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Research on the Production Process of Digital Media 3D Animation

-- Taking Blender as an Example

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Abstract: With the rapid advancement of science and technology in the field of digital media art, a large number of 3D animation production software have emerged in the industry, which has greatly improved the work efficiency of practitioners and facilitated learning for many enthusiasts. This article takes Blender as an example to deeply explore and explain the 3D animation production process in digital media art. Through the study of modeling, shading, motion and camera settings, rendering and other steps, it analyzes the implementation methods and techniques in Blender, providing a comprehensive production process reference for digital media practitioners and 3D animation enthusiasts and improving their efficiency and effect in 3D animation production.

Keywords: 3D Animation Production; Digital Media Art; Blender.

1. Introduction

With the continuous development of computer graphics, 3D animation production has become an important part of the field of digital media art. However, the production process of 3D animation is complicated and there are many types of software. Therefore, it is essential to choose appropriate and efficient production software and master the production process. Taking Blender as an example, this article introduces the basic concepts, characteristics and software functions of 3D animation production in detail, and gradually explores the use methods and techniques of the software in the relevant steps of 3D animation production, aiming to help producers fully understand and master the production process of 3D animation, to improve the production quality and efficiency of the works.

2. Basic Introduction and Features of Blender

Blender is an open-source 3D computer graphics software famous for its modeling and animation functions. The software began as an internal project called Blender created by the Dutch 3D animation company NeoGeo in 1995. After years of development, Blender was officially released as open source under the GNU General Public License (GPL) in 2002. From then on, it gradually grew into a comprehensive open-source 3D creation platform, attracting many developers and community users to expand its plug-ins and functions.

Blender provides users with a series of tools such as modeling, sculpting, UV editing, texture paint, shading, animation, rendering, compositing, geometry nodes, scripting, etc. In terms of rendering, Blender has two powerful rendering engines built in. The first is called Cycles, which performs graphics rendering based on backward ray tracing technology and has functions such as denoising, PBR shading, sampling offset, etc. In addition, during the rendering process, the Cycles rendering engine can also accelerate rendering by using frameworks such as OptiX, CUDA or Metal when rendering on the GPU, so that users can obtain more efficient 3D rendering production results. The second rendering engine is called Eevee, which performs graphics rendering based on a real-time rasterization solution and can be used as a preview tool for the Cycles shading workflow. It has functions such as ambient occlusion, bloom, screen space reflections, subsurface scattering, etc. Compared with the Cycles, the Eevee has a higher rendering speed. In addition, Blender also has the characteristics of small installation size, low requirements for basic computer configuration, and fast version update speed.

3. Application of Blender in 3D animation of digital media

3.1. Big Buck Bunny

Released in 2008, Big Buck Bunny is the second 10-minute animated short film produced entirely with open-source software by the Blender Foundation after Elephants Dream. Compared to Elephants Dream, the tone and visual effects of this film change from a mysterious story and dark visual effects to a comedic, cartoony, and lighthearted style. Big Buck Bunny was produced using Blender in all aspects of the project, from modeling and animation to rendering and compositing. It not only demonstrates Blender's capabilities as a 3D graphics production tool in the creation of animated films but also promotes its acceptance in the animation production community and small animation studios.

The film is the first project created by the Blender Institute, a department of the Foundation specifically established to promote the creation of open-content films and games. During the animation production, the developers made a lot of improvements and updates to the software according to the needs of film creation, such as adjustments to hair rendering, particle systems, UV mapping, shading, rendering pipelines, constraints, and skinning. In addition, the production of this project also introduced features such as ambient occlusion to Blender, which was updated in Blender version 2.46.

3.2. Next Gen

Next Gen is a science fiction animated film co-directed by

Kevin R. Adams and Joe Ksander. Produced by Alibaba Pictures Group and Wanda Film and Television Media Co., Ltd., the film was co-produced by domestic artist teams Sun Shiqian Studio and VOK Studio. It is the world's first large-scale commercial film produced using Blender. In 2018, Netflix acquired the overseas distribution rights of the film for $30 million and premiered it on its platform. The film has not only been well received by fans for its fascinating storyline and exquisite visual effects but also attracted social attention in animation and visual effects because of its extensive use of Blender in the production process.

4. Digital Media 3D Animation Production Process

The production of digital media 3D animation can be divided into three stages: pre-production, mid-production and post-production. Among them, pre-production is the basic stage of 3D animation production, which mainly includes creative conception, script writing, and storyboarding, which can help the production team build the overall creation framework of the animation. The mid-production stage is the core stage of 3D animation production, which mainly includes modeling, shading, motion, and camera settings. In this stage, production staff need to use various 3D graphics software for creation. The post-production stage is the finishing stage, which includes rendering, compositing and editing, and mainly involves the overall presentation and optimization of 3D animation videos.

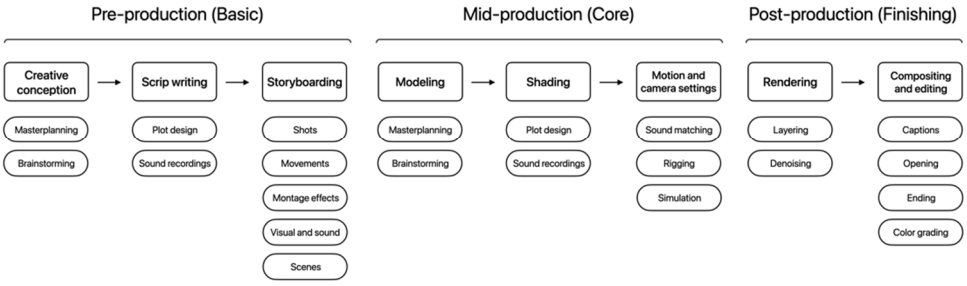

Figure 1. Schematic diagram of digital media 3D animation production process

4.1. Storyboarding

Storyboarding is an important part of the pre-production of digital media 3D animation. Excellent storyboard design can not only effectively help producers control production costs, but also help directors accurately understand the progress of shooting and production. It is like a bridge that connects the pre-planning and post-execution to ensure the smooth progress of the project [1].

In the process of storyboarding, producers need to design the shots, movements, montage effects, visual and sound, scenes and other content in 3D animation. Since storyboarding is done after the script is written, the key information such as the description of the characters, the plot, the scene setting, the camera position, the lighting effect, the sound design and the overall style of the film in the script needs to be drawn through a series of coherent pictures in the storyboard. It is an important guiding tool for animation production. After the storyboard is drawn, a series of storyboard images need to be imported into video production software such as Premiere Pro or After Effects and made into animatics. In terms of specific operations, the independent storyboard images need to be connected in sequence, and narration, music, sound effects and other content need to be added to the animatic according to the script and shooting production requirements, to obtain a preliminary video framework for producer to browse and refer to [2].

4.2. Modeling

3D modeling is a complicated process. It requires the characters or products involved in the animation and the scenes they are in to be made and restored as meticulously as possible. This process can be carried out in the modeling workspace of Blender. Taking product 3D animation as an example, if you want to model the product as accurately as possible, there are two main ways. The first is to obtain the 3D point cloud data of the product in the form of 3D scanning and import the data into Blender for adjustment. This method is more efficient and intuitive, but not most 3D animation producers can easily get access to those scanning equipment. The second way is to use Blender's modeling function to build the product. In this method, producers need to obtain the three-view or three-dimensional measurement data of the product and place the three-view on the X, Y and Z axes in Blender for modeling reference to ensure the accuracy of product modeling.

For scene modeling, the producer needs to flexibly decide the scene modeling situation according to the contribution of the scene to the main content of the animation. For scenes with a greater impact on the main body of the picture, the modeling needs to be as detailed and accurate as possible. Information such as 3D scanning and HDRI environment texture can be used to increase the details and realism of the scene. If the scene contributes less to the main content of the screen, producers can use pictures or even downloaded models to simplify the modeling process and improve efficiency. However, it is necessary to create a basic plane as the ground in the scene, because without the ground, objects cannot form shadows on the ground, causing the objects on the screen to look like they are floating in the air, seriously affecting the realism of the animation and the three-dimensional sense of the product [3]. In addition, due to the open-source nature of Blender, many efficient scene generation plug-ins have gradually emerged on the Internet, providing 3D animation producers with a more convenient scene modeling method.

4.3. Shading

Shading is an essential process in 3D animation production. In Blender, producers can use BSDF (Bidirectional scattering distribution function), Emission, Volume or background shaders to add color, texture and lighting information to 3D models and scenes, to form realistic visual effects in rendering. In the default settings of material properties, Blender provides a principled BSDF material node. This shader node uses the PBR (Physically based rendering) process and can be used to quickly adjust the model's base color, metallic, roughness, IOR, Alpha value and normal parameters.

In addition, if the producer wants to give the model or scene a more complex and personalized material, he or she can achieve effects such as glass, gloss and self-illumination by changing the shader in the material properties. In addition, by importing images containing height, roughness, normal and ambient occlusion information into the image texture node, a more realistic material can be produced. Producers can use the images provided by the material website to assist in shading.

In terms of specific operations, after opening the image in the image texture node, the color output needs to be connected to the base color input in the principled BSDF node. At the same time, if the material contains other usable image textures, those images need to be connected to the corresponding input in the same way. If the texture is a PNG image without a background color, it is necessary to connect the Alpha output in the image texture node to the Alpha input in the principled BSDF node, and the blending mode in the material properties setting needs to be changed from opaque to Alpha blending.

4.4. Motion and camera settings

Motion and camera settings are usually performed after modeling and shading. They are the last core process in animation production. They mainly include sound matching, rigging, and simulation. This process can be done in Blender's animation workspace. Sound and picture synchronization is a basic requirement for 3D animation production. To this end, the producers can add the sounds required for animation in the video sequence editor, mark the corresponding beats according to the waveform of the sound, and then insert the corresponding motion effect keyframes for the model or camera in the timeline according to the position of the markers. In 3D animation production, the movement of the model and its limbs needs to drive the vertices on the surface of the model to move through the movement of the bones [4]. Therefore, the producers need to introduce a skeleton system into the model and rig the skeleton to the vertices of the model through weight painting so that the model can deform with the movement of the bones. The process is similar to fitting a puppet with a string-operated device so that its movements can be controlled.

4.5. Rendering

The rendering process of 3D animation is relatively time-consuming. Its essence is to convert 3D models or scenes into 2D images so that these rendered images can be connected to make the final video. Blender has built-in rendering engines with different solutions called Eevee and Cycles. Eevee has a very fast rendering speed due to its rasterization characteristics and can provide real-time visual feedback to producers during modeling and editing, so it is also called a real-time rendering engine. Cycles simulates light in the real world by using ray tracing algorithms, so it can generate highly realistic images and animations under complex lighting conditions such as reflection, refraction and scattering, it is also called a ray tracing rendering engine.

Taking Cycles as an example, to obtain a more realistic image, in addition to more sophisticated object and scene modeling and more realistic lighting conditions, it is also necessary to increase the sampling value and enable OpenImageDenoise. Sampling controls the number of rays calculated for each pixel to determine the final color value. A high sampling number usually means higher image quality, but it also increases rendering time. The producers can determine the number of samples based on the complexity of the scene and whether to enable the denoiser to obtain the most efficient and appropriate rendering parameters.

In addition, if the scene contains a large number of refracting or reflective objects such as glass, water or mirrors, it is necessary to increase the maximum number of bounces in the light path settings to ensure that the software will not be unable to correctly find the light source information during the ray tracing process due to insufficient bounces, and ultimately render a completely black effect.

4.6. Compositing and Editing

Compositing and editing are the integration of the content of the pre-production 3D animation and the final optimization step for the visual effect. Compositing is essentially a technique that takes a variety of sources and types of digital material and ultimately integrates them into a coherent and realistic visual through a series of artistic processes. This technique can be traced back to Cel animation in the early 20th century. In Blender, the producer can complete most of the compositing effects such as color grading, filters and masks in the compositing workspace.

Different editing techniques have a greater impact on the storytelling and overall visual performance of the animation, and the producers need to edit the movie accurately according to the storyline and the logic of the screen and make sure that the caption information matches the screen perfectly. In this process, the producers need to pay special attention to the timing of picture and sound transitions as well as the accurate display time of captions. Since the Blender software itself does not include the caption editing function, if the producers want to add captions to the animation directly in the software, they can use third-party caption plug-ins to complete this work more efficiently.

5. Conclusion

In summary, the production of 3D animation for digital media art is a complicated process, which requires the producers to have a solid professional foundation and software skills. Based on the characteristics and skills of Blender, the article discusses the main process of digital media 3D animation production and describes in detail how to use Blender to complete the modeling, shading, motion and camera settings, rendering and compositing and editing more conveniently and efficiently, aiming at providing the industry with a production and process reference.

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