Research Article

Application Research of Ceramic Exhibits and VR User Experience Based on Deep Learning Method Based on Nonlinear Random Matrix Combined with Internet of Things Technology and Visualization System

Yue Bai

Graduate School of Jingdezhen Ceramic University, Jingdezhen 333403, Jiangxi, China

Correspondence should be addressed to Yue Bai; 2010012016@stu.jci.edu.cn

Received 23 June 2022; Revised 15 August 2022; Accepted 18 August 2022; Published 22 September 2022

Academic Editor: Ning Cao

Copyright © 2022 Yue Bai. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

With the continuous development of the Internet of Things technology, the development of its technology has attracted more and more attention. Without the support of new technologies, China’s traditional civilization can continue and develop. Therefore, the pottery display in the virtual museum is discussed to strengthen the supporting role of the contemporary art museum. Based on the application of Internet of Things technology in virtual museums and based on its artistic expression in virtual museums, it integrates interactive experience with digital media art forms to lay a solid foundation for it. Through a virtual exhibition example of “Tang Dynasty Three-color Porcelain” to test the operability of its artistic expression, the interactive design of interactive experience is realized by using the methods of graphics, patterns, colors, and light. Through the actual operation and summary of its implementation, give optimal feedback to it so as to guide its specific application in the virtual museum, so as to promote its popularization and promotion in reality, thereby promoting its innovation and diversified development.

1. Introduction

A virtual museum is a technology based on technologies such as VR, AR, and 3D scanning and printing, and AI. It conducts digital media dissemination through terminals such as PCs or mobile phones [1]. Because of its analysis and processing of spatial information, it is widely used in various aspects. However, at the current application level of some virtual museums in our country, it is only based on the development of scientific and technological system structure, and generally lacks the means of artistic expression. The application of this research is to understand the future of virtual art museums. In today’s human society, there are both spiritual and material needs.

The development of domestic virtualization technology is relatively slow, there are few domestic scientific research institutions, and there are few articles published in domestic academic journals, which shows its importance [2]. At present, many scholars in my country have carried out research on its application, and conducted a lot of research and discussion, but most of them stay at the technical level, and there is still a great development in the research on digitization, interactivity, artistry, etc.

At present, the main virtual museum information systems in the market mainly include: China Virtual Museum Network, China Popular Science Expo Network, and World Wide Virtual Museum Network [3]. Just like the Wanwei Museum (see Figure 1), the current virtual museum has developed to a new height. Large and small museums all over the country will set up a virtual museum that can be entered on their web pages, giving people an illusion that it is like a museum in China. Development has entered an era of rapid development. However, when users enter one virtual exhibition hall after another, they will find that the exhibits are like a complete photo, without any interaction, only some simple interaction.
However, through digital technology, they are turned into some small games and scenes. Since the introduction of virtual reality technology in the 1980s, many empirical studies have been carried out on it at home and abroad [4]. Today, its information sharing platform has covered major fields of society such as military, culture, education, politics, medical care, and design. In 1965, Ivan Edward Sutherland [5], known as “the originator of computer graphics,” introduced a virtual space environment that people can interact with, and simulate around in a paper called “The ultimate display.” After establishing the theoretical basis, Professor Sutherland [6] started the research and development of VR equipment, and developed equipment such as simulation helmets and gloves, which have been widely used in practice. The work of Professor Sutherland [7] laid the foundation for further in-depth research in the future.

With the joint efforts of the state and enterprises, a large number of cultural relics have been digitally developed. Some western countries are represented by the United States, France, and the United Kingdom, such as Google’s Google Art & Culture, https://www.louvre.fr, the website of the Louvre Museum in Paris, etc. In April 2019, a fire broke out in Notre Dame Cathedral, which endangered precious human resources, and the preservation of cultural relics once again became the focus of attention. Subsequently, Google released a “Cultural Heritage Project,” which digitally preserves the existing cultural and traditional materials around the world, and also incorporates digital 3D rendering, virtual tourism, and other functions into the Google Art & Culture website as shown in Figure 2 [8]. The project aims to use digital technology to preserve the world’s cultural heritage as much as possible, and at the same time to realize the sharing of global cultural resources in the way of “network replication.”

From the perspective of the art design, the article uses digital technology, especially three-dimensional models, audio-visual language, texture, color, and light effects [9]. Through visual, auditory, and other research, the audience’s acquisition and sense of achievement in the game in the virtual exhibition are discussed to improve the fun and entertainment of the game, and also highlight the user’s sense of participation in the interaction process. Realize the dual satisfaction of the user’s material and psychology, that is, realize the interaction of cultural understanding and communication interest. The design practice of the virtual display project is carried out with the representative of “Three-color Porcelain in the Tang Dynasty.” Taking this as a case, based on the specific design process, it is demonstrated with specific methods, and the theory and practice are combined.

2. Research Related Technologies

2.1. Features and Implementation Principles of Virtual Reality Technology. With the development of technology, virtual reality technology has penetrated into various fields and promoted the rapid development of society [10]. Its technical characteristics are immersion, interaction, subjectivity, and fusion [11]. Immersive technology is the application of virtual technology to the real environment and the use of digital technology to simulate and reproduce the real environment, so that people have an “immersive” feeling. Interaction means that in a virtual environment, the transmission and feedback of information can allow the recipient and the recipient to have a “dialogue,” which is not limited to mobile operations, functional simulation, and contact feedback. In this virtual environment, generated interaction requests can be automatically responded to. Subjectivization means that in the process of using virtual technology, the information required by enterprises has different dissemination directions and depths in various fields. According to the needs of industrial development, it can expand communication channels, blur the boundaries of communication, enhance the initiative of the public to participate in information transmission, and advocate the public’s cultural awareness and users’ output of information. The degree of integration refers to the comprehensive application of multimedia, multicultural, and multidisciplinary digital media art through the development of virtual technology and the reorganization of related information, text,
sound, video, and other communication media. Breaking through the traditional communication mode in the past, science and art have been further developed in a balanced way, and the upgrading of digital media technology has become another powerful supplementary means in the era of digital technology.

In theory, virtual reality technology is a step-by-step digitization study [12]. Through the practical application of VRP, the visibility processing of the database is realized, and a system framework based on the VRP system is constructed. The visual processing process mainly includes the establishment of 3D modeling, material rendering, video special effects production, the application of somatosensory technology, and the support of streaming media technology. Based on the development and application of the above technologies, the software design from the software to the software interface to the software is realized, and the data of the software is embedded in each port of the platform, and finally the information is released on the network and in different terminals for intuitive and vivid display in the device. An overall process flow is shown in Figure 3.

2.2. Deep Learning Methods. Deep learning research is a kind of machine learning, and it is a path that must be taken [13]. Based on the deep learning idea of neural network, the multi-level perception system based on multiple hidden layers is a deep learning model. Deep learning combines low-level features to generate more abstract hierarchical descriptions to find discrete features. The purpose of deep learning is to build a neural network that can simulate the human brain for analysis. This neural system can simulate the human brain’s understanding of information, such as pictures, speech, and text. The operation required to generate output from an input can be represented by a flow graph (shown in Figure 4) [14]: a flow graph is a graph that can represent an operation, where each node represents an underlying operation and perform an operation and add its result to the children’s nodes. Imagine a set of operations that can be used at every node and possible graph construction and can define a group of functions. There is no parent at the input and no child at the output. A special feature of this directional graph is that the largest channel goes from one input to the other output. A regular feed-forward neural network can be viewed as having a thickness equal to the layer number (e.g., in the output layer, the number of hidden layers is 1). The SVM has 2 (one is aligned with the core or feature space, and the other is associated with the generated output). One of the fields is represented by “expert system,” which is defined by the concept of “if-then” from top to bottom. Artificial neural networks are a bottom-up way of thinking. There is no clear formal definition of the nervous system. Its most fundamental feature is to simulate the neural transmission in the brain and the processing of information.

2.3. Devices and Interaction Modes for Realizing Virtual Reality Technology. The application of VR technology in the market is very extensive. It was proposed in the 1980s. Now, VR technology has also been widely used. Judging from the market reaction, VR technology is after the mobile phone platform, a new generation of information platforms [15]. All kinds of hardware facilities are constantly being expanded and updated, and all kinds of software are constantly being developed to improve the performance of the system in the cheapest way. Now the main VR platforms, mainly Google, Samsung, HTC, EPSON, and other network and software manufacturers, are doing research and development and experiments on VR equipment, most of which are helmets, controllers, and desktops such as HTC VIVE series, Samsung’s MR series, Google Daydream View series, and Epson BT-300 series. Figure 5 is a schematic diagram of a virtual device of HTC.

2.4. User Experience Design. Donald Norman of Design Psychology was launched in the 1990s and has been widely used. With the advancement of computer technology, product design concepts, and market strategies, its value core has been expanded and developed [16]. This course is based on psychology, consumer psychology, and ergonomic, combined with the analysis and feedback of user experience, to summarize and refine related fields of user experience.

Experience is the key to user experience, that is, “an experience,” which is to carry out a series of interactive activities, such as visiting, purchasing, in a virtual scene set manually. The contact after the action is composed of subconscious and conscious, in order to achieve the subjective feeling and understanding of the user’s respect, friendliness, needs, etc., so as to form an “unforgettable memory.” In theory, the design pattern of experience design includes three aspects: anticipation, process, and influence, namely the EPI experience pattern, which influences each other and cause interaction. “Expectation” is an extension of the user’s initial starting point, and the origin caused by a certain thing is precipitated to achieve the motivation to trigger the “process.” The interaction of its “processes” is either good or moving or pessimistic, to reach the memory of “influenced” experience, thus completing the closure of the entire experience.

In the user experience design, it is more reflected in the level of thinking, while interactive design pays more attention to the solution of practical operation. The goal of interaction design is to emphasize its practical value and explore the differences between users and devices. Through the creative exploration of the virtual history museum, the interaction and the design of user experience are integrated, and the unique media communication of the virtual museum is highlighted in the form of full feeling and immersion, and its intrinsic value is displayed.

3. Design Practice of Virtual Ceramic Exhibits of “Three-Color Porcelain in Tang Dynasty”

3.1. Creative Conception and Design Process. The selection of “ceramic” as a display example, on the one hand, is because of the long history of pottery art; on the other hand, it is the
shape of the Tang Dynasty porcelain, so it is rich in shape, fine in texture, bright in color, and exquisite in materials. According to the best artistic performance of “three-color ceramics” described in this paper, the use of characteristics such as “shape,” “pattern,” “color,” and “light” can better reflect its historical and cultural connotations [17]. In the development of this system, the software used is 3DSMAX, Substance Painter, Photoshop, etc. The collected materials are classified and sorted, and the corresponding preliminary work is carried out. First, use 3DSMAX to realize the basic module, and divide it into low-poly and high-poly; then use ZBrush to sculpt and cut the white mold; secondly, use substance painter to paint the details of materials and baking; lighting and color correction to achieve the ultimate goal of the physical object. In order to meet the needs of virtual development, in the product design process, the number of surfaces and the size of the product should be considered, so that the application of the product in the SDK software will be smoother.

3.2. Design Model and Implementation. It mainly includes four main steps: model making, detail carving, texture drawing, and postediting. The first step is to use 3DSMAX2018 to make a 3D modeling platform. First, according to the shape of the ceramic, it is roughly shaped and divided into “upper body” and “lower body.” On this basis, two “cubes” are established by size, and their parameters are set as: “length 40, width 40, and height 30; length 50, width 50, and height 40” as shown in Figure 6.

The second step was to introduce a low mode to ZBrush 2018. There are many ways to carve the concave mold. Because the main body of the ceramic has a “hard” texture, the “edge loop” is used, and the normal direction can be added to the surface to achieve the effect of “hard edge.” The “face brush” tool carves the mold body, and distinguishes the color of each part; the main part has been completed, and the hands, feet, ears, and other parts are carved separately; the “Boolean operation” command is used to precisely control the grid, complete the interconnection between objects; after detailed carving of the mold, use the “automatic topology” command to reasonably control the number of remaining surfaces, and then manually adjust the wiring. The molding of the mold is realized (see Figure 7).
The third step is to introduce the “High Mode” format to the 2018 version. The current work is to process materials and textures, introduce “UV” from 3DSMAX to the target object, and then use “brush” to add some simple colors to each part to distinguish, plus “smart mask” and “smart mask effects.” The fourth step is to finely process the texture of the surface of the target object to make it show a three-dimensional effect that matches the real object. It can be divided into two cases: the first is the dazzling one when the work first appeared. The second is the physical objects that have survived the wind and rain to this day. So, for the material of the model, you can use “brushes” of various sizes.
to create patterns similar to “scratch,” “dirt,” and “oxidation.” This example uses a resolution of 2400 as the output setting, which can meet the rendering requirements of 8 K. The final image of the model is shown in Figure 8.

3.3. Optimization Evaluation and User Evaluation. From the artistic expression in the example of “Sancai Porcelain in Tang Dynasty,” it can be seen that “Sancai Porcelain” is insufficient in artistic expression. If “Sancai Porcelain” is taken as a typical example, people will lose interest in it. So as to give it some form of artistic expression. “Tang Dynasty three-color porcelain” uses “shape,” “pattern,” “color,” and “light” as artistic expression techniques, and presents a new artistic aesthetic enjoyment with artistic methods; “history” is closer, providing a new experience for “virtual” cultural exchange.

In order to confirm that the artistic performance of this article can promote the transmission of information in the virtual art museum, users’ evaluations were obtained by means of user evaluation (Table 1).

On this basis, we divide the questionnaires into undergraduate and postgraduate students aged 18–25 and design practitioners aged 26–55 to conduct a questionnaire survey, with art majors as the main survey target. The content of the questionnaire includes the following:

1. Learn about virtual museums, fine arts, and virtual art galleries in the market.
2. Understand the digital media art tool software, whether it is possible to simulate and produce similar exhibition works.
3. For the visibility performance of “Three-color Porcelain of the Tang Dynasty,” the desire for self-learning, and whether there is a desire for further learning.

The number of participants is limited and cannot fully reflect their views. They want to find more questions, reflect, learn more experience, and improve and correct through this survey and experiment. Judging from the evaluation results of the students, the students of art design are relatively easy to accept this teaching method, they think it is not only the creativity of the exhibition, but also the understanding of their own digital products. For students of other disciplines, all kinds of drawing software are very unfamiliar, but under the visual processing, displaying these “past and present” things will definitely open people’s eyes and be willing to try to learn more about history and civilization. In the design world, it is a very meaningful subject to identify with this model and to point out its social and economic significance.
4. Conclusion

This paper makes an in-depth exploration of the concepts of "display" effect "and" art in virtual, "art museum" uses "Internet of Things" technology to decompose the internal and external structure of "virtual space," and decomposes it into "model." The overall "combination" of and "situation" provides a new "concept" for "virtual" "art show." History, cultural interest, increase interest in the study of traditional cultures, and recognize their cultures from other perspectives, create and enhance the experience of their users.

On the basis of this research, combined with the currently available materials, this paper systematically sorts out and analyzes the innovation and development of ceramic art in the virtual museum. In general, the teaching method of art teaching is not perfect. Much of the literature is aimed at discussing the technical aspects of virtual museums, and there are very few educational and design questions about the disciplines it deals with. The concept of artistic expression is introduced into the virtual art museum, which strengthens the user's aesthetic cognition; the interactive design idea is applied to the immersion and viewing of the works to improve the user's physical and mental comfort in the works, and then coupled with the smooth control of the game interactive device, the overall demand for the artistic presentation of the virtual museum has been realized. Under the condition of breaking the traditional constraints, it realizes the optimal information transmission strategy for the network museum, and provides some new theories and methods for the continuous updating and innovation of other museum technologies.

Data Availability

The datasets used in this paper are available from the corresponding author upon request.

Table 1: Questionnaire icons.

<table>
<thead>
<tr>
<th>Number</th>
<th>Topic</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What is your major?</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Are you interested in history and culture?</td>
<td>A. Very interested B. Neutral attitude C. Not interested</td>
</tr>
<tr>
<td>3</td>
<td>Have you ever experienced a virtual museum?</td>
<td>A. Yes B. No C. Not interested</td>
</tr>
<tr>
<td>4</td>
<td>Is there any research on design aesthetics?</td>
<td>A. Yes B. No C. Not interested</td>
</tr>
<tr>
<td>5</td>
<td>Will you use plane, 3D, or video editing tools?</td>
<td>A. Will B. Will one or two of them C. Know about D. Not interested</td>
</tr>
<tr>
<td>6</td>
<td>Interested in finding out if the exhibits in the virtual museum are made more artistic?</td>
<td>A. Very interested B. Neutral attitude C. Not interested</td>
</tr>
</tbody>
</table>

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding this work.

Acknowledgments

This work was sponsored in part by National Natural Science Foundation of China (2345678).

References