A Re-presentation of the Chinese Traditional Art by the VR Technology in the Digital Age: Taking Mogao Grottoes in Dunhuang as an Example

Ming Zhao¹, Lingling Jin²
¹School of Design and Art, Shenyang Jianzhu University, 110000, China
²School of Design and Art, Shenyang Jianzhu University, 110000, China
*Corresponding author’s email: 1445322771@qq.com

Abstract. As President Xi Jinping pointed out, “Throughout the history of world civilization, mankind has experienced the agricultural revolution, the industrial revolution and the information revolution.” With the rapid development of the information technology, we are living in a new era of digitization with the digital technology in rapid development, our way of life is being reconstructed by the Internet, and we are being more attracted by the spread of network information culture. In recent years, virtual reality technology has been deeply infiltrated into our lives, and this technology integrates the development results of the computer graphics technology, the computer simulation technology, the artificial intelligence, the sensing technology, the display technology, the network parallel processing and other technologies. The world is in accelerating digitization, so is the art world, with the emergence of the digital technologies highly associated with computers. Nowadays, the virtual reality technology has been applied in many literary and artistic fields, such as the VR immersion experience in games, the VR live game scenes, the VR films and the VR museums, and the emergence of the VR technology has given artists new artistic thinking and creative inspiration. For Chinese traditional art is an important part of the history of Chinese art development, we should vigorously protect and carry forward the traditional art, so as to avoid the disappearance of the traditional art. For this reason, we must conform to the trend of the times, change the old ideas, take advantage of the digital technology and the virtual reality VR, and keep pace with the times. The digital technology shouldn’t be excluded from representing the traditional art as a new development medium and method. Taking the Chinese traditional frescoes of Mogao Grottoes in Dunhuang as an example, this paper tries to discuss how the VR technology is used to digitally re-present the Chinese traditional art for communication.

1. Introduction
This paper discusses how to use VR technology to protect and present traditional art from the perspective of protecting traditional art. The following article introduces VR painting software, VR painting works, and the use of VR technology to present murals in Dunhuang Mogao Grottoes again.

2. The Development of the VR Technology under the Background of Digitization
2.1 The Concept of the VR Technology
The virtual reality technology, abbreviated to VR, is a comprehensive integration technology which involves many fields, including the computer graphics, the human-computer interaction technology,
the sensing technology and the artificial intelligence, etc. It uses computers to construct a virtual scene, analyzes the complex data through computers, and returns the 3D world images to interact. The virtual reality technology is a high-tech simulation system assisted by the computer technology.

2.2 Data Analysis of the VR Technology Market
The VR technology is a computer system that can create and experience the virtual world. It was first applied in the research of military bionics in the last century. The VR technology appeared very early, but it was not until 2016 that people began to promote the research of the VR technology to various industries. By analyzing the VR market in recent years, it was found that the scale of the VR market in 2016 reached 3.46 billion yuan, and it experienced a gradual increase from 2017 to 2018. By 2018, the market scale has reached 10.83 billion yuan, with an increase of 106.68 % year on year. By 2020, it has reached 46 billion yuan. The advent of 5G era has accelerated the network speed of the VR products, which has promoted the development of the VR industry.

![Figure1. Market size and growth of China's VR industry during 2016-2021](image)

2.3 The Integration of VR Technology and Art
Google developed a painting software “Tilt Brush” in 2015. This software uses the VR technology to enable the painters to paint with VR glasses on. The painters only need to pick tools and colors with the painting handle, and then move the handle to create in the visual space. Compared with traditional painting forms, the painting works created by the VR technology have stronger visual impact and shock power. The roll out of the new painting methods will also bring the emergence of excellent authors, such as the French illustrator, Anna Zhilyaeva, who ever performed how to paint with the VR technology in the Louvre. In details, she used the VR painting tools to tune colors at will and the color plate to pick colors and complete the layer, and they can also be very sensitive and convenient. Her VR painting works, reflecting the sense of space and volume, shocked the audience on the spot. The VR painting, which represents the progress and upgrading of the painting tools, is easier to achieve the desired visual effects.

![Figure2. Tilt Brush](image) ![Figure3. The Painting Spot of Anna Zhilyaeva](image)
3. Analysis of the Status Quo of the Chinese Traditional Art in the Digitized Era

In the course of Chinese five-thousand-year history, traditional art has experienced years of precipitation and has bred countless excellent works of art. [1] The artistic expression methods and painting styles in each period have the symbolic significance of the times, reflecting the continuous evolution and development of society with profound cultural heritage, and occupying an important position in the history of Chinese art. However, with the advent of the informatization and the digitization age, the works of art that once represented an era cannot adapt to the new era but to disappear into nothingness. In accordance with the development of the current era, traditional painters must find a new way while protecting their own culture, carry out new thinking, and promote the traditional painting by using the digital technology. Modern painters should integrate the spirit of the times into the creation process, pay attention to the artistic connotation, and create immortal works.

4. Cases of the Re-presentation of the Chinese Traditional Art by the VR Technology

4.1 The Application of the VR Technology in Re-presenting the Traditional Art

4.1.1 The Protection of Mogao Grottoes in Dunhuang by the Computer Technology

The third step is to process the images. The original image is preprocessed, and then the image is processed to form the fused images with the single fresco as a unit. [2] The obtained cloud data of the three-dimensional point in the cave are used to generate the intensity image, and the high-precision image is obtained by correction. The fourth step is to save data. The original images, the files of the image-processing procedure and the final files are stored in the specified location of the server according to the requirements of archiving storage, and the data are verified to ensure the integrity of the data archiving. In addition, the field construction technology, the three-dimensional reconstruction technology based on the structured three-dimensional sculptures with lights, the three-dimensional printing technology, the VR virtual roaming technology and other digital technologies play a key role in the construction of digitized Dunhuang. While sharply enhancing the audiences' sensory experience, they all reflect the value of data for digital civilization.

On December 29, 2020, Dunhuang Academy held the “Global Data Storage Forum for Professors”. Su Bomin, the vice-president of Dunhuang Academy, mentioned in the report of “The Scientific and Technological Protection of Dunhuang Grottoes and the Application of Its Achievements” that in the project of the digital Dunhuang, the computer technology and the digital image technology were used to realize the permanent preservation and sustainable utilization of the cultural relics in Dunhuang grottoes, broke the limits of time and space, and met people's needs of sightseeing, appreciation and research. In the future, the Dunhuang Digital Museum will be built to show Dunhuang art in a variety of presentations, which all require good support from the underlying data.

4.1.2 The Re-presentation of Dunhuang Mogao Grottoes by the VR Technology

On December 16, 2019, the Dunhuang Secret Lands---Song Dynasty VR Interactive Exhibition inaugurated in Yu Garden of Shanghai, lasted for three months. [3] The exhibition was about the Dunhuang Mogao Grottoes, fictionalized by the VR technology, and the giant fresco, produced by using the influence fusion technology. The creative team of the exhibition selected six representative art grottoes in Dunhuang Mogao Grottoes, including the works of the early Tang Dynasty. There were vivid sky-flying figures, scenes of singing and dancing, and musical instruments in the works, all reflecting the society at that time. The works of the late Tang Dynasty, the prosperous Tang Dynasty, and the Western Wei Dynasty reflected Buddhism and Taoism, the works in the middle of the tenth century were the large picture linked up by landscape paintings, and there were the art grottoes of the Sui Dynasty. [4] The frescoes were marked with yellow dots, and the viewers were equipped with VR glasses. While the eyes of the viewer were captured by the glasses sensor, the viewers could obtain the visual and auditory experience of the flying characters, the Buddha statues, the birds and animals flying slowly, the landscape flowing, and the musical instruments fluctuating, so that the viewers could
feel their presence in the frescoes of the Mogao Grottoes.

Figure4. The VR Exhibition of Dunhuang Mogao Grottoes

5. Conclusion
VR and AR can be developed if closely linked with the computer technology, and the virtual reality technology can be more breath-taking if the computer technology constantly develops to be more powerful in the future. [5]In this era of advanced science and technology, it is more advocated to use science and technology to preserve and develop culture, and the integration of culture and science and technology is the general trend of protecting traditional culture and art.

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