects. The first is active participation requires the experiencer to take the initiative in the application scene and participate in the experience activities of the application scene, so as to increase the viewing experience of the scene and indirectly improve the entertainment value of the scene[5]. The second is experience, so as to enhance the emotional experience of the experiencers, thus transferring the emotional value contained in the exhibits to the experiencers, so as to realize the emotional communication between the two, and further add the memory of the experiencers. Moreover, for interactivity, the equipment is used to enhance the experience of the experiencers to the virtual world, increase the interest and interactivity of the scene things display, subjectively enlarge the display space, change the display information from the fragment to the story, and improve the thinking cognition and understanding of the display. Finally, immersion breaks the limitation of vision and hearing, creates an immersive scene visiting environment, and triggers the emotional and thinking resonance of the experiencer, so as to change the rigid thinking of the experiencer to the scene, and realize the communication and communication between the display products and the experiencer. As shown in Figure 1.

Figure 1. User application of virtual reality technology in the museum scene (Source: Network)

3 The design content of the museum yuan-universe

3.1 Design requirements of museums

As a new era of new museum form, museum yuan universe in the design process, need to internal exhibits for digital processing, and meet the demand of museum service financing line,

and intelligent management demand, to let the museum yuan universe play its own cultural communication, cultural experience, entertainment experience, further improve the museum visit and experience value[6], As shown in Figure 2.

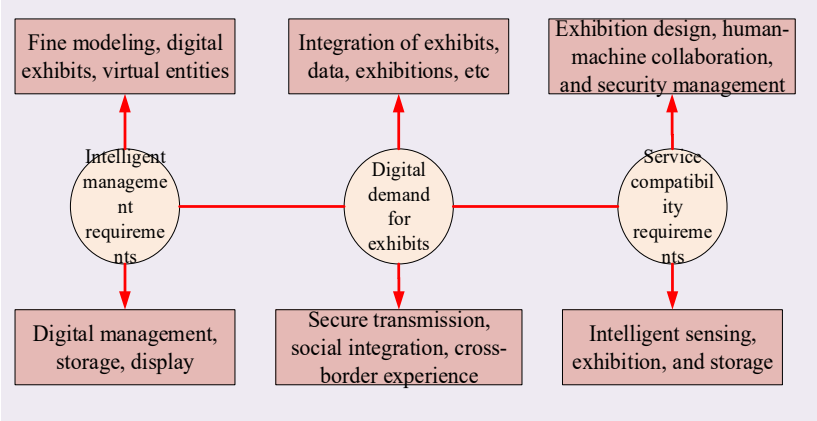


Figure 2 .Museum universe design requirements framework

3.2 Museum Meta-cosmic System Framework

In view of the construction of the museum metacom, this research uses a social physical information system (CPSS) to build a man-machine mixing system with parallel system, artificial system, computational experiment and parallel ACP method[8], As shown in Figure 3.

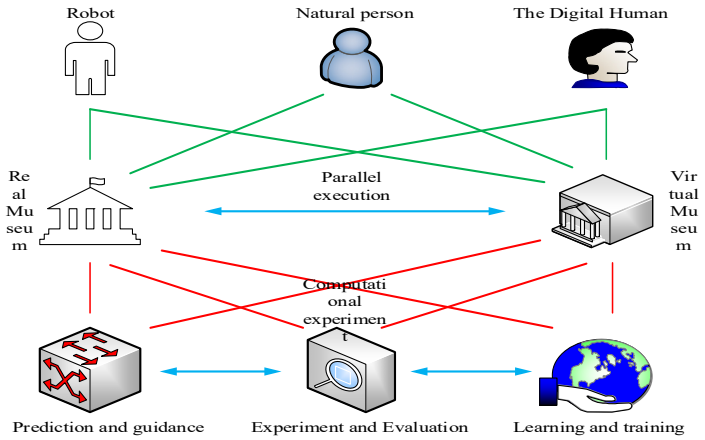


Figure 3. Metacverse architecture of human-machine hybrid museum

Through the parallel execution of real and virtual museums, the museum universe achieves the purpose of improving the management effect of the museum. Meanwhile, through proposing prediction and guidance, learning and training, the museum system model construction, business design and computational experiments are carried out.

In addition, the control and management objects of the museum meta-universe are mainly composed of basic facilities, exhibits, and staff, so according to the main contents of the museum meta-universe, the use of the above three control and management objects are described, as well as the management of prediction and guidance methods[9]. Therefore, it is necessary to personalize the system structure, basic methods and service content of the museum meta-universe, so that the design of the museum meta-universe system has strong pertinence and specificity, as shown in Figure 4.

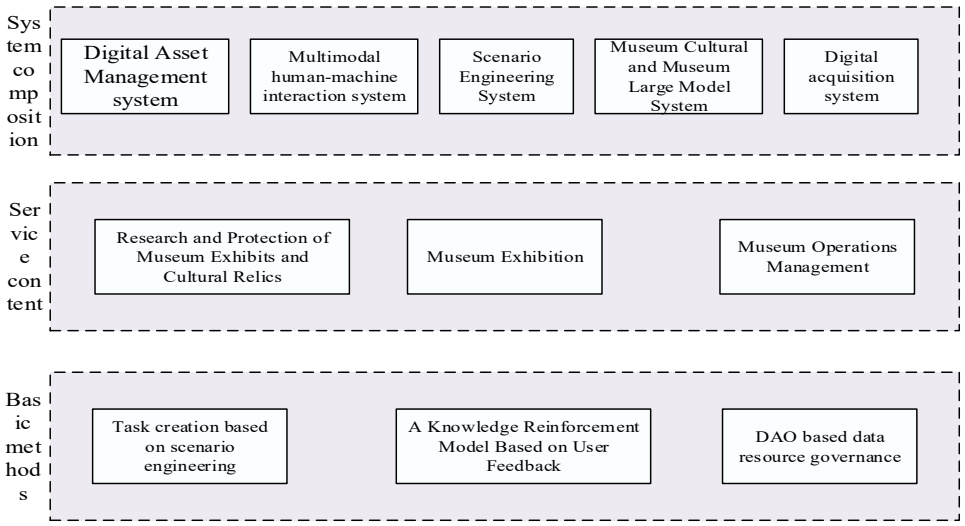


Figure 4. Design architecture of Museum

3.3 Application design of virtual reality technology

Take AR Toolkit's active visual localization technique as an example, as follows.
The technique uses the method of fixed position to segment the image, and the degree of the results directly affects the matching results. Among them, there are many kinds of changes between the image acquisition of the hardware device camera and the identification image in the template library, such as size, displacement, rotation, etc., and then the acquaintance degree between the two[7]. Therefore, the image (P (x, y)) with the same size of the template (T (x, y)) is obtained by rotation. If the template size is MM, then the acquaintance match R (x, y) formula is expressed as:

$$R(x,y)=\frac{\sum_{x}^{M}\sum_{y}^{M}\left[P(x,y)-\overline{P}\right]\left[T(x,y)-\overline{T}\right]}{\left\{\sum_{x}^{M}\sum_{y}^{M}\left[P(x,y)-\overline{P}\right]^{2}\sum_{x}^{M}\sum_{y}^{M}\left[T(x,y)-\overline{T}\right]^{2}\right\}^{\frac{1}{2}}} \tag{1}$$

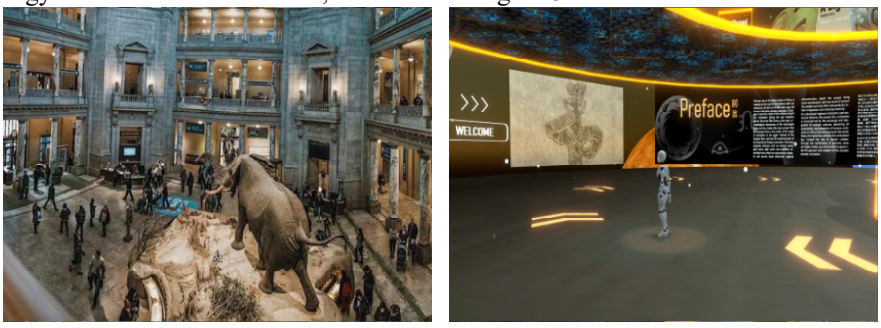
In addition, fault tolerance, inertial positioning, Kalman filter, image processing, and other technology will be used[8], As shown in Table 1.

Table 1. Active visual positioning technology and correlation techniques of AR Toolkit

name	formulate	explanatory note
Active visual positioning technology	$\begin{cases} X_{id} = (l+d)^{*}((id-1)\%row-1)+\frac{l}{2} \\ Y_{id} = (l+d)^{*}((id-1)/row-1)+\frac{l}{2} \\ Z_{id} = 0 \end{cases}$ (2) $P(x,y,z) = \begin{cases} x_p = t_1 + X_{id} \\ y_p = t_2 + Y_{id} \\ z_p = t_3 + Z_{id} \end{cases}$ (3)	t_1,t_2,t_3Is the translation quantity; P is the coordinate of the user's head in the world coordinate system;
fault-tolerant technique	The inertial positioning method is used to correct the visual positioning results to obtain the precise position;	
Inertial positioning technology	$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} \cos(\theta(t)) & \sin(\theta(t)) \\ -\sin(\theta(t)) & \cos(\theta(t)) \end{bmatrix} \begin{bmatrix} v_L \\ v_T \end{bmatrix}$ (4)	θ Is the bias Angle between the world coordinate system and the robot coordinate system;
Kalman filter	$Z_{k+1} = A_k Z_k + G_k n_k$ $Y_k = C_k Z_k + w_k$ (5)	Y_kIs the measured state matrix; n_kFor the system noise; w_kFor the measurement noise; $A_k$take part in G_kFor system parameters;
Fixed-threshold segmentation method	$O(x,y) = \begin{cases} 0 & 0 \le f(x,y) \le T \\ 255 & T < f(x,y) \le 255 \end{cases}$ (6)	/
Global thresholding segmentation method	$\delta^2(T) = w_0 w_1 (u_0 - u_1)^2$ (7) $\delta^2(T) = w_0 w_1 (u_0 - u_1)^2$ (8)	w_0Is the total image pixel ratio; u_0Is the average gray scale; T * is the optimal threshold.

3.4 Practical application of museum meta-universe based on virtual reality technology

At present, the practical application of the museum yuan-universe based on virtual reality technology is reflected in real life[10], As shown in Figure 5.



A. Natural Museum Metaverse Scene B. Museum Metaverse Operation Display Interface

Figure 5 . Practical application of virtual reality technology **(Source: Network)**

In Figure 5a, It is clear that the museum belongs of nature, Main exhibition of the living things in nature, And in the museum, The picture will be based on biodiversity, environmental

diversity and species evolution, When letting users visit such museums, To enjoy the charm of natural creatures; Figure 5b is the introduction of individual exhibits in the museum, Which integrates the operation interface of the metacom, Can enable users to follow their own needs, Actively search for relevant information about the exhibits, And this virtual world to the user's visual impact is very strong, It fully embodies the characteristics of the metacuniverse as a five-dimensional space.

4 An interactive system based on the combination of the metaverse

An interactive system based on the combination of the virtual and reality of the metaverse, Control panel containing the content settings, As the main control system and operating interface of the system, Is the main component of the execution of the developer commands; The acquisition module is to collect the shadow and visual data information around the system; The AI building module, It is the main module to construct the virtual human model and configure it to the control panel; Analysis module, the function and acquisition module, Different types of data information collected on the acquisition module for text extraction, To prepare for the subsequent display module, And to match the extracted data information with the collected data information, Transfer to the save module, As shown in Figure 6. Thus, a universe based on the structure of interaction system, have high practicability, and do not need to invest more cost, let the user experience the universe in convenient and cheap way, at the same time in the system of the user personalized operation and editing process, can make the system can accommodate a variety of things, and its true, bring the user a good experience of physical space. Therefore, this interactive system based on the virtual combination of meta-universe can be applied to the fields of urban public space development, natural history management, schools, enterprise operation, scientific and technological research, and other fields, and even to the media field to conduct publicity activities.

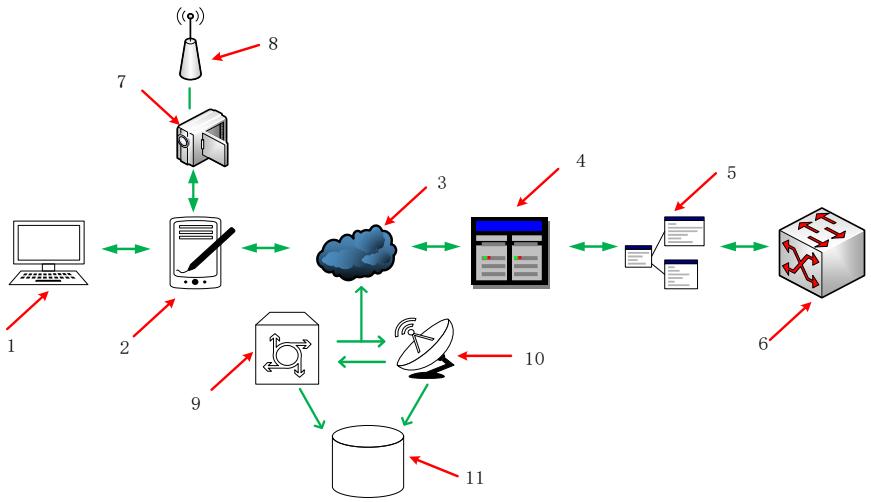


Figure 6 . A structure of a virtual and real structure interaction system based on the metaverse

Note: 1 is control panel; 2 is acquisition module; 3 artificial intelligence construction module; 4 is analysis module; 5 is transition module; 7 is camera module; 8 is audio capture module; 9 is recognition unit; 10 is acquisition unit; 11 is database (save unit).

5 Conclusion

In summary, Research on Museum Prime Space Design and User Experience based on Virtual Reality Technology, From a theoretical perspective, By outlining the theory, Cause this research has a strong scientific nature, And to provide theoretical support for this study; Then, by introducing the design content of the museum's meta-universe, Bring in the virtual reality technology-related content, The key research contents are for the framework of the museum meta-universe system and the application design of virtual reality technology, The other two parts are used for refining the focus of this study, Causes the research has a strong logic and comprehensiveness; Finally, by proposing an interactive system based on the virtual and real combination of the metauniverse, Studying the user experience from a technical perspective, Cause this study has certain implementation. In addition, the study has certain shortcomings, mainly reflected in the introduction of virtual reality technology is not comprehensive, followed by the user experience research content, Angle choice is relatively single, so in the future research, will focus from the perspective of technology, and comprehensive analysis of the user experience, further increase research feasibility and scientific, provides museum reference value for the development of the universe.

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