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A New Exploration based on Unreal Engine4 Particle Effects of Unreal Engine in 3D Animation Scenes

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Abstract:- With the continuous expansion of the digital animation market, the continuous innovation of special effects technology provides strong technical support for the production of three-dimensional animations such as film and television animation and film and television advertisements. The production technology of virtual reality provides a robust technical guarantee for the realization of unconstrained artistic creation. In terms of 3D special effects production, Unreal Engine UE4 relies on its efficient design functions to simulate the reproduction of natural scenes, reducing the cost of film and television producers while making the animation effects more realistic, directly improving the artistic expression of 3D animation. This article summarizes the characteristics and functions of UE4 particle effects through the analysis of UE4 particle effects and finally uses them in actual projects.

Keywords:- *UE4 Special Effects Technology*; *3D Animation*; *Animation Scene.*

I. INTRODUCTION

3D animation is an integral part of virtual reality, and it has gradually penetrated our daily lives to serve people. Movies, TV, games, advertising, architecture, medicine, Etc., these industries closely related to our daily lives can see the presence of 3D animation technology. In today's society, people are increasingly demanding material and spiritual enjoyment [1]. Analyzed by animated movies, in addition to scripts that must attract the audience's attention, animated movies also need gorgeous 3D special effects to bring box office popularity to animated movies [2].Shots that are too expensive to shoot and pictures that cannot be achieved by hand-painting, 3D animation special effects can be well simulated and completed. 3D animation special effects technology in high-tech, virtual products, and other advertisements can effectively control costs so that the film can show brilliant effects in all directions. It has become an essential expression of advertising and has been valued [3].

In this paper, we study the application and function of 3D animation special effects produced by UE4 in the unreal engine in animated films to know more about animated films' development history and special effects. The role and significance of 3D animation effects in animated films, technological innovation and research and development, application fields and other related contents. The author hopes that completing this animation technology practice will play an essential role in promoting the development of the current animation industry.

II. THE CONCEPT OF UNREAL ENGINE UE4 SPECIAL EFFECTS AND 3D ANIMATION

A. The concept of the Unreal Engine4 Special Effects

UE4 is a set of integrated tools for game developers to design, build, simulate, and visualize games. It is a game engine developed by Epic Games. The essence of its engine technology is to integrate the written program code and blueprint real-time image processing technology into the software and use its functions to complete the effect of real-time virtual reality. Compared with the commonly used special effects software AE, NUKE, UE4, the designer's design can be quickly displayed and rendered on the screen. It can quickly occupy a special effects field position because its real-time nature requires multiple rendering tests [4].

UE4 particle special effects are a module developed and produced by simulating the effects of water, fire, fog, and air in reality with the backing of UE4 software. The principle combines countless individual particles to present a fixed form, with controllers and scripts to control their overall or individual movements and simulate real effects. Make the film's visual effect to a higher level so that the film has a visual impact. The common strengths of 3D animation special effects technology and 3D animation make the initially boring animation film show new vitality [5].

B. The concept of the 3D animation scene

3Danimation software can create a virtual world on the computer. 3D animation scene refers to the shape of all objects in the movie that change with time except for the character shape. It can be a background model or a variety of weather changes. The primary research is the production of various special effects through particles—the weather changes [6].

III. THE MEANING OF 3D ANIMATION SPECIAL EFFECTS

The application of 3D special effects is pervasive, most prominently in the field of movies. Although today's 3D animation special effects technology is still in the process of development, in response to the needs of the masses, the three-dimensional animation special effects technology is developing rapidly. In the domestic and international animation film market, the innovative achievements of 3D animation special effects technology are constantly refreshed. The roles of 3D special effects in animated movies are as follows:

A. The production of 3D special effects eliminates the need for on-the-spot framing of movie shooting, burning and blasting of natural objects and other dangerous shooting.

The practical application in the movie can provide better technical support for animated movies. Shorten production time, ensure staff safety, reduce film production costs, and improve production efficiency [7].

B. The integration of 3D animation special effects technology can help animators quickly shape natural elements such as clouds, fog, rain, and water. Add life to the scene effects of the film. Get the vivid and gorgeous scene picture. It plays an essential role in shaping the scene and rendering the atmosphere. In Fig. 1 "The Day After Tomorrow", special particle effects were used to create a colossal snowstorm, surging, and highly destructive tsunami; Los Angeles can involve cars in tornadoes that hover tens of meters in the air; observe from outer space Scenes such as the wind at hand and the Manhattan tsunami with squally winds and waves.

Fig 1:-Movie scene of the day after tomorrow

C. Synthetic animated movies of realistic scenes plus animated characters in the category of animated movies. The quality of its synthesis effect also depends on the application and skills of 3D special effects technology. In other words, 3D special effects play a decisive and essential role [8].

All of the above proves that 3D animation special effects technology has played a role in promoting the animation film industry. Furthermore, it promoted the development of the animation film industry.

IV. ANALYSIS OF THE APPLICATION OF CLOUDS, SNOW, WATER AND FLAMES IN 3D ANIMATION SCENES

In digital animation scenes, some atmospheric and climatic effects in the natural environment significantly influence the atmosphere, such as clouds, smoke, rain, snow, and floating dust in the air. These effects can add many different psychological atmosphere effects to the animation scene.

A. Performance of cloud effect

In the outdoor scenes of 3D animation, we will inevitably encounter shots showing the sky and clouds. Sometimes the sky and clouds are just a static background, and sometimes we need the effect of wind and clouds to set off the atmosphere, and sometimes we need animated characters. Shuttle through the layers of clouds and mist [9].

For the first static background effect, only a panoramic sky and cloud texture is needed, and it is pasted under the sky ball material for the sky cloud effect of the entire scene. Nevertheless, when the cloud layer is the main body of the scene, the effect of the cloud layer becomes the focus of the atmosphere expression of the entire scene. We need to use advanced particle flow software or a plug-in specially made for volumetric clouds to express the cloud layer's volume, movement, and other effects. By setting the effect of multi-layer volume clouds in detail and setting corresponding animations, we can get a more realistic cloud effect with the assistance of wind or space distortion. To create a cloud layer in UE4, we need to create a cloud layer shader, connect to the blueprint in Fig.2 and adjust the parameters in Fig.3.

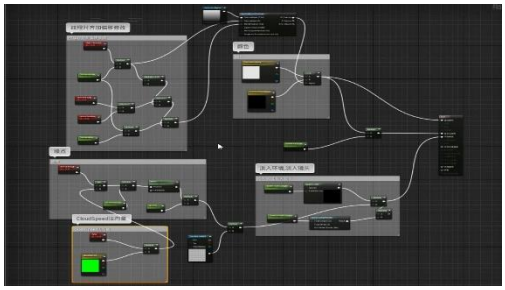

Fig 2:-Blueprint creation of cloud special effects

Fig 3:-Adjust the parameters of the cloud material

The cloud layer produced by this method has a thicker feeling of hanging and can also accept and produce light and shadow effects and accept the influence of wind. Clouds and other light and shadow special effects can produce special visual effects and shocking scenes. Previously, the amount of data calculation was huge when making the particle cloud layer, and it became time-consuming to clean and stain. The special effects produced by UE4 can quickly solve this problem.

B. Performance of floating dust effects such as blizzards

Natural phenomena such as rain and snow are often used in animation scenes to create atmosphere and express emotions in Fig.4. The smoke effect is added to the animation scene, which can give the scene an illusory atmosphere. In some cases, the smoke is caused by Sichuan to obscure the distant view, which highlights the subject and improves the reality of the scene. In addition, there are some explosions or friction fields that will produce a lot of smoke and dust [10].

➢ *Blizzards*

Fig 4:-Blizzard simulation

The blizzard special effect is a GPU plane particle system that uses many tiny plane particles with illuminated translucent materials. The material used on the snowflake is marked with Enable Responsive AA (Enable Responsive Anti-aliasing), which can be found under the Translucency category under the Properties panel of the material editor in Fig.5.

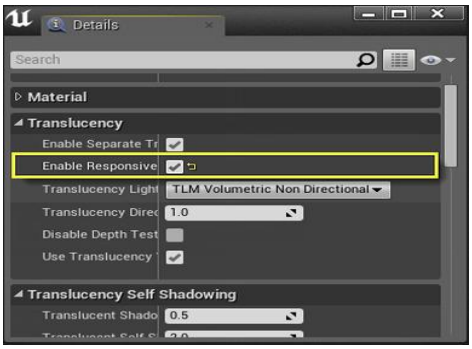

Fig 5:-Adjustment parameters

This attribute is used for tiny translucent objects (snowflakes_ in this case) because the temporary anti-aliasing of Unreal Engine will likely lose contour quality. However, **Enable Responsive AA** (Enable Responsive Anti-Aliasing) should only be used in this type of example, as it will cause background aliasing.

The blizzard particle system also uses a low-velocity vector velocity grid to slow down the snowflake plane particles entering the volume. This slow speed effect simulates the sensation of dragging on the particles, and at the same time, helps to collide, making them feel less rigid in Fig.6. [11].

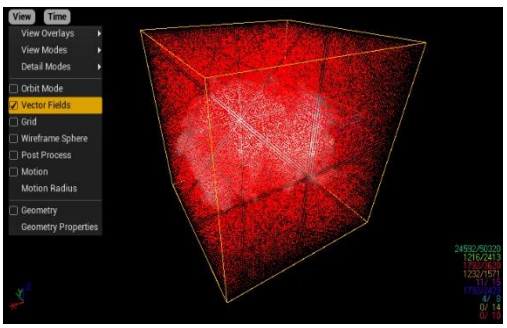

Fig 6:-snowflakes

➢ *Wind and snow flow at the edge*

Fig 7:-Wind and snow flow simulation

The wind and snow flow effect at the edge is a simple GPU plane particle system, which simulates the wind and snow flow through the cracks and cave cracks and near the entrance in Fig.7. It can be found near the hole at the top of the cave. Collision is mainly handled by the Collision (Scene Depth) collision (depth of field) module, which will cause GPU particles to collide based on the Scene Depth geometry buffer in Fig.8.

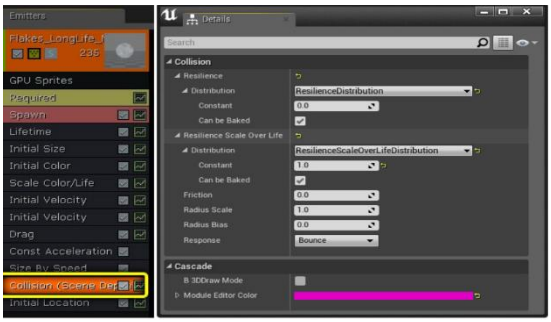

Fig 8:-Collision (Scene Depth)

This module allows particles to interact with the world so that they can collide with the surface. Depending on the different settings of the Collision (Scene Depth) collision (depth of field) module, they can also stick to the level surface or slide along the level surface [12].

C. Water performance

➢ *Waterfall*

Fig 9:- Water simulation

The special waterfall effect combines multiple material and particle system settings to simulate the effect of the water hitting the rock formation. An essential point in this effect is

that camera alignment is critical; the player will not walk directly into the water but will observe the waterfall closer in Fig.9.

Because these particles use translucent materials, they can cause excessive drawing performance consumption-which means that many waterfalls must be rendered on top of each other. However, because these water streams are GPU plane particles, the simulation performance is deficient because these costs are passed to the GPU for processing [13]. In this way, we can achieve more complex and interactive behaviours than just using materials and static meshes to create special effects. However, we can combine the above two techniques to make the special effects have changes.

➢ *Collision*

Fig 10:-Collision simulation

When the waterfall water ushes down the rock surface, we notice the water splashing and colliding with the rock surface in Fig.10. It is done through the collision (depth of field) operator, only available for GPU sprites. It uses the depth of field G-Buffer to calculate the collision surface and only produces minimal system performance consumption [14].

➢ *Particle colour*

Note that GPU plane particles do not support dynamic parameters. They are generally used to send data from the particle system to the material. For this reason, we used some tricks, using the particle colour node in the material. Generally speaking, this node allows us to change the colour of the particles as the waterfall flows. It is accomplished by animating the colour and alpha value during its life cycle. However, we use red, green, blue, and Alpha (RGBA) data to drive more content. Since there is no need to change the colour of the waterfall (the water is colourless), in Fig.11. we use the particle colour data as follows:

- Red: It drives the refractive index of water or the degree to which it shifts the light.
- Green: the actual colour of the drive. It means that the green channel drives all the RGB data for the colour, resulting in grayscale results.
- Alpha: The opacity of the driving water.

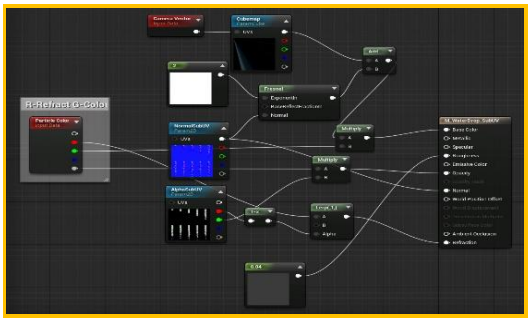

Fig 11:-Node blueprint with changing color

If we open the P_Waterfall particle system in Cascade, pay special attention to the zoom colour/lifecycle module. For the first half of the life cycle, the colour is animated as a very bright state (greater than 1.0), and when the alpha changes from black to white, it gradually decays to black. The final result is a clear fade-in and fade-out, as shown in the image below in Fig.12.

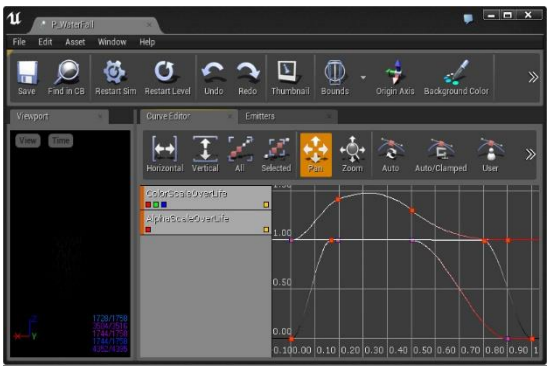

Fig 12:-The P_Waterfall particle system

D. Fire performance

Fig 13:-Fire simulation

This particle system simulates a real flame to illuminate the surrounding environment in Fig.13. This light is generated by the light module in the particle system. This module generates dynamic lighting at the particle position. The user can control the brightness, light colour, and light radius during the life cycle of the particle. However, we should note that these lights currently do not affect Lit Translucent Materials, which is why the flames used in this level also have standard lighting Actors at nearby locations [15].

Fig 14:-The radius of the particle light

In in Fig.14.we can see that the radius of the particle light is visible when the Preview Light Radius option in Cascade is checked [16].

This special effect also has a series of spark particles from the flame and moves with a believable vortex. We use Local Vector Field (local vector field) to complete this movement, an available feature of GPU plane particles. The vector field is a three-dimensional vector volume created from fluid simulation data, which will then be used to drive the motion of GPU particles. As the particle passes through the volume, the vector at each position can affect its speed. The vector field can be observed in Cascade through the view menu of the viewport [17-18].

In the figure above, the vector field can be seen as a giant cube with red lines, and the red line represents a single vector. The VF Rotation Rate (VF rotation rate) module is also used to rotate the vector field in this particular effect. It means that even if the vector field applies vortex to the particles, the vector field itself is already in motion, which will make the particle motion highly randomized and have a natural turbulent feeling.

V. CONCLUSION

Digital information technology will occupy a dominant position in future social development. People have gradually become accustomed to the changes brought about by digital information technology in their daily life and work. Digital media has also significantly strengthened the relationship between people. Communication and exchange. The digital environment has improved our lives and, at the same time, affects the direction of design education. Traditional visual expression and Visual design are far from meeting the aesthetic requirements and viewing needs of current audiences. The use of all-digital design styles is already a mature development trend of digital art [19].

This article analyzes and explores how the UE4 particle special effects technology assists and realizes the performance of various atmospheres in the design of animation scenes from clouds, snow, water and flames, highlighting the characteristics and advantages of computer graphics technology and making it bear. It has the function of meeting people's physiological and psychological needs and creates animation works that are more in line with modern people's aesthetic requirements and appreciation needs. UE4 special effects 3D animation special effects replace the clouds, rain, thunder and other weather in real life, making animated films move to the highest point of box office and popularity, thus getting more attention from animators. It is also because of this that animated films will continue to develop and enter a new era. The development prospects of three-dimensional animation special effects in animation movies are limitless. It impacts the shortcomings of traditional animation movies and continues to innovate. Shortly, we will see more versions of UE4 particle technology with more convenient operation and more impactful excellent animation films.

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