Research on Visual Simulation of C2 System’s Multi-functional Display and Control Console With 3ds MAX

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Abstract. Making use of 3ds MAX, Photoshop, UDK engine, etc., the paper proposes the methods for the visual simulation of C² system’s multi-functional display and control console from 3 aspects: modeling, animation, and scene simulation. It is scientific, efficient and innovative, which is helpful for expanding new ways for the learning of C² system and enhancing the combat capability of forces.

Introduction

To familiarize the features of equipment and master their application in combat, the teaching of naval equipment mainly composes of theory instruction and equipment operation. But the operators’ learning is usually low efficient. This paper proposes the visual simulation of C² system from 3 aspects: modeling, animation, and scene simulation, which is clear and helpful for the learners to master the composition and performance parameters of the equipment.

The Realization of Modeling

The design idea in modeling is to focus from the entirety to locality, and then from locality to entirety. To be specific, the layout design is realized by firstly using simple spline modeling according to the real console. Then, the Boolean Operation and Extrude will be used to draw the overall shape of the console. For the structures of different parts, the display screen, touch screen, keyboard, shortcut key, tracker ball, and indicate light will be modeled one by one in detail. At last, these parts will be incorporated into the whole design.

The Framework Construction

C² system’s multi-functional display and control console contains several display screens, which are suitable for spline modeling. The detailed steps for spline modeling in this paper are as follows:

Step 1: Choose “Spline—line” to create 3 continuous polygonal lines. Adjust the length according to the real size of the console and the scale. Convert them into “Editable Polygons”. Choose “Polygon” and “Extrude” the cube in the scale.

Step 2: Adjust the vertex and the framework according to the shape and scale of the console.

Step 3: As circular arc gap exists at the back of the new generation console, Boolean Operation is thus used to subtract the cylinder.

Step 4: Use “Connect” to add two horizontal lines at the table-board and extrude the working table-board (and then make the touch screen platform). Extrude corresponding height at the door of the cabinet to finish the framework construction.

The Modeling of Different Parts

The key parts of display screen, touch screen, keyboard, shortcut key, tracker ball, and indicate light will be modeled one by one in detail.
The Modeling of Display Screen. Choose a “Cuboid” in “Standard Primitives”. Adjust the length, beam and height according to the size and scale. Convert it into an “Editable Polygon” or load a modifier of “Editing Polygon”. Choose “Editable Polygon—Polygon” in “Modifier” to extrude the height and choose four edges of the polygon to use “Beveling”. Use “Insert” according to the distance between the display screen and the border and set appropriate parameters. Choose the inserted polygon to apply “Beveling” and set appropriate parameters (set the height and profile as negative).

The Modeling of Touch Screen. The modeling of touch screen is the same with that of the display screen, with only difference on size. The method will be omitted here.

The Modeling of Keyboard. Sketch the distribution of the keys in a paper according to the real size and scale of the keyboard. Create a “Cuboid” and convert it into editable polygon. Select the edges on two sides according to the distribution area of the keys and divide the polygon into 6 parts by using “Connecting”. Then, extrude 6 grooves and “chamfer” the borders. In each area, draw the keys by using “Connecting”. Choose the polygons in each groove, click “Insert (press polygons, number 0, 1)”, and extrude the keys upward by “beveling”. Finish the modeling of keys in each area. Adjust the base of the keyboard by “chamfering”. At last the modeling of keyboard is completed.

The Modeling of Shortcut Key. Create a cuboid as a key according to the real size and scale of the shortcut key. Create a smaller sized cuboid and cylinder as the rotational axis of the visor. Create a highly transparent visor on the key and use Boolean Operation at the rotational axis to form a groove. Copy and arrange the single shortcut key to accomplish its modeling.

The Modeling of Tracker Ball. The tracker ball of the console looks complicated, making it difficult for modeling. Therefore, it is imperative to measure the size and master the profile of the tracker ball in detail beforehand. The main methods used in modeling include creating “splines”, loading “extrusion”, “FFD 4*4*4” and modifier “editing polygon”. The detailed steps are as follows.

The Modeling of Indicate Light. Create a trapezoid by using “splines” (according to the size of indicate light’s cutaway view). Adjust the axis for operating the trapezoid by putting it to the middle of the indicate light. Load modifier “Turning” to form a tubular body with different radii at the upper and lower sides of itself. Create a “ball” to act as the light of the Indicate Light.

The Assembling of Different Parts
Put these parts to the main body and then make the auxiliaries like the handle and the screw spike. At last, use modifier “Chamfer” on the edges of the framework to make them smoother.

The Mapping and Rendering of the Model
In order to make it more authentic, it is necessary to apply texture to the model with suitable lights and appropriate camera angle. At last, export the model after rendering. In choosing 3D modeling tools, we selected 3ds Max for modeling and installed Vray 2.0 renderer. As Vray renderer contains a large amount of textures, it is easy and convenient to edit the textures with it. It is also required to make some maps with Photoshop after taking the pictures of the equipment and apply them to the model.

Setting the Texture and Mapping. For the textures that can be used in the C^2 system’s structure, edit them in the texture settings for black plastics, LED screen, etc. For the textures with the characteristics of the equipment, it is required to use the Eyedropper tool in Photoshop to extract the target color from the photos of the equipment provided by the instructor. Then, the texture map can be generated for rendering. For the logos and numbers on keyboard, photos can be captured for use or text maps can be made by Photoshop. When making maps, it is advisable to make whole maps rather than small maps, which will be more convenient for rendering.

Rendering and Exporting. After finishing the modeling and texture setting, check it and prepare for rendering and exporting. Here, the rendering is only for a single model, in the form of a picture.
The Realization of Animation

After modeling, animation is needed for display, which contains three steps. The first step is to display one console of the system with viewpoint of the camera circling around it. The console is required to be static, while the camera in motion. The second step is to display the details of the console, which is static. The camera will move in broken lines to see the details of the console, which resembles the zigzag scan of radar. The third step is to display the whole C² system with viewpoint of the camera circling around the whole system.

Animation Display of a Single Console

Create a circle in “spline” with the console as the center. Set appropriate height and radius. Create a “target camera” which is automatically named “Camera 001” and put the camera on the track of the circle. Switch the viewpoint to Camera 001 and “perspective”. Adjust the angle and position of the camera to ensure that the camera can view the whole console. Set the track of the circle as the constraint path of the target camera in “Animation” - “Constraint” - “Path Constraint”. Set the speed and number of play frames when playing the animation in “Time Settings”.

Display for the Details

Create a zigzag moving route from the topside to below in an appropriate position in front of the C² system. Create a target camera and set the length of animation as 460 frames. Take the zigzag route as the constraint path of the target camera. Adjust the vertex of the zigzag line to ensure that the moving camera can view the main structures. Adjust the pitch angle of the camera so that the camera can direct at the details of the display screen, the touch screen, the buzzer, the power key, the indication light, the shortcut key, the keyboard and the tracker while in display. Set the key points. The moving speed of the camera in each line can be set with the help of the key points.

Display of the C² System

Take the center of all consoles in C² system as the center point, create a track of circle. Adjust its radius and height. Create a “target camera” and put the camera on the track of the circle. Switch the viewpoint to Camera and “perspective”. Adjust the angle and position of the camera to ensure that the camera can view the whole C² system. Set the track of the circle as the constraint path of the target camera in “Animation” - “Constraint” - “Path Constraint”. Set the speed and number of play frames when playing the animation in “Time Settings”.

Rendering Settings and Exporting

The Rendering Settings. Rendering means to render the image of each frame and then play all the frames. Check each frame before rendering. As long as it is rendered, the video of animation cannot be changed unless render it again. In rendering settings, set the length and number of frames in animation as well as the start time and end time. Choose to render the whole frames or a part of it while setting the time. The video rendered and exported should be edited respectively.

Exporting. Set the exporting parameters after rendering settings. Firstly, select the exporting size according to the requirement for image quality. Choose the aspect ratio and pixel. If the pixel is large, the rendering will be slower and the requirement for graphics card will be higher. At last, choose the exporting place in “files” and set “saving format” and “file name”. Since it is exported as a video, choose the format “*.avi” and click rendering to start the process.

The Realization of Scene Simulation

The design idea in scene simulation is in line with modeling, which is to focus from the overall structure to details and from the entirety to locality. In scene simulation, complicate modeling methods should be avoided to ensure swift and convenient construction of virtual scenes.
The Construction of the Main Scene

The main scene is in the command room. Open UDK engine and choose to create a Blank Map. Create a box and modify its size. Check “Hollow” to form a hollow box. Click Ctrl+A to add the created box. Then, create a passageway which has the same height and width with the combat command room as well as an appropriate length. At last, create a box between the passageway and the combat command room and form a hatch by check “hollow”. In this way, the construction of the framework is finished.

The Construction of Components in the Scene

The main components in the scene include the lights, the bulkhead and the visual hatch. Make them easy and convenient in construction.

The Construction of the Light. Light is the most basic component. Without it, the scene will be running in darkness. Therefore, the construction of light has the top priority after the framework construction. It is required to have light outside the room. Here, we can choose a “Skylight” and drag it on the room. For the construction of the inner light, use “PointLight” and put it inside the room. Meanwhile, reduplicate several to the combat command room and the passageway.

The Construction of the Bulkhead. In the compartment, the bulkhead is the skeleton that supports the ship. Firstly, choose a box which is as high as the platform but with minor width and put it on the side near the bulkhead of the ship. Create 4 pieces of horizontal bulkheads and 11 pieces of vertical bulkheads. Put the design emphasis of the bulkhead on its arch structure since each bulkhead is in an arched shape. In designing the arch structure, choose the same width with the previous one and make use of the edit functions under Geometry Tool. Add the number of vertex and adjust their positions to form the arched shape around the corner. After finishing the design of bulkhead on one side, rotation and translation will be used to create horizontal and vertical bulkheads on the other side. At last, construct a cuboid to connect the arch structure on both sides. In this way, the design of the bulkheads in the compartment is finished.

Texture Production of the Scene. To simplify the design process, texture settings are mainly embodied in texture mapping, whose key point is the color of the scene. Here, we will make the texture by ourselves with the edit function of UDK’s texture ball. Firstly, open the browser and click “newpackage”. Right click the blank space in the texture and mapping area on the right. Add “create material” and set different groups and names. Hold down “key 1” on the keyboard and click to create the map in the mapping area. Adjust the number of “Passage R” in attribute column. Create a grey map and connect it to “Diffuse”. Click the green “check the number” on the upper left to finish the editing of the texture and return to the scene. Finally, drag this texture to the surface.

Import and Output of the Models

The imported 3ds MAX models are strictly prescribed in UDK: the covers of the model should be less than 65535; the model should be simplified before importing; the format of the map is “.tag”; the size is the integer power of two; no files should have Chinese paths.

Import of the Model. Since there are requirements for models, they should be edited with collapse tools before importing. In the editing process, collapse all models with the same texture to ensure their attributes not changed. Import the different parts respectively and integrate them into one model. The maps in 3ds MAX can be imported directly.

Output in Package. After the construction of the scene and the components, set the place and direction of the actor. Add “PlayStart” in “browser” and drag it to a designated position. Change the direction with rotation. See figure 1 for detail. Check the scene again. If there is no problem, pack it with Unreal Frontend in UDK. See figure 2 for detail.
Summary

This paper analyzes the C² system’s multi-functional display and control console and realizes the construction and display of the virtual scene for C² system. In the research process, we firstly make use of 3ds MAX modeling tools and Photoshop mapping tools to construct models. Then, the animation function of 3ds MAX is used to view the components and details of the C² system and the display and control consoles. At last, the structure and layout are simulated by using UDK engine. The model of the C² system is imported for scene simulation with the first view point. The visualization and simulation introduced in this paper is scientific, efficient and innovative, which is helpful for the learning of C² system and leave deep impression for the appearance and attributes of the C² system. Meanwhile, the display of the visual scene and functions of the equipment can also assist the training of forces.

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References