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Research on the Technology of Virtual Reality Empowering Manchu Dance Cultural Communication

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Abstract: *Manchu dance showcases the hardworking and brave national character of the Manchu people, their proficiency in horseback riding and archery, as well as their love for singing and proficiency in dance. Applying virtual reality to Manchu dance culture can perfectly restore Manchu painting dance postures, construct virtual performance scenes, and allow users to appreciate in the virtual environment with the help of unique output and input devices. The virtual environment provides feedback to users, making them feel and experience as if they are in a real environment. This article first studies the characteristics of virtual reality technology, including multi perception, immersion, interactivity, timeliness, and conceptualization; Key virtual reality empowers the dissemination technology of Manchu dance culture, including 3D modeling technology, 3D display technology, and human-computer interaction technology. By applying virtual reality technology, Manchu dance culture can gain broader development space.*

Keywords: *Virtual Reality; Manchu Dance; Cultural Communication; Three-dimensional Modeling Technology; Stereoscopic Display Technology; Human-computer Interaction Technology*

1. Introduction

Virtual reality technology is a computer system that can create and experience a virtual world, reflecting the latest achievements in multiple fields such as computer graphics, multimedia technology, display technology, ergonomics, human-computer interaction theory, and artificial intelligence. It achieves vision, hearing, touch, smell, and taste through multiple sensory channels[1]. As an ancient nomadic ethnic group in the northern region of China, the Manchu people have their own brilliant and splendid art and civilization[2]. In the long river of history, the Manchu ancestors have created a variety of excellent ethnic cultures with rich connotations. Among them, Manchu dance showcases the hardworking and brave national character of the Manchu people, their proficiency in horseback riding and archery, as well as their love for singing and proficiency in dance[3]. In the face of fierce impact on national culture today, it is not only necessary to attach importance to Manchu dance culture, but also to inherit its ancient forms of expression, charming artistic charm, and rich cultural connotations. Only in this way can the vitality of Manchu dance be preserved forever, which is also a respect for traditional Chinese culture.

2. Characteristics of Virtual Reality Technology

Virtual reality is the use of computer simulation to create a three-dimensional virtual world, providing users with simulations of visual, auditory, and tactile senses, allowing them to experience the environment in a timely and unrestricted manner. It has the characteristics of multi perception, immersion, interactivity, and conceptualization, also known as spiritual realm or illusion. It is a high-tech field in the field of graphics and images that has emerged in recent years, Also known as spiritual realm technology or artificial environment, virtual reality technology has characteristics such as multi perception, immersion, interactivity, timeliness, and conceptualization [4,5].

2.1 Multi Perception

Multi perception refers to the various perceptual experiences that virtual reality technology may

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bring to people. In addition to the stunning visual impact, it also includes auditory, tactile, force, and motion perception. Smell and taste are also being attempted in perception, and the current virtual environment has maturely utilized relevant devices to create diverse perceptual scenes for the audience, So theoretically, it can provide people with all the perceptions that can be provided in real life.

2.2 Immersion

Immersion is the most prominent feature of augmented reality and virtual reality. Users can truly feel the things around them through their senses in virtual space, and their feelings in the virtual environment are consistent with those in the real environment. At the same time, augmented reality and virtual reality have different levels of immersion. The virtual perception space created by virtual reality can stimulate users' sensory thinking in more realistic scenarios. Compared to augmented reality, it can generate a stronger sense of immersion for users.

2.3 Interactivity

Interactivity refers to the ability of users to perform certain operations on objects in a virtual environment and receive feedback from the environment. For example, in virtual reality, when a power switch is pressed, the light will turn on, and when the hand touches the power switch, the presence of the switch can also be felt. Users can interact with objects in the virtual world through auxiliary technologies or tools, enhancing their multidimensional experience and bringing them an immersive experience.

2.4 Timely Extension

Timely delay refers to the low latency of scene changes and interactions in virtual reality, which is basically consistent with the real world. For example, in virtual reality, after adjusting the gaze of the human eye, the content seen must be updated quickly, and slow response is not allowed, otherwise it will lose its realism. Similarly, in interaction, when users make requests to the environment, they must quickly receive a response. Therefore, virtual reality requires high computer processing power and high network latency.

2.5 Imagination

Imagination refers to the ability of virtual reality technology to satisfy people's infinite fantasies. In addition to familiar daily life scenes, it can also be future scenes, even limited to scenarios where fantasy cannot be achieved. In a virtual reality environment, people can not only enjoy the natural scenery of various countries around the world, but also travel back and forth to experience the traces of history. They can also prevent future disasters, let people feel the cruelty brought in advance, and learn how to deal with emergency situations.

3. 3D Modeling Technology

Virtual reproduction of real scenes with fully realistic 3D effects, providing users with the experience of enjoying Manchu dance culture without leaving their homes. The immersive Manchu dance culture viewing project relies on 3D realistic modeling technology and spatial geographic information technology, integrating key technologies such as artificial intelligence, high-performance computing, and virtual reality, including data collection, data processing, data processing services, and application system development customization [6,7]. As a high-tech technology, 3D laser scanning and drone oblique photography have provided revolutionary influence on the dissemination of Manchu dance culture. Provide the most comprehensive data for the promotion of Manchu dance culture through 3D modeling.

3.1 Main Technical Parameters

The technical indicators for evaluating 3D virtual environment modeling mainly include: first, display speed. Many applications have significant limitations on display time. In interactive applications, it is desirable to have a shorter response time as it can affect the system's availability. Secondly, accuracy. Accuracy is an indicator of the accuracy of a model in representing real objects,

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and it is also an important factor in representing the authenticity of a scene. Thirdly, ease of use. Creating effective models is a complex task, and modelers must present the geometric and behavioral models of objects as accurately as possible. Modeling techniques should make it as easy as possible to construct and develop a good model. The fourth is the efficiency of manipulation. In practical applications, model display, motion model behavior, and conflict detection in virtual environments with multiple moving objects are all frequent operations that must be efficiently implemented. Sixth, universality. The universality of modeling techniques refers to the scope of representation. Good modeling techniques can provide a wider range of geometric, physical, and behavioral modeling.

3.2 3D Modeling Process

3D models can qualitatively reflect the shape, color, and texture of objects; It can also quantitatively describe the geometric information such as position reference, length and area, as well as volume of the modeled object, thus attracting widespread attention. The 3D modeling process is shown in Figure 1.

Optimization is an important part of the 3D modeling process, and the optimization results directly constrain the display speed and operational efficiency of the system. Virtual reality empowers the dissemination of Manchu dance culture, improving traditional optimization techniques that run through the entire modeling process. The specific steps of 3D modeling optimization process are as follows: Firstly, structural optimization. Process the initialization of virtual scenes according to the principles of scene segmentation or model segmentation, and establish a hierarchical structure. Process the processed structure according to the principle of adjusting hierarchical modeling and make structural adjustments. The second is texture optimization. Process the preprocessed textures according to the actual modeling requirements, including processing them into simple component textures, optimizing texture formats, and stitching textures. Thirdly, model optimization. The created model will be processed using visible masking techniques, texture mapping techniques, instantiation techniques, and LOD techniques to simplify the number of polygons and optimize the model. Fourthly, scene optimization. Optimize the entire scene using texture mapping techniques, instantiation techniques, LOD techniques, and external referencing techniques for all established model systems.

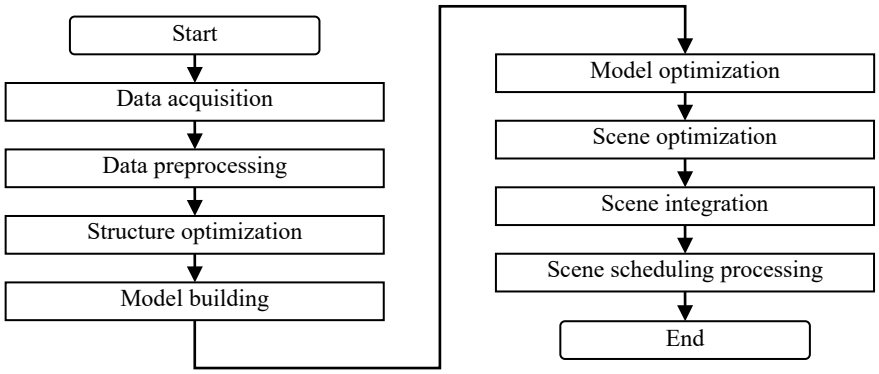

Figure 1: Three-dimensional modeling process

3.3 Instantiation Techniques

When there are multiple objects with the same geometric shape and attributes but different positions in a three-dimensional complex model, instantiation techniques can be used. Instantiation is very effective in rendering a large number of duplicate objects, requiring only one rendering command, saving a lot of communication between CPU and GPU. Instantiated arrays are defined as vertex properties that allow for storing more data, drawing more instance objects, and updating each plane rather than each vertex. The main processing method of instantiation technology is matrix transformation, which sacrifices time and replaces memory space.

The main purpose of instantiation technology is to save memory and accelerate display speed. However, due to the geometric position of the object being obtained through geometric transformation, as the number of instance objects increases, the computational complexity of the system will

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significantly increase, leading to a decrease in the system's running speed and affecting real-time performance. Therefore, when using instantiation techniques, it is necessary to comprehensively consider the number of instance objects and the number of geometric transformations, striving to not affect the real-time performance of the system.

4. Stereo Display Technology

Stereoscopic display technology covers many disciplines such as image processing, computer technology, computer graphics, optics, display materials, machinery, and art. Due to technological limitations, the development of stereoscopic displays has been slow. With the improvement of modern science and technology, it has become possible to obtain and display three-dimensional information. Various 3D information acquisition technologies have been able to accurately and detailedly obtain the 3D information of the scene, and 3D display technology is becoming increasingly mature. Various 3D display methods have emerged, including wearing glasses, naked eyes, and holography. Although different display methods use different technical methods, they can all reproduce the 3D scene, showing a sense of hierarchy, realism, and depth of the scene, enabling viewers to more accurately recognize the shape of objects, Having an immersive feeling[8]. A brief explanation of commonly used stereoscopic display technologies is as follows:

(1) HMD head mounted display technology. HMD head mounted display technology is achieved by reflecting images through prisms into the human eyes and imaging them in the retina, creating the effect of viewing a large screen at an ultra short distance with sufficient resolution. Because head mounted displays typically have two monitors, each driven by a computer to provide different images to both eyes. This creates binocular parallax, which is then fused through the human brain to obtain depth perception, resulting in a three-dimensional image.

(2) Holographic projection technology. 3D holographic projection technology can be divided into two types: projection holographic projection and reflection holographic projection, which are the reverse display of holographic photography technology. Unlike traditional stereoscopic display technologies that utilize the principle of binocular parallax, 3D holographic projection technology can truly present 3D images by projecting light onto air or special media. People can view different sides of an image from any angle up to 360 degrees, achieving the same visual effect as viewing objects in the real world.

(3) Light field imaging technology. The mysterious Magic Leap uses so-called "light field imaging" technology, which in a sense is "quasi holographic projection" technology. The principle is to use spiral shaped vibrating optical fibers to form images and directly eject light from the fibers onto the human retina. Simply put, it is to project the entire digital light field directly onto the retina using optical fibers, creating what is known as cinematic reality.

5. Human Computer Interaction Technology

Virtual reality interaction technology allows users to wear a certain device and enter a pre-set virtual environment, engaging in various forms of interaction and communication with the virtual environment [9]. In the design process of virtual reality interaction technology, it is necessary to further study the audience's behavior feedback, and use the corresponding behavior feedback as the starting point and standard for building a virtual world, so as to further optimize the human-computer interaction experience. In the design process, it is necessary to comprehensively consider the virtual environment, audience objects, audience behavior, and audience experience.

5.1 Analysis of Human-Computer Interaction Technology

In the field of virtual reality, human-computer interaction technologies applied to the dissemination of Manchu dance culture mainly include motion capture interaction technology, somatosensory interaction technology, and penetration phenomenon processing.

(1) Motion capture interaction technology. By capturing and recording the actions of real things, these actions are integrated into virtual characters through computers, connecting the actions of virtual characters and real things together, forming a more realistic and smooth visual experience. From a technical perspective, the essence of motion capture is to measure, track, and record the motion trajectory of an object in three-dimensional space.

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(2) Sensory interaction technology. Sensory interaction technology is a revolution in the history of human-computer interaction, utilizing natural language to manipulate multimedia devices and provide innovative experiences for humans. If the virtual environment is viewed as a computer system, the human body can be transformed into a mouse through sensory interaction. By perceiving various sensory changes in the human body, the virtual environment can be controlled.

(3) Penetration phenomenon handling. Non-contact interactive systems do not have force feedback devices, nor do they correspond to actual objects and objects in the virtual world. If a virtual human collides with a virtual object, the physical constraints brought about by the collision cannot be felt. Further actions can easily lead to penetration between humans and virtual objects in the virtual world, resulting in penetration phenomena.

5.2 Content of Human-Computer Interaction Technology

With the continuous development of intelligent technology, people feel the problem of unnatural interaction methods when interacting with virtual environments, and natural language methods such as human gestures, postures, speech, and actions can precisely solve this problem.

(1) Gesture interaction. As one of the main ways of transmitting information in daily life, gesture recognition has always been a research hotspot in the field of human-computer interaction, providing a more convenient communication bridge between machines and humans. In human-computer interaction, gesture recognition usually refers to the use of algorithms to recognize human gestures. Users can control or interact with devices by using simple gestures, allowing computers to understand human behavior.

(2) Pose interaction. In people's daily communication, every body movement contains enormous interactive information. When a person makes a gesture of crossing their hands and leaning against the seat, the body movement reflects a reluctance to engage in communication from the side. In the process of interpersonal communication, body language often contains more information than verbal language. Therefore, exchanging information with objects in virtual space through human posture makes human-computer interaction more precise, making it easier for virtual objects to correctly understand the interaction intention.

(3) Voice interaction. Voice is the most efficient and direct form of daily communication between people, which is more in line with human communication habits compared to traditional interaction methods such as mice and keyboards. Speech recognition technology can convert user's speech input information into text information, which can be used for intelligent question answering. The current automatic speech recognition technology has gradually matured, involving multiple disciplines such as acoustics, analog recognition, artificial intelligence, and deep learning. With the popularization of 5G technology, the range of voice interaction applications is becoming increasingly wide.

6. Conclusions

According to the degree of immersion and interaction in virtual reality technology, it can be divided into four typical types: immersive virtual reality systems, desktop virtual reality systems, augmented virtual reality systems, and distributed virtual reality systems. Ethnic dance is a native art of ethnic regions, reflecting the unique historical relics and cultural accumulation of the ethnic group. In the long river of Chinese history, various ethnic groups have formed unique ethnic dance cultures. Applying virtual reality to the dissemination of Manchu dance culture can perfectly restore the dance posture of Manchu painting, construct virtual performance scenes, and allow users to appreciate in the virtual environment with the help of unique output and input devices. The virtual environment provides feedback to users, making them feel and experience as if they are in a real environment.

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