Discussion on the Design and Application of Digital Display System

wei Zhao

zhaowei@wxic.edu.cn

Wuxi Vocational Institute of Commerce, Wuxi 214153, China

Abstract: The involvement of digital technology promotes the diversification of display methods, reverses the traditional single expression form of display, and creates environmental realism in modern display design. Its advanced digital communication technology and unique display mode not only turn modern display into a visual feast, but also provide an educational place for the audience to entertain and educate. Digital exhibition design is to simulate the three-dimensional real space and object information into a digital virtual image by computer technology, and then integrate it with multimedia means such as graphics, images, sounds and videos, and convey the information in the virtual space simulated by computer as a carrier, so that people can have a real feeling about the object and the environment itself, thus creating a new multimedia exhibition space with interactive characteristics.

Keywords: Digital exhibition design; digital technology; virtual image

1.   Introduction

The progress of the times has promoted the emergence of various new tools and technical methods. As a new method, digital media technology has been widely used in different industries and played its corresponding value. Infiltrating it into the exhibition design process can make the exhibition design more modern, show the designer's design concept and further display the achievements of scientific and technological development. In the process of concrete exhibition design, it is necessary for the relevant staff to have a correct understanding of digital media art, and thoroughly study and discuss the effective application methods of digital media art, so as to give full play to its value and make the overall exhibition results more unique and distinctive[1].

"Model display" is one of the important links in large-scale complex equipment exhibition and training. The method of real display is easy to be restricted by many factors such as site, environment, time, personnel, and some parts are difficult to display visually. At present, in the process of display and interaction, 3D animation or 2D pictures are mostly used, and the parameters of the x, y, and z axes are continuously adjusted through the traditional mouse to display the structure of different parts. This method based on "plane+mouse", on the one hand, lacks stereo realism; Second, it lacks natural interactivity and is difficult to provide intuitive and convenient information display and interaction. Phantom imaging technology has been widely used in the field of commodity display in recent years[2]. Compared with real holographic technology, it is cheap, but it can provide realism and stereoscopic sense, which is very suitable

for the display of equipment models. However, most of the film sources in the actual development are at the non-interactive stage, lacking efficient development environment and more natural interactive tools. LeapMotion is a millimeter-level desktop short-range gesture control device launched by Leap in 2013. Compared with Kinect, Wii and other devices suitable for long-distance full-body sensing, LeapMotion focuses more on capturing and recognizing the detailed movements of hands and fingers in close range. Applying it in combination with phantom imaging technology to the close display interaction of equipment models has a stronger sense of immersion, as if the real object is in the hand, and can be manipulated at will, with better display effect. Unity3D is the top cross-platform virtual reality development engine at this stage, with powerful scene editing function and rendering ability. Compared with traditional film source development tools such as 3dsmax and video editing software, Unity3D is more flexible and efficient, and can also provide better support for LeapMotion devices[3].

2.   Analysis of digital display design

In addition to using graphic display boards, scene restoration and other forms, digital display design can display the main body of the exhibition with the help of science and technology on the premise of following the design principles and exhibition concepts. The theme content is emphasized to bring colorful multi-sensory experience to the audience, enhance the display effect of the content, so as to arouse the enthusiasm of the audience and increase the interest.

(1) Virtual reality technology

Virtual reality technology, also known as spirit technology. With computer technology as the core, a realistic virtual environment of sensory integration is presented for people in a specific range. A variety of sensor devices assist visitors to get involved in the immersive interactive environment built by computing information, which can make visitors immerse in this environment, and seems to be immersive[4]. It also allows the audience to carry out various activities in this virtual environment, like interacting and influencing objects in the real world. Virtual reality technology can make the audience feel the artistic atmosphere and the environment created by the artist more realistically, as if they were visiting and experiencing in the real environment.

(2) Hybrid reality technology

Hybrid reality technology is the combination of physical reality and virtual reality, so that the two different types of reality are mixed together. This hybrid reality technology enables physical objects and virtual objects to coexist and interact with each other, thus forming a new environment technology. Hybrid reality technology creates new space for entertainment and art industries, and also provides new topics for theoretical research. In a certain sense, it also belongs to the development direction and trend of augmented reality and interactive media[5-7].

3.   System software design

(1) System software architecture

The main function of the display system is to realize the natural interactive display of different models. Two main functions are fully reflected in the design: one is to control the view of the model from any angle, that is, to realize the view of the virtual model from different angles by controlling the rotation and movement of the camera in the virtual scene through the gesture; The second is the hand gesture control model switching, that is, the different models in the scene are loaded through the hand gesture control. In order to achieve the above functions, the key classes shown in Table 1 are specifically defined.

Table 1 Key classes and their functions

Key classes	function
Leap data Manager．cs	Leap comprehensive management class provides the interface to obtain Leap data through LeapMa-nager prefab, calls LeapExtension.cs to realize coordinate transformation and register custom gestures (open, front hand gestures)
Leap data Extension．cs	The Leap data conversion class transforms the real-world coordinates tracked by the Leap to the corresponding coordinates within the Unity virtual scene
Revolving Gamera．cs	Unity camera control class, monitor gesture events, realize the camera rotation and movement according to the hand and palm state, and control the model switch
Change Target．cs	Model switching class, realize the model switching, for Re-volvingGamera.cs call
Config Reader．cs	Config file reader, read the model configuration information for ChangeTarget.cs calls

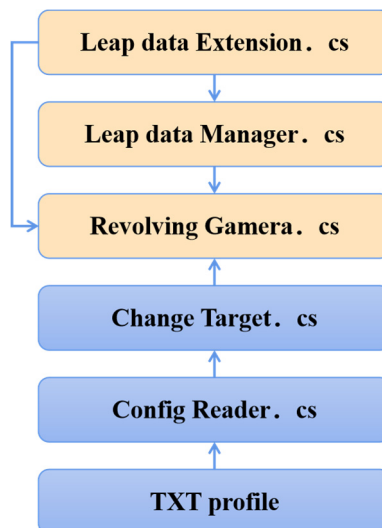The relationship diagram of the individual classes in the program is shown in Figure 1.

Figure 1：Program class diagram

The system has configured corresponding txt data files for each exhibition model, including the path of resources, initial position, rotation, scale and other information, for easy reading and loading at runtime. When running, RevolvingGamera first finds the "LeapdataManager" GameObject and "LeapdataManager. cs" script to realize Leap initialization and monitor the information of fingers and palms, Convert the acquired data into data in Unity through LeapdataExtension.cs, determine gesture events based on the acquired effective data information, and control camera rotation, pull in and out, or switch models.

(2) Coordinate transformation from Leap to Unity environment

The recognition area of LeapMotion is the inverted pyramid above the device. When using LeapMotion, a right-handed coordinate system with the center of the device as the coordinate origin will be created. In order to better realize natural interactive operation, coordinate transformation from real world to virtual environment must be carried out. In the real world, LeapMotion follows the right-handed coordinate system, while in the Unity3D scene, it is based on the left-handed coordinate system, so when converting the position data (x, y, z) obtained by LeapMotion to the data in the Unity-y3D scene, the z-axis must be reversed first. Leap detects the movement of the hand in mm, while Unity3D is in m, so it should also be multiplied by a certain scaling factor S (set according to the needs of the system scene configuration), so that every 1mm movement of the hand in the real world is detected, Sm will move in the scene. In reality, the y values detected by Leap are all positive. If negative coordinates are needed in the scene, it is necessary to add offset in the y direction.

(3) Implementation of gesture interactive control task

Another key technology implemented by the system is the gesture interactive control task, that is, the camera in the scene can be controlled by gesture through Leap. After the Leap device is running, it will regularly send the motion information data of hands, fingers or tools within the field of vision. Each detected information is called a frame, which contains the attributes of Hands, Fingers, Pointables and Tools. By calling the attribute list information in the frame, the overall movement observed in the field of vision of the device can be described or defined. When the device detects a hand or finger tool, it will be given a unique ID as a mark. As long as the entity does not leave the visible area of the device, the ID number will remain unchanged. Leap will give it a new ID for the entity that appears after the loss. In order to reflect the position information, characteristics and movement mode of the bound hand after binding, Leap provides the Hand object, which contains several important physical characteristics of the hand, as shown in Table 2.

Table 2 The Hand object properties

Attribute	Meaning
PlamPosition	Distance from the palm center to the origin of the device
PalmVelocity	The speed of the palm movement
PalmNormal	A vector perpendicular to the plane formed by the palm, coming out of the palm and pointing down
Direction	The vector pointing from the palm to the finger

4.   The application of digital display design

At present, the application of digital technology in exhibition design has reached a stage of in-depth development. In all kinds of exhibition activities, image technology and virtual technology have realized the ability to convey information to thousands of visitors. In contrast, the signs that spread information through text introduction and picture performance in traditional exhibition design are relatively outdated, and the ring screen movies, laser projection and interactive touch screen in modern exhibition have become the mainstream of exhibition. The continuous development of digital technology makes the application of exhibition design more and more frequent, which has brought far-reaching influence to the art of exhibition design and greatly expanded the design ideas and expressions in the exhibition field. Figure 2 is the functional structure diagram of the above-mentioned system.
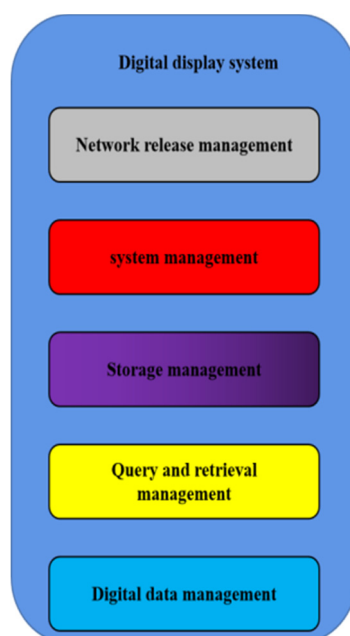

Figure 2: System function structure diagram

Compared with static display design and dynamic display design, interactive display design is deeply loved by the audience today because of its unique interactivity. In traditional exhibition design, exhibitors and creators are independent of each other, but the use of digital media art can maximize and stimulate the creative interest and enthusiasm of exhibitors, so that exhibitors can fully participate. Therefore, how to give full play to the role of digital media art in information transmission has become one of the important topics in current research. In essence, interactive display design is a new way of information transmission with people as the main body. It is precisely because the interactive display design in digital media art emphasizes the status of people and the physical and mental needs of exhibitors in the exhibition activities that the interactive display design can effectively realize the information transmission. In the early stage, by investigating the major building materials markets, we compared different materials

such as wood, traditional plastic, linen and special paper, and chose acrylic as the main material for the light box. This simple sentence shows that acrylic not only has some characteristics of artistic creation, but also has practical characteristics of being strong and practical. As shown in Table 3. Therefore, it is in line with the needs of creative content. Compared with the traditional display design, an experimental device is made to verify it. As shown in Table 4.

Table 3 Selection of materials

	characteristic(s)；character；performance；features；identity	Choose the reason
1	High transparency	Suitable for light box, good light transmission, which is convenient for the design of light and heat transmission
2	The natural ring stress is very strong, durable	It can still be used forever after the graduation demonstration
3	Strong plasticity, easy processing and molding	Suitable for art production, such as the author's design of carving patterns, decorative design, handicraft production and so on
4	Non-toxic, and it does not produce toxic gases when burning	Suitable for human, animals and plants and other life applications
5	Strong anti-impact force	Suitable for installation in particularly safe areas, such as for the suspension, shaking, etc
6	Excellent insulation performance	There is some security for the production and display
7	High recovery rate	environmental protection

Table 4 Comparison between traditional and modern

	Traditional display	Modern display
1	Display space limitations	Space is infinite, without restriction
2	Designers and visitors are independent of each other	Interactive display with visitors, start the whole display design by pushing the shake, participate, and experience the fun
3	Only the "view" of the display design	Visual, hearing, smell and other all-round experience

The existence of space is an important basis for anything and a visit to be displayed, and it is also a specific requirement. If there is no space, everything in the display design will cease to exist. That is to say, when carrying out exhibition design, we should pay attention to the rational application of space design, and make the arrangement of things in the space more unique through appropriate and reasonable transformation of the space. The application of digital media art in exhibition design has successfully created a good foundation for the breakthrough of space limitation, especially the application value of brand-new photography technology will be higher. The innovative application of this brand-new photography technology in exhibition design itself reflects its uniqueness, which can create infinite space in a limited space or virtual space in real space[8-10].

5.   Conclusion

In a word, digital media art is a new technical product produced in the process of the continuous development of modern society. It is an important result of the combination of modern digital technology and traditional technology and art. As a brand-new art form, digital media art can combine computer technology to produce more unique effects and bring refreshing feelings to the audience. Based on the actual situation, this paper analyzes the innovative application ideas and methods of digital media art in exhibition design, and understands the important connotation and specific application advantages of digital media art, hoping to better promote the improvement of exhibition design level and ensure the practical application results of digital media art.

References

[1]   Wang, X. , Qun, N. , Yan, L. , Liang, W. , Wang, R. , & Gu, W. . (2021). Design and application of public opinion analysis system based on python. Clausius Scientific Press, 51(39), 654.
[2]   Yga, B. , Jia, Z. , Jz, A. , Gw, B. , Hui, W. B. , & Xh, B. . (2021). Design and application of groundwater dynamic online monitoring system in aeolian desertification area, 2(15), 51-56.
[3]   Goes, M. M. , Merci, A. , Andrello, A. C. , Yamashita, F. , & Carvalho, G. D. . (2021). Design and application of multi-layer starch-latex blends as phosphorous delivery system. Journal of polymers and the environment,7(55), 41.

[4]   Chen, H. . (2021). Design and application of english grammar error correction system based on deep learning. Security and Communication Networks,22(155), 66.

[5]   Andrianof, H. . (2021). Design and built an expert system application fir diagnosing human eye diseases by using forward cahining metodh web-based,1(32),1511-1523.

[6]   Li, C. Z. , Chen, Z. , Zhao, Y. , Zhou, M. , & Zhang, L. . (2021). Design and application of prefabricated substation based on bim technology. Springer Books,1324(54), 42.

[7]   Chiu, P. H. . (2021). The design and application of a virtual field trip system. IASL Annual Conference Proceedings,84(354), 1996.

[8]   He, Y. , Wang, Z. , & Zhang, Y. . (2021). The design, test and application on the satellite separation system of space power supply based on graphene supercapacitors. Acta Astronautica, 186(3),3541-3561.

[9]   Casas-Orozco, D. , Laky, D. , Wang, V. , Abdi, M. , & Nagy, Z. K. . (2021). Application of pharmapy in the digital design of the manufacturing process of an active pharmaceutical ingredient. Computer Aided Chemical Engineering,451(2455), 74.

[10]   Brauner, M. , Naismith, N. , & Ghaffarianhoseini, A. . (2021). System approach in complex integral design methodology and its application in new zealand. Sustainability,13(65), 24.