Research and Analysis of 3D games

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Abstract. With the progress of game technology, 3D games have gradually become an important part of the game field. However, the relevant analysis and discussion literature is not sufficient. Therefore, this paper discusses the relevant content of 3D games, starting with understanding the development history of 3D games, and analysing 3D game technology step by step. The characteristics of game engine and unreal engine are analysed. In addition, this paper details some of the early games that were considered 3D games. Including 3D game software and a series of production steps. Focus on the analysis of the most popular virtual engine, it is a good 3D game software. There are many similar tutorials on the Virtual Engine website, as well as a series of demos of the finished product. Finally, the development prospect of 3D games and the development direction of similar games are discussed.

Keywords: 3D game; stereoscopic game; game engine; unreal engine.

1. Introduction

3D games, it uses the concept of three-dimensional space coordinates, so more realistic, and the randomness of space operation is also strong. It's also easier to attract people. Also, 3D game is a general concept, which gives the impression that any game with three-dimensional sense is called 3D game. 3D games have become the most mainstream genre of games. In addition, there is also a 2D+3D pseudo-3D, also known as 2.5D technology, which is the combination of 2D and 3D technology to meet different needs of customers. However, due to the number of faces and complexity of 3D models, 3D games require much more computing power than 2D games [1].

Therefore, many 3D games require high configuration of individual graphics cards to complete the exciting 3D game experience. The graphics are also less detailed than 2D games. 3D here was limited to expressing depth through light and shade in a flat surface, until the advent of stereoscopic technology. Piled up with the progress of The Times, from the simple colors and images to millions of polygons formed from the accumulation of surprise, games are show us more and more real and vast world, in recent years to contact game playing world of warcraft, "resident evil 5", the players of the game, maybe can't imagine how much more than a decade ago 3 d game is simple. The 3D game engine, as the heart of 3D game production, has been the most central part of the development of 3D games. Star Villains and Ultima Underground, developed by Genesis Systems, were the first 3D games to be made, and the custom of a game engine named after a game. More than 20 years ago, these pioneers of 3D gaming began an unprecedented attempt at stereoscopic graphics on a Stone Age PC platform.

Several articles about 3D games have been very clear about the introduction of 3D games, their evolution, and some background [2-3]. But the game engine, three-dimensional game is not a comprehensive introduction in these papers. In addition, some other papers did not consist of some app such of UE5 and so on [4], which means this paper is more general and readers can find the relevant learning direction and learning content more easily. In order to describe this information in more detail and clearly, this work talking about game engine, the process involves collision detection of the engine, which determines what happens when different objects come into contact and also provides some samples and sketch maps to let readers know what they talking about, what the process or final product looks like.

2. 3D stereoscopic games

Show a coherent three-dimensional picture, so that the player feels the scene coming, or into the screen deep concave, can produce a strong sense of "immersive" [2].

3D stereoscopic games have special requirements for display (except red and blue), which are mainly divided into time division (also called active shutter type) and light division (also called non-flash type or polarized light type). Of course, the mainstream market is still light division, for several reasons:

The hour fraction is expensive.

The hour fraction has a very high requirement on the screen brushing rate.

Time fraction type anti-interference ability is poor

The optical fraction is different and has the following advantages:

Optical fractional glasses and display system are relatively cheap.

Optical fraction glasses can be recycled (need to charge at time).

There are almost no optical fractions.

Comprehensive above points, or light fraction of economic benefits, and 3D games should not play for a long time, eyes for a long time to accept different polarized light brain will bear a huge burden, and easy to produce vertigo adverse reactions.

3. What is Game Engine?

Most of the explanations given by people are based on the English translation of engine, the game engine is equivalent to the engine in the car (engine), and even better, the explanation is power. These explanations are correct, but the power only said is not comprehensive, cannot fully reflect the role and status of the game engine in the game. Let's start with a simple example of a scene in a game where a player-controlled character is hiding in a house and enemies are searching for the player outside. Suddenly, the player controls a soldier in camouflage, and suddenly knocks over a cup on the table, and the cup crashes to the ground with a shattering sound. After hearing the noise in the room, the enemy gathers to the player's position, and the player shoots the enemy, and the bullet detonates the combustible material around it, producing an explosion effect. In this simple and common process, the game engine works in the background, controlling everything that happens in the game.

The process involves collision detection of the engine, which determines what happens when different objects come into contact. Some games can go through walls and some don't. In this example, you knock the cup over and it makes a shattering sound. Making a sound at the same time as an action is sound processing in the engine. The sound of the cup breaking attracts the attention of the enemy, which is the AI operation in the engine. Finally, the two sides exchange fire and trigger the explosion, which produces smoke and explosives flying away, which is the physical effect of the engine. The main program used to control all game functions, from calculating the relative positions of collisions, physical systems and objects, to receiving input from the player, and producing sound at the correct volume."

Games of a decade or so ago were simple (in today's eyes), with volumes measured in meters, and the average development cycle for a game was about 8 to 10 months. On top of that, each game was written from scratch, and there was a lot of rework and effort involved. Slowly, the developers come to the conclusion that a law, some games are always some of the same codes, can be applied on the same theme of the game, so that it can greatly reduce the game development cycle and development costs, slowly this generic code is the embryonic form of the engine, with the development of technology, eventually evolved into a game engine it is today [3].

In the same way, when game engines came along, they also promoted game development in another way. With more powerful graphics cards and better graphics, game development cycles are getting longer, usually three to five years, and even longer if you're developing your own game engine, so most companies are buying an off-the-shelf game engine to simplify the development process.

So, in the actual game development process, how does the game engine connect the game with the video card, and how does the various special effects in the game call the video card to achieve? If you want to answer this question in a professional way, I'm afraid it's beyond my knowledge, but we can explain it in a very simple way.

4. Unreal Engine

Unreal engine 3 design purpose is very clear, every aspect has a relatively high usability, especially focuses on the aspects of data generated and programming, in this case, art without the help of a programmer is very small, only will be able to develop the data resources of the game as much as possible, and this process is done in complete visual environment, the actual operation is very convenient (Figure 1).

Figure 1. Unreal engine

64 bit colour high precision dynamic rendering pipeline.

Gamma correction and linear color space renders provide high color accuracy while supporting various post-effect effects such as halos, lens halos, and depth of field. During the release of the latest generation of display chips, we noticed a very obvious feature, that is, the new generation of display chips are no longer satisfied with the traditional 32-bit color depth, and instead need a more high-precision color range, which can be seen very clearly on the NV40 and R420. On the NV40, this technology is called HPDR technology, and on the R420, this technology is also reflected [4].

Supports all current pixel-based lighting and rendering techniques, including parameterized Phong lighting using normal mapping techniques; Virtual displacement map; Light attenuation function; Precomputed shadow masking technique and precomputed concave and convex self-shading using spherical harmonic maps were used

Advanced dynamic shading.

Unreal Engine 3 provides full support for the following three shading techniques: Shadow Volume technology with dynamic template buffering, which fully supports dynamic light sources, so that shadows can be cast accurately on all objects in the scene. Enable dynamic characters to cast dynamic, soft fuzzy shadows in the scene, this process is achieved by using 16X Super sampling shadow buffer

A pre-calculated shadow mask of extremely high quality and high performance is used, which allows the interaction of static light sources to be processed offline, while preserving the full dynamic highlight and reflection effect (Figure 2).

Figure 2. Gears of war 2

All supported shading techniques are visual and can be freely mixed as desired by the artist. In addition, it can also be combined with a colored attenuation function to achieve parallel light with appropriate shadows, spotlight effects, and cast light effects. Characters can create dynamic soft shadows using shadow technology in Unreal Engine 3 The powerful material system allows artists to create arbitrarily complex real-time shaders in a real-time graphical interface that is as friendly as Maya's non-real-time Shader graphical editing interface. All renderable materials contain physical properties, such as friction coefficients and other parameters [5].

In UnrealEd, the editing tool provided by Unreal Engine 3, you can modify the properties of objects in real time.

Sound effect that conforms to the physical principle

Fully integrated physics-based vehicle support, including player control, artificial intelligence and networking. UnrealEd's built-in visual physical modeling tool supports the establishment of primetimes for optimized collision detection of models and skeletal animation meshs; Constrained editing; Interactive physical simulation and adjustment in the editor. UnrealMatinee, a tool for visualizing sequences, animations, and curve paths based on time lines. Designers can use this tool to create in-game cutscenes, which can be interactive or non-interactive, to serialize animations, move objects including the camera, control sound and visual effects, and trigger game and AI events. The "Matinee" tool in UnrealEd is able to edit the sequence of events based on the timeline [6]. Support various platform output formats, including 5.1 surround sound and high-quality Dolby digital sound.

3D sound source position setting, Doppler effect.

Doppler effect: When the sound object is moving, the tone of the sound will change with the speed of the object moving -- the change of the sound frequency. This principle is also used in the sound card 3D production principle. The underlying game network transport is UDP-based and can combine reliable and unreliable transport to optimize the feel of the game, even in low bandwidth and high latency environments.

Up to 64 players can play at the same time in client-server mode. At the same time, it supports 16 players in non-server mode (point-to-point mode).

Support network interconnection between different platforms (such as PC server and game console client; Windows, MacOS and Linux clients play together). All game features are supported in online game mode, including vehicle-based multiplayer, team-based competition with NPCS and robots, cooperative play in single player mode, and more. Supports automatic downloads, including

consistent Unreal script code across platforms. This feature makes everything from user-created maps to bonus packs to full game mods available at will [7].

A "master server" component is provided to track servers worldwide, provide players with a list of filtered servers, etc. Worldwide game statistics tracking system. Please note that we will not provide a server or network framework suitable for a large number of players to play online network games. Although this work is a multi-person project that takes many years, there are still many teams that have done this with the Unreal Engine (including NCSoft's Paradise 2 and EA's Genesis X), which shows the possibility of using the Unreal engine as an MMORPG game client and tool.

4.1. UnrealEd content creation tool

UnrealEd is a pure "WYSIWYG" data generation tool that fills the gap between 3D Studio Max, Maya, and publishable games. Visual placement and editing of game objects such as players, NPCS, items, AI waypoints, and light sources - with full live previews, including 100% dynamic shadows. Includes a data-driven editing framework that allows level designers to easily customize any game object, as well as allowing programmers to use new customizable properties to designers via scripts.

Monster characters created by Unreal Engine. Visual material browser with search and management capabilities [8]. Artists can use real-time terrain editing tools to raise the ground, draw Alpha layers to the ground to control layer mixing and assembly, collision detection data and displacement maps. Artists can use animation tools to introduce models, bones, and animations and connect them to in-game events such as sound and script events. The visual Material editor makes it easy for artists to create materials that can be applied in a Shader program. The "Play Here" button in the editor allows the game to be played in the editor with a single mouse click. This way, you can test the game in the editor and edit it at the same time.

Each Unreal Engine license includes the right to recombine and distribute UnrealEd, allowing game makers to distribute their data creation tools along with their games to mod-makers. The visual terrain editor can reflect the changes of terrain in real time. Everything you'd expect from a modern data editing tool: multiple layers of undo/repeat functionality, drag and drop, copy and paste, custom shortcuts and color configurations, view management [9].

Most of our characters in Unreal Engine 3 are built from two mesh models: a real-time mesh with thousands of polygons, and a detailed mesh with millions of polygons. We provide a distributed computing program that ray-traces detailed meshs and generates a normal map from a high polygonal geometry to give real-time meshs in the game. The result is a mesh in the game that has all the light and shadow details of a high-polygon mesh, but can still be rendered very easily in real time.

Over 100 million triangle effects using the normal map are actually only 500,000 triangles. Unreal Engine 3 contains the routines section and 100% of the source code, including the engine itself, the editor, the Max/Maya export plug-in, and the game code. Script editor provided by Unreal Engine 3.

4.2. Unreal Engine can also easily support multiple languages

Unreal Engine 3 data resources and code are localizable, extending all the text, sound, graphics, and video in the game through a simple framework. Our games have been published in nine languages, including Chinese, Japanese, and Korean.

Attention to detail, other special specifications at a glance. Here are some guidelines we're building for our next Unreal Engine 3 game. Different types of games will have very different numbers of players, scene sizes, and performance. So, these specifications can only be used as a guide for one project, not all projects.

Low role

For each of the main characters and static grid resources, we build two versions of the grid model: an optional grid model with UV coordinates, and the one with the details of the geometry information grid model through the unreal engine 3 we deal with these two models, model based on the details of all the geometry information to generate a high-resolution rendering model of normal maps.

Renderable models: Game used 3000 to 12,000 triangles to build render able models, with about 5 to 20 characters visible simultaneously in the scene.

Low environmental

Some games used 2048 by 2048 resolution tiles for most of the normal and normal tiles for characters and scenes. This is a very reasonable goal for a game running on a mid-range PC around 2006. Next generation consoles may need to reduce the tile size by a factor of 2, while low-end PCS may need to reduce it by a factor of 4, depending on the number of tiles and the complexity of the scene.

A typical scene environment consists of 1000 to 5000 renderable objects, including static grids and grids with bones.

Low light

There is no hard-coded limit on the number of light sources, but for performance considerations, we tried to limit the number of large ranges of light sources to 2 to 5 because each light/object interaction is based on the time-consuming high precision per pixel illumination and shadow rendering pipeline in the engine. A small range OF Light sources for highlight and detail lighting will obviously take less time than a large range of light that affects the entire scene [10].

Very special software such as games does not create any real value in people's actual work, but it can let people relax in the process of using the computer. Whether a game can bring consumers the best possible sensory enjoyment has become the most basic factor for the success of a game.

For the most popular 3D games in the game, the difficulty of development increases with the game capacity, so how to quickly develop a high-quality game has become the key, and the way to separate the game engine and game content is naturally the best solution.

As the soul of the game, the success of the game engine will determine the final effect of a series of games. We introduced the latest version of one of the most advanced game engines, Unreal Engine, to give you a certain conceptual understanding of the game engine, but also know some things behind the scenes of a game.

5. Conclusion

This paper discusses the related content of 3D games, analyzes the development history of 3D games, and discusses the related characteristics of game engine and virtual engine. Details some of the early 3D games. In addition, this paper focuses on the analysis of the most popular virtual engine. In general, Unreal Engine 3 is indeed a very advanced engine, it provides very advanced functions, almost all the functions provided by the top graphics card, in such a technical background, this engine brings a very gorgeous effect, its demonstration picture is enough to shock every audience. Finally discusses the development prospects of 3D games and the development direction of similar games. The relevant content has reference significance for the future research of 3D games.

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