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Development and Application of 3D Modeling in Game

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Abstract: The development and progress of computer graphics and 3D modeling technology play an important role in the development of 3D game animation. Three-dimensional modeling technology combines artistic design and computer technology perfectly with a real sense of depth, so it has been widely used in the game industry. This paper introduces the development process of 3D modeling technology and the application of 3D modeling technology in games. At the same time, it gives suggestions on the problems existing in the application of 3D modeling technology in games, as well as researches and looks forward to the development trend of 3D modeling technology.

Keywords: 3D modeling, Games, Applications.

1. Introduction

3D modeling technology is a 3D digital image processing technology that generates 3D models by simulating real objects through a computer program. Users can rotate, scale, move and other operations on the model to meet the expectations of the output into a variety of formats. In recent years, with the rapid development of digital cities, the demand for 3D modeling has further increased, and many research institutions have launched research and development of 3D modeling technology. Domestic 3D modeling research mainly focuses on modeling technology, engineering applications and system research based on 3D modeling. In addition to the above three aspects, foreign 3D modeling research also involves deep learning, automated modeling and other technologies, as well as the application of 3D modeling in the fields of medicine, biology and geographic information systems.

After entering the 21st century, the rapid development of computer technology has given birth to a variety of games. The interactive entertainment industry, with computer games as its pioneer, has gradually risen to become the latest sunrise industry, and has developed into a new growth point of the global industry [1].Meanwhile, with the continuous development of the computer game industry and the increasing demand of players for games, game designers are constantly exploring new technologies and gameplay to make games more vivid, realistic and rich. 3D modeling technology is undoubtedly an important part of it, which can provide more three-dimensional and realistic scenes and characters for games and improve the playability and user experience of games. This paper will explore the development and practice of 3D modeling techniques in game production and will propose modifications to the problems that still exist.

2. Literature Review

Eckschlager et al. described the development of a new agent emotion elicitation model called Nemesys [2]. Joselli et al. described a novel touch/accelerometer gesture recognition framework that used Hidden Markov Models to recognize gestures [3]. Video game technology is rapidly maturing and approaching the real-time fidelity of 3D rendering applications used in architecture and can respond to user input in real-time. Valls et al. described an educational experience using video game technology in architecture education, exploring the applicability of video games in architecture compared to more traditional media [4]. The gaming industry has played an important role in this area and has led to the development of edutainment applications. Yangyang Yan et al. fused 3D laser point cloud data and UAV orthophoto data to obtain spatial 3D information of the ground and the top of the building respectively, and used 3ds Max software for 3D reconstruction of the building to realize small-scale scene construction [5]. Vukolov et. al. studyed 3d application for modeling of involute gear manufacturing as the assistance solution for tmm training [6]. The description of special educational experiment carried in Bauman Moscow State Technical University is given. Xue Jia et al. used a 3D laser scanner to acquire the point cloud of the building, and processed the point cloud data with HD-3LS-SCENE software to obtain high-quality point cloud data [7]. Then these point cloud data were imported into 3dsMax software for block modeling, and finally unified assembly was carried out to obtain a complete, high-precision 3D model of the building with high realism. Prokhorov et al. revealed the process of creating a career guidance 3D exploration game for applicants applying to IT departments [8]. The development tasks accomplished included (1) integrating historic building models and 3D GIS attribute data, (2) obtaining all necessary visualization information, (3) updating the historic building and historic district models and data at any time, and (4) providing virtual reality simulation functionality and an interactive experience of the environment. The contribution of Nguyen et al. focuses on proposing a complete methodology that is an integrated approach consisting of previously proposed methods for reconstructing 3D objects from 3D point cloud datasets [9].

3. The Development of 3D Modeling Technology

3.1. Inception - Wire Frame Model and Surface Model

In the late 1960s, research on constructing 3D solid with wire-frames and polygons began, and such models are called wire-frame models. A 3D object is described by the set of all its vertices and edges, hence the name wireframe. The structural model is like the skeleton of the human body. Wire-frame models are widely used in factory parts production. Although it has been applied to games later, the realism of objects in the wireframe model are ambiguous. It is difficult to represent cylindrical, sphere and other curved surfaces due to the lack of curve contours. It lacks the relationship between edges and faces and the relationship between faces and faces, and cannot form entities, so the screen is rough and difficult for players to understand.

To improve these shortcomings, surface models are produced. Compared with the wire-frame model, the surface model has an additional face table, which records the topological relationship between edges and faces. A surface model is like a muscle attached to a bone. The three-dimensional game screen made by this model has been greatly improved, but the object still has no profile, center of gravity, moment of inertia and other data [10].

3.2. First Improvement - Solid model

To further improve, NASA first created solid model technology in the 1980s. Solid models are more complete. If a hole is dug in the solid model, a new surface is automatically generated, while the interior and exterior are automatically identified. As a result, solidly modeled parts will have no missing edges and faces, and no edges will be passed into the part solids, thus avoiding errors and unachievable designs. Solid model = skeleton + muscle + viscera, a complete human body.

3.3. Second Improvement - Feature Parameterization Techniques

Parametric technology appeared in the 1990s. Its main idea is to use geometric constraints, engineering equations and relationships to describe the shape characteristics of product models, so as to design a series of design schemes that are similar in shape or function. At present, the types of geometric constraints that can be handled are basically the nominal dimension relations of the geometric entities composing the product shape and the engineering relations between dimensions, so the parameterization technology is also called size-driven geometry technology. Parametric systems require full-size constraints to ensure the correctness and efficiency of the generated designs, but they leave little room for designers to play.

3.4. Third Improvement - Variational Technique

To break through these limitations, SDRC has come up with a more advanced variational technique. Based on the characteristic parameter technology, the variational technology first determines the necessary design conditions, and then the free design can be carried out, and retain every intermediate result for repeated design and optimization design. So designers can think about shape before size; meet the design requirements first, and then consider the geometric design [10].

4. Application of 3D Modeling Technology in Games

4.1. Scene Modeling

The scene is an important part of the game, which determines the design style and type of the game. The game scene refers to the collection of all objects except the character modeling. The role of the game scene is to explain the worldview of the game, reflect the game's art style, cooperate with the development of the plot, enhance the overall atmosphere and meet the needs of human-computer interaction. The design of the game scene needs to determine the appropriate scale and composition of the original painting and grasp the balance between reality and exaggeration, so as to form a sense of reality, give the players the feeling of visiting the real scene, and bring visual appeal [11]. In addition, particle systems are needed to simulate natural phenomena such as clouds, fog, rain, etc. to fully reflect the randomness and dynamics of these objects.

4.2. Post Rendering

Post-rendering makes the modeling subject more three-dimensional and realistic. Therefore, after the modeling is completed, we usually need to adjust the relationship between light and dark and the perspective structure of the modeled object through four cameras at four angles. In addition, a large number of auxiliary light sources should be used for all-round light adjustment. Objects made of different materials reflect and refract light differently, so we also need to input the parameters of the object's material to calculate the state of the cast shadow. Renderers for particle systems also require special attention.

4.3. Character Modeling and Motion

The characters in the game are different, and the original drawing is particularly important in the process of designing the game. Designers need to have a deep understanding of human features, body proportions and movement behaviors to design character models.

4.3.1. Character Modeling

4.3.2. In the role model, it is necessary to master the proportion structure of the role and the skeleton and muscle structure of the role to make the role model more perfect.

Distributing the density of the lines reasonably, increasing the wiring of most parts of the motion amplitude appropriately, as shown in Figure. 1. Increasing the wiring at appropriate positions can not only show the details, but also provide support for the animation extension. On the contrary, the wiring of parts with small motion amplitude can be reduced by a moderate amount, as shown in Figure. 2.

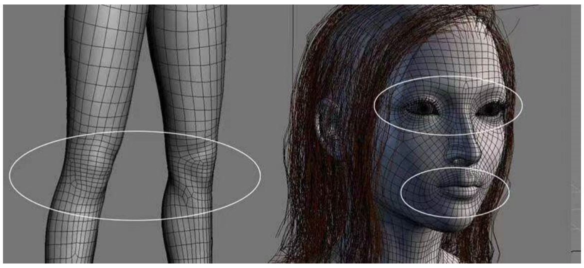

Figure 1. The joints, the muscles that are active.

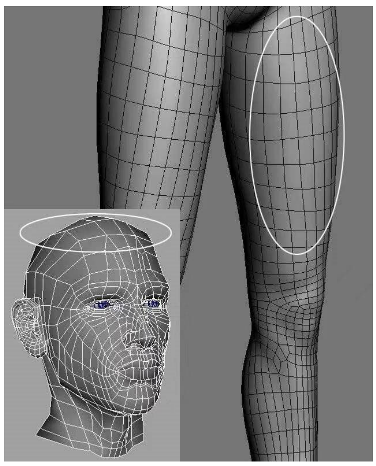

Figure 2. The cranium, front of thigh

Move the position of the model's vertices with the Move tool so that the model outline matches the original drawing of the background flat figure.

Check whether there are redundant free points in the finished model, delete or weld to save the number of model faces.

4.3.3. Character actions

Three-dimensional human motion capture technology can obtain three-dimensional motion data through three-dimensional digitization of each character's facial expression or body activity information, so as to realistically simulate a variety of complex expressions and movements, thus achieving the purpose of reproducing real life. It not only improves and enhances the efficiency of animation production, but also makes the production process of this animation more intuitive, and the characters become more flexible [12].It is also necessary to use the key parent-child relationship to bind the bones of the 3D character model to obtain the skeletal data format, and then optimize the performance effect of the action through the convolutional neural network.

5. Disadvantages of 3D Modeling Technology and Suggestions for Improvement

5.1. Disadvantages

5.1.1. Huge manpower and financial needs

Game modeling is a complex technology, and the creation of scenes and characters in the game, rendering from 2D to 3D, etc., requires technicians to spend up to several months. Even a small motion change for a game character involves many keyframe adjustments. Moreover, due to the high professional requirements of game production for designers, the game modeling takes a long time and cycle, and the game modeling needs to invest a huge amount of money. The huge time and money consumption has become a realistic factor limiting the development of game modeling.

5.1.2. High hardware requirements

The process of game modeling is very complex, and each action of the character involves the production of more than ten key frames. If there are better requirements for picture quality and resolution, more key frames need to be made. Therefore, the storage space required by 3D games is huge, and only specialized devices designed to store data can store the modeling data. And in order to prevent the phenomenon of stalling in the modeling process, the electronic equipment configuration used in the modeling needs to be high to ensure the smooth progress of the 3D modeling work. Therefore, the limitations of equipment and storage conditions are also one of the important factors restricting the application of 3D modeling technology in games. With the mainstream of mobile games, how to use the limited memory and simple device configuration to show the exquisite picture of 3D games may become one of the future research directions of 3D modeling technology.

5.1.3. The effect of vertigo in 3D games

Because the 3D game scene makes the game perspective more difficult to control than ordinary games, especially in the first person game, the game will simulate the real perspective of people at ordinary times, although the experience is strong, some players may experience fatigue and dizziness.

5.2. Suggestions

Relevant technicians need to further update the software for making 3D models by integrating the various steps of modeling into a single system, so that designers can quickly get the model by inputting parameters and other information. Even if there may be a lack of details and personal style, the designer only needs to make changes on the basis of the model. This greatly reduces the time and money spent on making 3D models.

Designers should try to compress the storage space needed for beautiful models by using innovative software compression techniques when they are finished making them. In addition, it is also possible to try to make most devices have enough storage space to download games by expanding the storage space of computers or cell phones, or increasing the production and popularity of highly configured devices.

Game designers can design two game modes for people to choose: normal mode and anti-glare mode. In anti-glare mode, reduce the resolution and brightness of the screen to reduce eye irritation; reduce the frame rate of the game to make the screen more stable; adjust the field of view to the maximum to reduce the magnitude of the scene changes, which gives the brain more time to react; turn off vertical synchronization and motion blur, and turn off, reduce, or increase shadows to make the visual experience more comfortable, while keeping the game smooth.

6. Development Trend of 3D Modeling Technology

With the development and progress of hardware equipment and software facilities, 3D technology has gradually penetrated into human production and life, and is helping many industries to realize the three-dimensional enhancement of technology and products. In the digital assets will show a surge trend in the digital era, 3D data information as one of the most intuitive way to store assets, will also usher in a surge in data volume. At this stage, 3D technology is in a period of rapid development, all aspects of the rules and the use of the environment have not been fully formed, it is necessary to strictly control the safety issues. 3D is no longer limited to high-tech application scenarios, the daily environment will also be more and more use of 3D. such as 3D printing, AR entertainment applications, VR equipment is entering the tens of thousands of households, 3D technology has been in the daily inseparable. 3D technology will bring new value-added approach to a number of industries, and will also bring a new way for the industry to enhance its products in 3D. A new value-added approach for many industries, such as the banking system using 3D technology, creating 3D virtual characters, so as to realize the value-added business. In the future, our e-commerce, entertainment, and socialization will encounter more digital and virtual people that serve social life. The meta-universe, as a product under the craze, will not return to silence. the landing of 3D technology can promote the meta-universe to be closer to the dream, and based on 3d technology, a better future will be closer to people.

For online games, many technicians combine with the psychological characteristics and practical needs of people in the new era, not only improve the game's buildings and other infrastructure, but also introduce the audience to pinch their own faces or adjust the height, skin color and other detail data of the game characters, as well as the climate change of the game scene, rain and snow, day and night, etc., which makes the game more realistic. This promotes the healthy development of 3D game modeling and brings corresponding economic benefits to game producers [13]. The future market of cell phone games will also be bigger and bigger due to its portability and instant playability. At the same time, with the expansion of the market, the application of 3D modeling technology in games will also become more common.

7. Conclusion

In summary, since the 1960s, with the development of computer graphics and motion capture technology and other related technologies, 3D modeling technology has gradually attracted people's attention, especially in the game production has a relatively complete design system. However, there are still some shortcomings in 3D modeling technology, and related technicians must continuously optimize and improve it to improve the quality of 3D game modeling and promote the long-term development of the game modeling industry.

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