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Research on 3D Animation Technology of Human and Scene Based on Virtual Reality

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Abstract: The integration of virtual scene and reality is a research focus and direction in many industries at present. In order to improve the immersive experience of traditional animation design, this paper proposes an interactive animation design scheme for the integration of human and natural environment based on virtual reality technology. Firstly, the construction of virtual scene of 3D animation is analyzed. Then, the integration technology of human and nature in virtual scene is studied, focusing on human body surface data collection, bone data extraction and virtual and real scene integration; finally, based on Unity3D software, the 3D animation design practice of integration and interaction between man and nature is carried out. Taking the interaction between human arm and fireball as an example, it demonstrated the integration and interactive control of fireball by man in virtual scene. The research results of this paper have certain reference value for human-computer interactive 3D animation design.

1. Introduction

The development of computer simulation technology has greatly enriched people's entertainment and cultural life. Nowadays, the mainstream technical schemes on combination of intelligent computing, computer simulation and visual recognition have gradually formed a technical development direction of integrating virtual and reality [1]. This technology can make people get immersive experience, and reach a new level of perception of environment and understanding of nature. With the further development of artificial intelligence technology, the interaction research in the future will be oriented towards more intelligent, closer to nature and more convenient information interaction, and create a more reasonable and real virtual world [2]. The development of virtual reality technology began in 1970s. American researchers found that integrating pilot helmet and operation directly in the head will greatly improve pilot's flight skills [3-5]. Since then, relevant researchers have started the development of virtual reality helmet technology. The first generation of virtual reality sensor was developed by Microsoft, which broke the door of human-machine interaction and has broad prospects for scientific research and application.

This paper is based on human motion recognition and virtual assistance, and combines human motions with natural scenes, which realized the interactive integration technology of virtuality and reality. By constructing the system architecture, 3D animation design is carried out, and human can interact highly with the body in animation in the design process, which provides a new innovative

way for users' entertainment experience.

2. Virtual Scene Construction

Virtual scene is the foundation of the research on the interaction between human and nature, and there is still much room for development and technical needs in the current frontier scientific research [6]. In the construction of virtual scene, it is the core on how to improve the interactive experience of human scene. Developers should consider the follow-up scene interaction scheme and verify the natural interaction with human body in the process of scene design, so as to ensure the real interactive experience. Generally speaking, there are the following difficulties in the construction of virtual scenes at present: First, the picture quality of virtual scenes, because the interaction between human and nature needs more real virtual effects, how to improve the rendering quality to ensure the realism of development and narrow the distance between human and virtual scenes is a realistic requirement of current software and hardware; Second, the accuracy and efficiency of interaction between human and virtual environment, and how to consider the reality, effect and synchronization of the scene after human enters the virtual environment, the virtual scene must be innovated in light, texture and refresh rate of the environment. The establishment of a virtual environment needs the following three links at the same time (Figure 1).

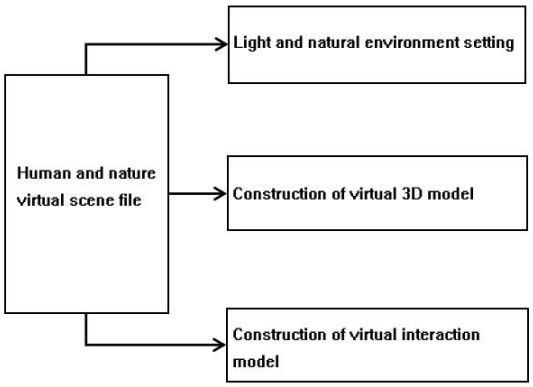

Figure 1: Virtual scene construction elements

During the construction of virtual scene, in order to save system resources and reduce hardware requirements, this paper starts with improving system modeling efficiency, using Unity3D modeling software, and edits and modifies them directly in the application store from integrated natural environment elements such as flowers, grass, numbers and sky models in the interior. By building sence module in the software, and then adding different picture elements on the canvas and identifying scenes interactively, the scene construction method flow in this paper is as follows:

First of all, build the system panel, and build the carrier of virtual picture by using Pannel tool.

Then, human motion recognition association, use the clapping action in the start interface, establish the connection between virtual scene and motion. For example, when a person is recognized to slide left and right in a virtual scene, the virtual scene switching instruction can be obtained, thus forming a 3D effect.

Finally, build 3D effect. The specific operation method is to set Plane control at the main camera position, which is used for displaying 3D interface, and then set RawIamge control right in front of the main camera for bearing 3D virtual scene. Finally, carry out script file programming on Raw control to realize 3D interaction of the system.

3. Research on the Integration of Virtual Scene and Nature

In the process of modern news live broadcast, the host is often in a 3D picture, which makes news viewers have the illusion that the host is on the spot, thus realizing the integration technology of virtual and reality [7, 8]. The basic idea of this integration technology is: firstly, shoot the video image of a real person with a camera, then strip the person from the original scene, and then use the virtual scene constructed in the early stage to integrate the two. This integration method has been popularized in most videos and news at home and abroad, but there are still some defects, such as using green curtain for matting during shooting [9]. Therefore, this paper proposes a real-time interaction and integration scheme between human and objects in virtual scenes, so as to solve the complex problem of post-image processing.

3.1. Body Surface Data Acquisition

The outer surface data of human body is directly connected with the external virtual environment, so its data processing is particularly important. In this paper, Kinect software is used to process the data in-depth, in which the customized sensor is placed on the surface of the human body, and the sensor receives a certain length of infrared rays in the environment. The infrared rays' information can read the depth information of the outer surface of the human body, and can capture and monitor the movement of the human body in a short time. Its main components are as follows:

First, infrared light emitting equipment and sensors can emit infrared rays with specific wavelengths, with low emission power and no interference to the environment. Second, the infrared optical lens and filter, which are mainly used for infrared signals emitted by the luminous unit of mobile phones. The function of the filter is to filter signals of other wavelengths and improve the accuracy of signal mobile phones. Thirdly, image processor, the study in this paper uses TOF core camera, which can receive infrared reflection signal, estimate the light intensity of pixels and the direct distance from the emitter to the receiver. Kinect II equipment can obtain human depth data (detection distance is 0.1~10 m) on the one hand, and can also identify color data of objects on the other hand, with a recognition frame rate of 50 fps.

3.2. Bone Data Acquisition

Human bone data is the key to the accurate simulation of human motion data. Based on the depth data obtained by Kinect technology, bone data analysis and application are carried out. The bone data acquisition method adopted by this paper is completed by the following steps:

(1) Extract the depth and distance image in the system, and use fuzzy neural network algorithm to extract the human contour in the image.

(2) In the human contour image, the action of different regions of the human body is classified and extracted by background difference and then the clutter filtering and noise points of the human body are removed by Poisson equation. Finally, the bone data is edited by the removed refined contour image of the human body.

(3) Determination of bone point data. In the refined bone data obtained in the previous step, 25 points in human bone joints are intelligently detected and analyzed to form a mapping relation diagram. Before the algorithm is processed, the height, posture and behavior data of human body can be obtained in advance as the matching database of bone point data. When human body enters the virtual system, it automatically matches the bone point data, thus achieving the recognition effect.

(4) Bone data conversion. After processing the bone data points, the bone position of human body can be divided into trunk, arm, leg and head, etc., which can be controlled and developed as a whole. 10 APIs are encapsulated into Kinect SDK, each of which contains color information, motion

information, infrared distance and data flow, etc. Different bone data points are saved in the form of 3D coordinates and displayed in GAME panel (Figure 2).

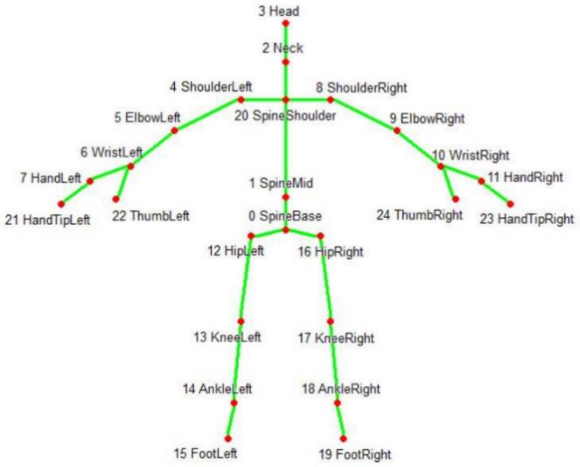

Figure 2: Bone data display

3.3. Integration of Virtual and Real Scenes

In the integration technology of virtual and real scenes, deep integration of images is the main integration acquisition point [10]. In depth data processing, due to the natural barrier between human body and virtual reality data, there are many abnormal points, and it is necessary to reduce noise of virtual reality data. In the process of noise reduction, this paper used the mean filtering method to deal with the noise reduction. In the calculation process, the gray value of the center pixel of the filtering window is smoothed, and the response formula of the center of the window is obtained as follows:

$$f(x,y) = \frac{1}{mn}\sum_{(r,s)\subset SABCD} g(r,s) \tag{1}$$

In which

$$\mathrm{g(r,s)} = \sqrt[2]{[(x_i - x_0)^2 + (y_i - y)^2 + (z_i - z_0)^2]} \tag{2}$$

Where f (x) represents the response degree, g (r, s) represents the gray value of a certain point, and r and s represent the coordinates of the 2D UI interface respectively.

Because the filtering algorithm will affect the clarity of the image, after filtering, this paper uses Side Filtering function to preserve the edge of the image depth and restore the original clarity of the image. The specific operation flow is as follows (Figure 3):

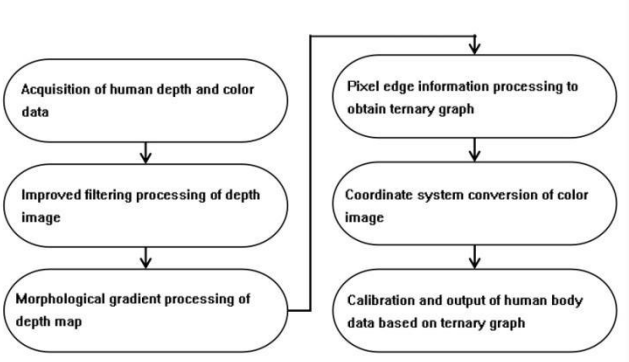

Figure 3: Data integration processing flow

4. Realization of 3D Animation Interactive System

4.1. System Requirements Analysis

In order to verify the feasibility and operation effect of the virtual and natural interaction scene proposed in this paper, the system is built based on Unity3D software, including 2D scene design, 3D animation model interaction, gesture recognition and other functions of human and nature integration. The system structure framework is shown in Figure 4, and the system design process mainly starts from the following aspects:

The virtual scene is realistic, and 3D animation elements such as flowers, birds and numbers are introduced into the virtual scene, which increases the sense of integration for human in the virtual environment.

Human-computer interaction, in order to ensure the interaction effect between human and virtual natural environment, dynamic gesture analysis is also carried out in the process of gesture recognition and posture recognition. The scene will be switched when the user slides the gesture.

Stable and reliable, because the process when human enters into the system needs to be identified, it is impossible to establish bone data ID for every user entering the virtual environment and track it in real time. In this paper, the geometric algorithm of large font is defined and integrated into the 3D animation interactive system. When the user who joins later enters the camera range, the system will automatically start the recognition function and match the appropriate bone data, and actions of the user, such as grasping, moving and raising hands, will be responded.

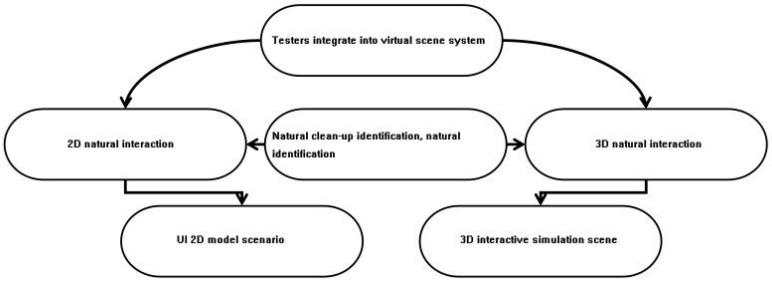

Figure 4: System construction idea

4.2. Virtual Scene Interaction

The 3D animation natural interaction system designed in this paper takes Cavnas control as the operation interface, and the 3D model operation interface is also developed with it. In the process of system development, firstly establish a Kinect empty module based on C# script, which is mainly used to mount various natural and human image data; then, add Manager script at the bottom of Kinect empty module as a 3D communication and editing tool in the system; finally, establish a Canvas, and the functions of mounting natural elements and interacting with 3D human body model are realized on the Canvas. Taking the interaction between the human arm and the fireball in the scene as an example, the specific operation steps are as follows:

(1) Establish the body bone coordinates and point data of the tester, and obtain the 3D coordinates of the arm.

(2) Project the obtained 3D coordinates into the 2D animation with the screen as the background;

(3) Associate the coordinate position in the 2D screen with the GUI 3D arm;

(4) Trace the motion of the arm in GUI 3D coordinates and judge whether it is on a 3D object (torch);

(5) If the arm is near the torch, the system starts to mobilize Manger script to judge whether the arm has grasping action. If there is grasping action, the torch is integrated with the human arm image

to represent the human starting to grasp the fireball (Figure 5).

Figure 5: Simulation of contact integration between human body and fireball

5. Conclusion

By means of virtual reality technology and motion capture technology, the paper studied the interactive integration between human and virtual natural scene and 3D animation design. The conclusions are as follows:

(1) Based on the interactivity, authenticity and immersive experience of virtual scene, it established the basic requirements and construction scheme of virtual scene. Infrared rays are emitted by somatosensory devices, and then the chromatography and distance information of infrared rays are obtained by light receiving sensors, and image integration is carried out finally.

(2) The integration of depth and color data needs filtering and noise reduction, and the human body shape is segmented and refined by means of mean difference method, which prevents the damage of edge information and improves the integration effect of virtual and real scenes.

(3) The 3D animation system designed in this paper is the interaction and integration of human and nature, which has high recognition rate. It can accurately judge human's actions in 3D scenes and make judgment and integration, but the research in this paper still has shortcomings in function and reflection rate. In the future, the study may focus on the recognition and integration of voice and image to further increase the interactive experience.

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