FPS Game Design and Implementation Based on Unity3D

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Abstract. This paper describes the planning process of a first person shooter game (FPS in short), including game scenario design, playing method design, game passed condition, the enemy AI intelligent system logic design and energy system design. Meanwhile the main implementation technologies of the game are introduced here by the mainstream Unity3D engine. Practice shows that a picture lifelike realism, movements’ smooth game works can be efficiently made using the unity3D engine.

Introduction

Unity engine is developed by Unity Technologies Company which is a multi-platform game development tools, and a comprehensive professional game engine. Three-dimensional video games, architectural visualization, real-time three-dimensional animation and other types of interactive content can be easily created with Unity. It uses interactive graphical development environment software editor as the main form, runs on windows and Mac OS X operating system, releases to games for windows, MAC, Wii, iPhone, Windows Phone 8 and Android platform, supports embedded in web pages. Currently Unity is widely used in games, construction estate, virtual display, education and training, industrial simulation, system simulation and others [1].

Unity is divided into two parts, the game engine and the editor. The game engine covers physical simulation, graphical interface, audio channel, and network capabilities, which are common in game research and development. Its script is based on Mono, C#, Boo, and JavaScript programming. The Unity editor is a integrated development environment of the game scene setting, the game preview window, and the layered object project panel. It is also equipped with several language script editors and a unique prefabricated assembly system [2].

Unity aims at the independent development market, and is suitable for weak teams and individual development because there are a lot of third parties plug-in. At present, the share of Unity in Mobile Games market accounted for 85%, while the cross platform advantages for client game and webpage game would be a trend which cannot be halted. At present, the engine has registered more than 1.5 million people. Off-line Unity is still the main development engine in the game market, and will continue to play a pivotal role in the future.

FPS Game Design

FPS (shortcut for the First Person Shooter game) is a kind of game that takes the player's subjective perspective. People play games not only by manipulating the virtual characters in the screen, but also by the visual impact on immersive experience of the game. Then the game's initiative and real sense is greatly enhanced. Early FPS games bring players the stimulation of the screen light in general, and simple and fast game rhythm. With the gradual improvement of game hardware as well as the combination of various games, FPS game provides a richer plot, exquisite picture and vivid sound effects. [3]
Plot Design

The story of game "purification" takes place in the future. It describes that the earth has been invaded by aliens and is being transformed, human beings seek the purification way and make the earth suitable for human existence. The hero is a future soldier sent back to the earth who will complete the task by the way of finding out two energy crystals.

The game "purification" is a 3D interactive simulation shooting game which has the Chinese style as elements, has of China's ancient debris construction as the background, and restore an immersive game scene using Unity3D game engine.

Play Design

Players were born in the map of the designated position, press the WASD keys in keyboard to carry out mobile operations, and press the left mouse button to shoot. There are have two scene maps, an ancient city gate is the demarcation point in the middle of these two maps. The gate cannot be passed until the task in the first scene is succeeded. The user interface will be showed to tell a player the current mission when he starts the game. For example, the user interface will pop up to tell the players to find out the two lost energy crystals in this scene and put them in the specified energy installation groove point to complete the game level using the right mouse button. Players can use G key to select one of the three guns: flame gun, laser gun, or laser gun while they face to face enemies in the game scene. They can also use the Q key to select the telescope to spy on the enemy's trends. The function key is shown as Table 1.

Energy consumption system is added to gun in order to increase the difficulty of the game. The gun weapon core ammunition in the future is in form of energy reserves. The energy will reduce continually, so guns will not shoot once the energy disappeared (players can only be beaten or escape).

Table 1. Game function key.

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
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<tbody>
<tr>
<td>Key Q</td>
<td>Use a telescope</td>
</tr>
<tr>
<td>Key G</td>
<td>Switch in flame guns, laser guns, laser guns</td>
</tr>
<tr>
<td>Key WASD</td>
<td>Move: forward, backward, left, right</td>
</tr>
<tr>
<td>Mouse left button</td>
<td>Shooting</td>
</tr>
<tr>
<td>Mouse right button</td>
<td>Pick up items</td>
</tr>
<tr>
<td>Key ESC</td>
<td>Open menu</td>
</tr>
</tbody>
</table>

Passing Conditions

Game passing conditions are 3:
1. To complete the assigned tasks within 5 minutes;
2. To find the crystal in the first scene, and then open the forward door;
3. To find the remaining crystals in the second scene, put all of them into the specified place to open the purifying task.

Enemy AI Intelligent Logic Design

When a player is at the enemy AI 35 meters away, the enemy AI cannot find the specific location of the player, not to fire, and just repeats patrolling in its own area. Here a Move Points array is set up to get the corresponding point, whenever AI reach at Move Points position, Point's target position will be added 1, and points to the next patrol point. Players also continue to play walking animation.

When the player is less than 35 meters from AI, AI can perceive the specific location of the players, play running animation and choose the most reasonable route toward the players. When AI runs away from the player 20 meters, he will stop and attack players with attack animation.
When players escape beyond the range of AI enemies attack scope, AI will chase players in running animation.

When AI is attacked and injured, game will play AI injured animation. The specific distance from AI to players will be judged, when the distance is more than 35 meters, AI will returned to their patrol area and continue to patrol; when the distance is between 20 meters and 35 meters, AI will switch to running state and chase players; when the distance is less 20 meters, AI will be in place and continued shooting at players.

**Energy System Design**

Players supply of energy to guns to achieve sustained fire in the designated point. The energy of guns will be consumed by time passing.

The design logic of energy state is: There is a UI strip with a full energy position and a null one. The gun’s current energy state is between them, and will move from the full energy 2D coordinate to the null when time passing. The gun can fire when its energy state is on the strip, otherwise it cannot fire. If the current energy reaches the boundary point, the movement is stopped. It shows energy supplement is necessary.

**FPS Game Key Technology**

Many key technologies must be considered in the game development. For example, the state machine control of AI enemies, players control, non-player control, data transfer, sighting telescope, particle effects, energy systems, object preload technology, etc.

**Automatic Search**

"Purify" automatic search path system is completed with unity3d embedding navigation system. Check to open the window, set to static for all terrains and scenes which cannot be moved, then bake. The AI enemies will only calculate the nearest distance on the baked terrain, and determine the fastest moving direction. Class MonoBehaviour.Vector3 is called to get the above functions.

**AI Role Intelligent Control and Animation State Machine**

The enemy AI role control and state machine switch in "Purification" mainly used embedded Mecanim animation system which is used to complete the game animation control system in Unity3D (shown as figure 1) [4].

![Figure 1. Animator interface enemy AI animation state control chain.](image)

There are two main aspects. One is avatar, with visual interface, developers can browse role each joint point to understand the implementation of skeletal animation, and also can fine-tuning artificially, such as controlling a single joint to realize the matching of bones and muscles to ensure normal role display animation. The other is Animator Controller, used for animation control.
Mecanim animation system can do the visual logical processing corresponding to the specific logical relationship based on the script, determine what kind of animation will be play according to the logic of the script, and control AI enemies through complex logic processing. There are two steps, visual logic operation in the animator and C# script logic processing.

**Collision Detection and Data Transfer**

Many collision detections, such as the collision between bullets and objects, are used in the development of the "purification". The function is OnTriggerEnter in monobehaviour. First of all, the bullet object is made into Prefab, adds BoxCollider and RigidBody components, and the BoxCollider component is also added to the corresponding object. When OnTriggerEnter function is called, you need to check the Trigger attribute in the BoxCollider component of the gameobject which also has RigidBody component.

**Performance Optimization**

2 kinds of performance optimization techniques are used mainly in this game, that is LOD (Levels of Detail) and Occlusion Culling [5].

The principle of LOD multi-layer rendering technology is: developers control the distance from cameras to target objects, to implement different models or texture mapping. For example, when the object is far from the camera, the system automatically calls low precision models and texture mapping which are added beforehand. Otherwise, when the target object is close to the camera, it can choose to use high precision model and mapping.

The OCC occlusion technology doesn’t render the image content for a player that isn’t in the camera. The objects within the camera can also be determined to the rendering levels by their locations. The rendering level is low for the early rendering objects, and is high for the new rendering objects. This results the new one covering the original. Using this technology, just the visible objects are rendered, but the objects hidden others are eliminated.

**Conclusions**

Unity3D engine is playing a more and more important role for the game industry. The Unity3D utilization rate is 75% that ranks first globally at Chinese hand-games market according to data statistics in August 2014. Development cycle of FPS game is shorter, less difficulty by using Unity3D. A FPS game with good effect and meeting needs of users can be created, just using Unity own systems such as the visualization of meconium animation system, particle system, and navigation automatic routing system, etc. At the same time a realistic gaming environment can be restored by the Shader which can process effect details.

**References**


