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Research on Computer 3D Interactive Software Design of Animation Peripheral Products

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***Abstract*—In this paper, a 3D animation engine based on OGRE is designed and implemented. It has a relatively perfect functional system for 3D animation production. Including the rendering system. By adding 3D animation material module, 3D animation production is simplified and efficient. An interactive segmentation algorithm of 3D animation model based on 3D data alignment technique is proposed, and the segmentation results with the same hierarchical structure are obtained. The system adopts object - oriented mechanism design, based on OGRE platform. Extend the implementation of other engine modules through the MVC design pattern. Parameters such as constant, space group, atomic coordinate and atomic radius are used to make the animation image of structure in the 3D space simulated by computer. The concept of 3D structure animation is introduced to make the drawing technique of structure develop from static graph to dynamic graph. The whole system structure is clear and has good expansibility. Finally, the 3D animation engine is developed and tested. The function has been preliminarily verified.**

Keywords*—*3D animation design, three-dimensional interaction, programming, scene modeling

I. Introduction

Animation refers to a series of slightly different pictures displayed on a screen in a continuous manner. As a new research direction to bring vitality to graphic science, computer animation is being used more and more deeply in scientific research. Using dynamic simulation technology, the kinematics, dynamics and control of the actual system are simulated, which can not only show the mutual influence mechanism between the targets, but also clearly show the internal structure of the targets. And adjust the relevant parameters to ensure that it works in the best working state. However, animation used in scientific research can not only be limited to animation in the general sense, it also needs to simulate the real motion rules according to certain constraints and motion trajectories. Some of the existing simulation tools, such as AutoCAD, 3DStudio, Animator, etc., are computer-generated, that is, with keyframes. Modeling animation refers to computer animation based on physics [1]. It can incorporate environmental and characteristic factors into it, and use kinematics, dynamics and other laws to build a model motion equation, which can be used as the motion route of the animation model. Moreover, the object can be transformed in real time under the design requirements, so as to form a continuous animation process. Therefore, the modeling of 3D stereoscopic model has become the ultimate goal of cartoon designers and users. This paper conducts a systematic study of 3D animation design by taking the animation major of Wuhan Business College as an example based on the feasibility study of the 1+X Certificate system implemented by application-oriented undergraduate colleges and universities. Then the system uses object-oriented mechanism design, based on OGRE platform. Extend the implementation of other engine modules through the MVC design pattern. It is found that the whole system has clear structure and good expansibility.

II. System architecture and function modules

A. System Architecture

In VisualC++ environment, 3D modeling, lighting and material processing are carried out by OpenGL. This 3D entity modeling animation system is realized by Open- GL display list and double cache technology. This paper focuses on the implementation of rotating animation, blasting animation and blasting animation. In the process of producing 3D animation, a timing device must be used. A system timer periodically prompts your application to do certain tasks. Use the Set Timer () function provided by Windows to assign a system timer to the application, and use the parameters of this function to set a certain interval. Windows will use this interval value to periodically send messages to the program to execute the animation generator [2]. The 3D physical model moves through the scene at intervals specified by a timer, creating a visually continuous animation effect. Time interval is a very important part of animation using OpenGL. If they are far apart, they will consume a lot of system time and make the image appear incoherent. If in a very short time, due to the image cannot be properly updated, it will lead to the loss of image data in the image. Typically, the animation duration must be 15 frames per second, whereas in interactive real-time computers, 8-60 frames are commonly used. This system is a 3D animation generating software, using OGRE real-time rendering technology. The use of handles and materials can realize the 3D animation fast and easy effect. In the scenario Manager module, the consumer can select a role and make changes to it. Users can choose scripts with different actions and plots according to their preferences to arrange the plot of the story. After that, users can also use the virtual camera module to adjust the shooting mode, so that they can shoot the simulated scene just like playing 3D games, and produce a three-dimensional animation short film in a relatively short time. The structure of the system is based on modules [3]. The following respectively describes the role of each module and the specific implementation process. Its system block diagram is shown in Figure l (the picture is quoted in Virtual Character Animation Based on Affordable Motion Capture and Reconfigurable Tangible Interfaces):

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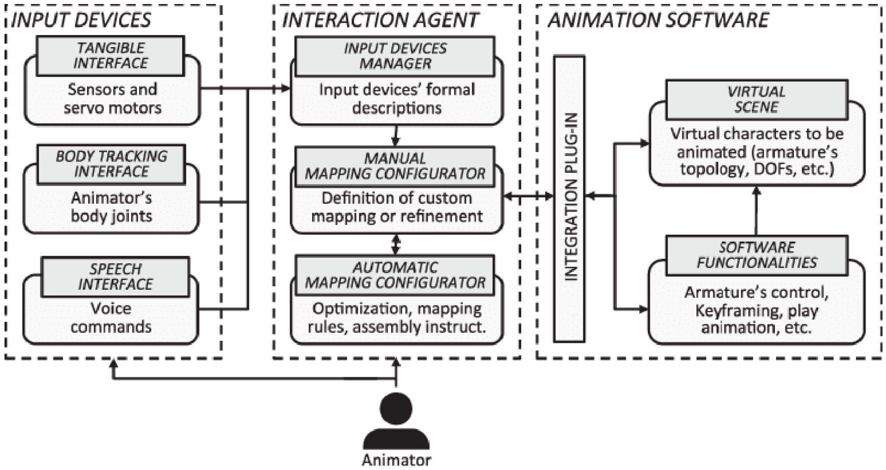

Fig. 1. Architecture of 3D animation design system

B. Function Design

1) Core of the animation engine

The OGRE based animation engine hierarchy is shown in Figure 2 (image referenced from MPEG-4 3D Graphics: from specifications to the screen). The system mainly includes resource manager, input and output system, presentation system, and network system. Drawing system in the animation engine is a very important function, which is responsible for real-time drawing of images. The network system is a C++ network library based on UDP network transport protocol to provide users with a set of network related application programming interface, through which users can quickly build socket connections and deliver all the interactive material packets in animation production. Files, speech, text, and entities are also lower-level modules [4]. The ODE is an ODE of open-source code. ODE is developed by C++ and has a clear interface for easy integration with OGRE. Scene management, character management, animation system, graphical user interface and so on are the upper level of this engine. The scene management module can manage all the virtual animation scenes and deal with the changes and events more effectively. The animation part is responsible for the key processing of the picture to make the picture more vivid; The graphical interface realizes the man-machine dialogue.

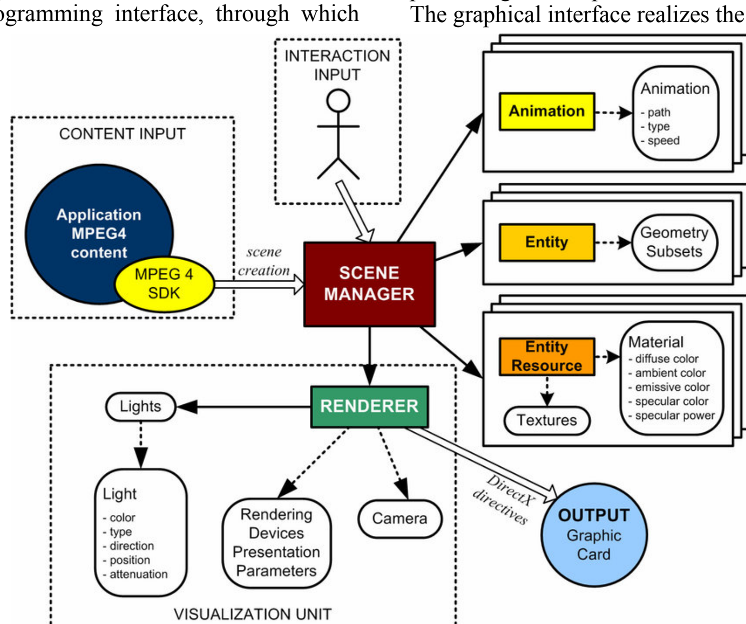

Fig. 2. Animation engine hierarchy diagram

2) Function and process of rendering system

The basic function of OGRE graphics generation system is to use virtual camera, combined with 3D scene, light source, lighting mode, and material, to generate 2D graphics onto a picture. This method determines the shape and location of the target by selecting the geometric features of the target, the orientation of the camera and various parameters. The performance of the object on the screen is mainly determined by the object's material properties, light source properties, texture, and lighting model. The OGRE drawing process can be divided into three steps. During rendering, you can divide the rendering process into object layer, vertex layer, and pixel layer [5]. The object layer is driven by the application, which can be implemented by software, such as collision detection, visibility judgment, deformation animation, etc.: Most of the operations of the vertex layer are implemented by hardware, including the setting of camera parameters, etc.: The last step is to color the data generated by the vertex layer into the final image in the graphics hardware.

3) Solution management module

The system takes the scene manager as the center, and realizes the effective control of virtual objects in each scene, and realizes the control of objects through the upper and the lower two ways. The arrangement of the scenery seemed more like that of a director, setting the scenery, arranging the lighting, the costumes; And instructs the actors in acting. The setting is arranged like a large stage composed of cameras, lights, costumes, props and actors [6]. The situation organization principle of OGRE is to divide the real situation into multiple abstract areas and multiple small Spaces. Each small space is managed by the Scene Node object, which deals with spatial behaviors such as movement, rotation and scaling. Different scene elements can be connected to each Scene Node, such as entity, light, Camera, etc. By layering massive scene nodes according to different spatial partitions, OGRE realizes the systematic organization of the whole scene.

4) Animation material module

Anime materials contain two main aspects: character modeling and character action. Users can select the models and animations they need from the local client, or select the materials they need from the remote server. Material preparation before animation is realized by means of what you see is what you get. Users can also use 3D software such as 3 dam and Maya for modeling and animation. However, OGRE adopts a special mode, which cannot directly adopt the mode of other modes, so the mode must be transformed into OGRE mode by means of mode derivative tools. OGRE also adds plugins to today's most popular three-dimensional models. OGRE has three forms of animation, which are bone animation, morphing animation and posture animation.

5) Script system

Scripting language is a kind of simple, intuitive, clear, accurate for the goal of programming language. Script is the core of the whole animation engine, which plays a role in driving the whole process of animation shooting [7]. The actions of the characters dominate the development of the plot. At the same time, most operations such as the scheduling of the virtual camera lens are based on the script.

6) Bulletin board application

The bulletin board is a simple quadrilateral that depends on the camera to determine its orientation. The software automatically adjusts the lens Angle as the camera moves, so that the first half of the bulletin board is always facing the camera. In the bulletin board can be the character dialogue, narration, photos, etc. Things like a character bubble that follows the movement of the character on top of some characters, and things like giving the character a name, are done using bulletin board technology. Bulletin boards can also use special effects such as smoke and natural effects such as clouds, rain and lightning. Bulletin boards can also create a lot of simple scenes, such as trees and grass, in a way that saves you from having to create a lot of real models.

III. Algorithm overview

In this method, the continuous segmentation of 3D animation images is realized by using man-machine dialogue. In general, a dynamic modeling is composed of a fixed main component and several external components. Therefore, the image segmentation work is to extract each sub-block from each sub-block. Figure 3 shows the flow of the entire algorithm [8]. First, by clicking the mouse to interact, the user can place the logo on the first grid near the clipped edge. The corresponding image segmentation results are obtained by extracting the marker information in the grid. Note that these parts can be identified by two markers: a point on the outside and a point on the inside. The outer center refers to the center farther away from the center, while the junction of two centers refers to the junction of two centers. The method can be divided into three steps. Firstly, the alignment is completed by using multi-dimensional scale conversion. Secondly, feature extraction is carried out on the image after alignment. The final classification effect is obtained by two - step method.

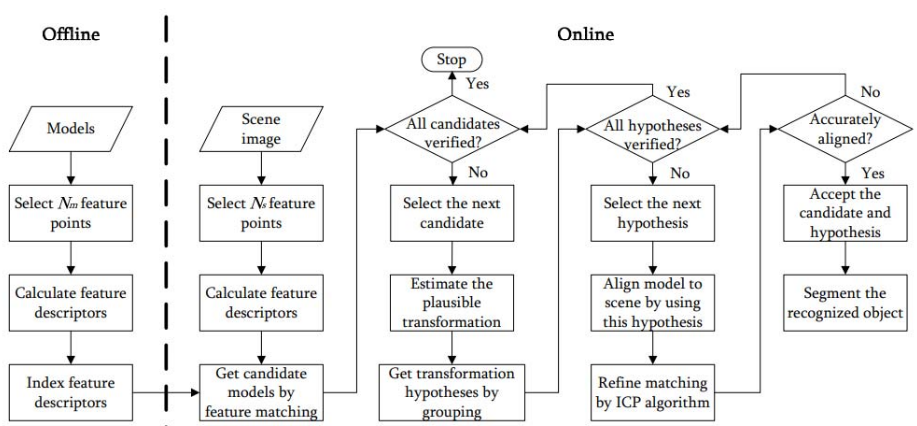

Fig. 3. Algorithm flow chart

IV. ALGORITHM DETAILS

Suppose the three-dimensional shape is represented by a triangular grid. Other three-dimensional shape representations, such as NURBS surfaces, meta spheres, subdivision surfaces and volumes, can be easily converted into triangular meshes. For A three-dimensional grid, the set of vertices and the set of faces are V and F, and the number of vertices is N_v and N_f , respectively. For any two vertices v_i and v_j , the geodesic distance is $gd(v_i,v_j)$. Similarly, the geodesic distance between the two faces is $gd(f_i,f_j)$. The segmentation task is defined by user interaction, which divides the grid sequence into subparts $S_1,\cdots,S_i,\cdots,S_j,\cdots,S_K$ (K is the number of subparts) of the same structure. Here each section contains a set of connected faces. For each part S_j , it has a length L_j . Length is the geodesic distance from the outer point to the joint point. All subparts meet the following conditions:

$$\begin{cases} S_i \cap S_j = \phi, i \neq j \\ S_1 \cup \cdots \cup S_i \cup \cdots \cup S_k = F \end{cases} \tag{1}$$

In addition, without annotation, it can be seen that the posture of the two 3-D grids when moving is not the same, but the outer grids are the same [9]. Through the method of alignment, the fast data acquisition is realized. First, MDS is used to implement the transformation of the two models to the standard posture. This method uses the geodesic distance between two nodes to determine the matrix required for MDS conversion. In that case, you can define the target function as

$$S(V) = \min \sum_{i<j} (d_{i,j}(v_i,v_j) - gd(v_i,v_j)) \tag{2}$$

Where $d_{i,j}$ is the Euclidean distance between any two vertices. The above function approximates geodesic distance by Euclidean distance. Choose the least distance direction as the best alignment result. The Euclidean distance of two-point sets is calculated as

$$\begin{cases} Er =\leq \sum_{v_i \in V_A} v_i - N(v_i) \\ N(v_i) = \{v_j \mid \min_{v_j \in V_B} |v_i - v_j|\} \end{cases} \tag{3}$$

Where, V_A and V_B are respectively the point sets of the two grids after changes. For the source grid, the nearest neighbor points can be found in the target network by using this method [10]. The optimum matching method is used to find the corresponding external points on the unmarked grid. I'm going to use $f_{i,e}$ to represent the outer point of S_i . On the premise of ensuring calibration accuracy, a post-processing will be carried out. The purpose of this post-processing method is to keep the detected mark as far away from the central point as possible. The central point is calculated as

$$f_c = \{f_j \mid \min \sum_{i=1}^{K} |gd(f_{i,e}, f_i)|, f_j \in F\} \tag{4}$$

After the central point is obtained, the following formula is used to complete the updated position of the outer point

$$\begin{aligned} f_{i,e} = \{f_q \mid & \min_{f_w \in E \cup f_c} gd(f_q, f_w) \\ & \max_{f_q' \in F} gd(f_q, f_c) > gd(f_{i,e}, f_c)\} \end{aligned} \tag{5}$$

Where E is the external point set. The above equation maximizes the minimum distance from the center point to the other specified external point.

V. EXPERIMENTAL ANALYSIS

The system uses Intel kernel T9300.2 chip. Windows XP is used. Finally, we will use a variety of 3D data processing methods to test the universality of this method. This algorithm gets good results on TOSCA data set. Each sequence is a three-dimensional grid with various postures. For each order, we define an interactive flag on the first cell. Then, each piece of data is classified according to this method. Figure 4 shows what happens in various sequences.

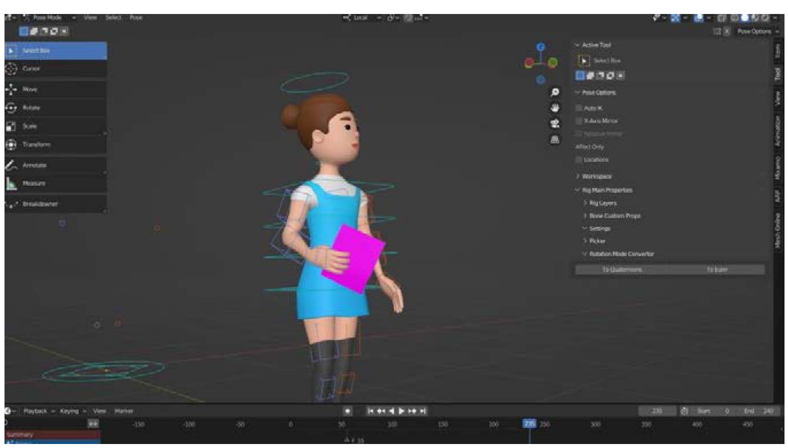

Fig. 4. 3D animation design effect

VI. Conclusion

This paper designs and implements a 3D animation engine based on OGRE. It has a relatively perfect functional system for 3D animation production. Including rendering system, animation system and so on. By adding 3D animation material module, the 3D animation production is simplified and efficient. The system adopts object-oriented mechanism design, OGRE as the base platform, through MVC design pattern to expand the implementation of other engine modules, the whole system structure is clear and has good scalability. Finally, through the development and testing of 3D animation engine, the function has been preliminarily verified.

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