Virtual training system design for portable equipment

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Abstract. In view of the equipment operation training, a portable equipment virtual training system based on android platform was designed by us. Through the 3D Unity engine technology and the reasonable use of gesture touch technology, the simulation and interaction of mobile equipment were realized, the convenience and fun of the training were improved.

Introduction

Currently in the interactive aspects of virtual operating equipment, mostly using immersive VR peripherals such as keyboard, mouse, HMD, data gloves, and other operating handle. In view of the gesture touch technology which develops rapidly in the field of human computer interaction in recent years, this paper develops a virtual training system based on the portable Android platform, which has a certain significance to improve the training's portability, interest and immersion, and reduce the training cost.

The system overall design

Considering the virtual training system eventually run on the android platform, in order to guarantee both software runs smoothly, and do not break the pertinence of training, the system uses a "3D game" design ideas, keep the main training function, strengthen the user experience. According to the general rules of the training, the training mode is divided into three models: learning, training and examination.

Learning mode functions: automatically, complete and clearly shows the whole operation process of equipment, each place has the tooltip function operation, enable trainees to according to the text prompts guide, gradually use the specific gestures to complete the operation of the virtual object.

Training mode function: in view of the trainees gradually master the training content, can choose to operate equipment virtual objects independently without any information, the correct operation of the virtual object will make the state changes, virtual objects will not response when operating errors, and issue an error message. In the training process, the operator through the gesture of arbitrary rotation, scaling, moving virtual objects, 360 degrees to view the virtual object and its components.

Assessment mode function: on the basis of the training mode, set the countdown for operation. Within the prescribed time, trainees need to gradually complete all the necessary operations, at the same time make logic judgment of right and wrong for each step operation, according to the operation result to give certain evaluation.

Key technologies

(1) general architecture implementation

System adopts the design thought of "three layer architecture", namely the data layer, logic layer, UI layer separated from each other. In order to facilitate the processing of events and messages between the layers, achieve the generality of the program structure, we define the key class as shown in table 1:

Table.1. Key classes and functions

The key class	function
GlobalManger.cs	Global Management, identifies the current mode, the current state of the system, the UI that is currently displayed on the interface, and any class that can interact with this class;
UIManager.cs	UI management and UI message processing;
StepManager.cs	Step control class, after the animation between the two frames is completed, the next thing to do, can scalability in this class;
StepPlayer.cs	Step class, play the animation between two frames;
StepUnit.cs	Step data structure, by reading the configuration file to generate the required data structure;
AnimationPlayer.cs	Animation player, play the animation on the object, there are several overloaded. Can provide play, pause, stop, play back, pause callback, check callback and other functions;
AudioPlayer.cs	Voice player, that is, the background music player, all sound functions can be expanded on the basis of this class;
ConfigReader.cs	Configuration file reader, used to read the configuration file, supply StepUnit. Cs generate different data structure, ready for use;
DelegateDefine.cs	The callback base class defines a variety of formats to facilitate the return of different messages and handle different events;

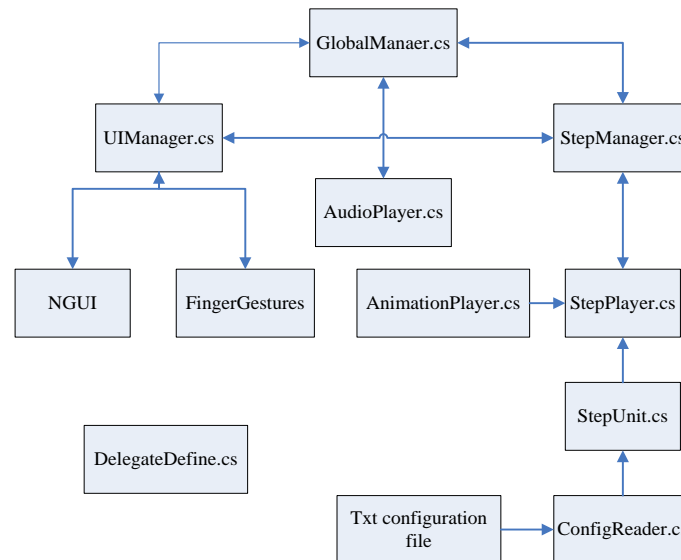The key relationships in the program are shown in Figure 2.

Figure.2. program class diagrams

Between GlobalManaer.cs, UIManager.cs and StepManager.cs three are mutually interactive. UIManager. Cs is mainly responsible for the response and handling UI message, but also responsible for handling system information with StepManager.cs, and the results will be notified GlobalManaer.cs.

System configures the corresponding Txt data file for each training mode, including the virtual object resource location, virtual object animation steps, each step of the starting frame and ending frame and a series of information. Once the trainees select a mode, the model will be stored in GlobalManaer. Cs object, convenient query at any time. The ConfigReader. Cs is responsible for reading the corresponding mode of TXT configuration files, and transmitting the data to StepUnit. Cs, generate a fixed data structure {firstFram (Qi Shizheng), lastFram (end frame), delayTime (time delay playing time), description (for the action description)}unit, stored in the linked list for StepPlayer.cs ready to play. If trained personnel operating right or need the animation, StepManager.cs then informs the StepPlayer.cs to play the needed animation, StepPlayer.cs uses the AnimationPlayer.cs to play corresponding animation listed in the unit.

(2)Implementation of multi task gesture interaction operation

Gesture touch is mainly used to realize the virtual environment navigation, the operation of UI, operating equipment virtual object three functions. So we need according to the function to determine a variety of tasks gestures.

The navigation of virtual environment, that is, to realize through gestures to check the function

of the virtual object, is in fact according to the need to change the camera Angle, orientation, location. So in addition to the ordinary click, we design several gestures can satisfy the need of navigation: single finger sliding around to realize the the function of rotating virtual objects, double that sliding around the sliding to achieve a mobile virtual object, double refers to the relatively close, relatively far away to realize the virtual object.

Operation UI is mainly the UI button, mainly use a single hand gesture.

Unity 3 d specifically for the gesture task provides two input objects touch and input for the developer. Convenient access to the state of the trainees to touch, including touch location, away from the location of the touch, the touch of time, the number of touch and a series of information description, using input and touch two classes, through the combination of each variable can solve each single gesture event, but this method is not easy to use, is not conducive to solving the complex problems we face. For that we use a Finger Gestures plugin written specifically for Unity, the plug-in is through the c # proxy at the bottom of the form to realize the gestures, contains five default, use it convenient to listen to all kinds of gestures in the Unity of events: the up and down or so four direction of sliding events, press event, lift, mobile event, long press events and so on.
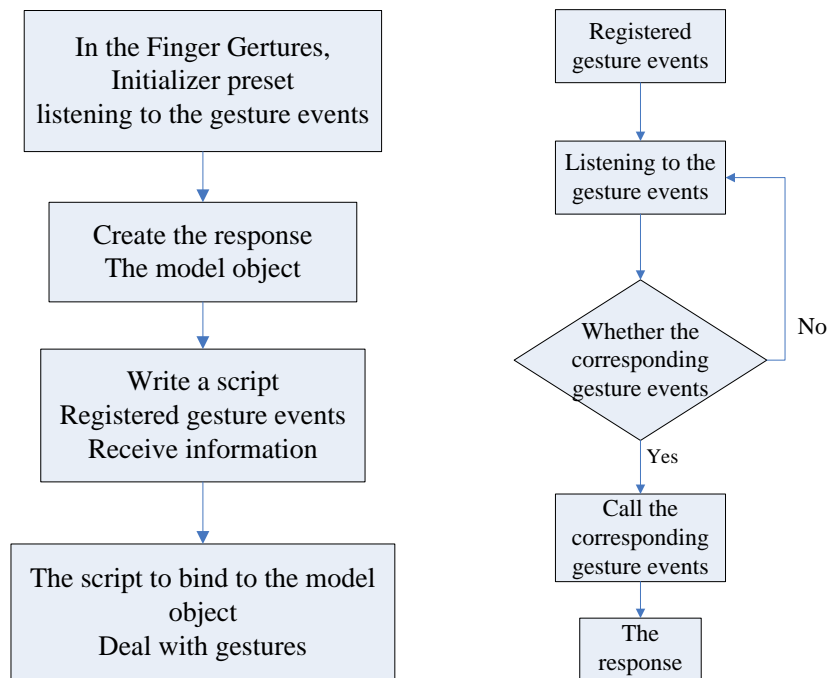

Figure.3. usage method of gesture plug-in & process for script programming

Here we use a single hand event for example to illustrate the application of Gestures Finger, as shown in Figure 3, you first need to add "Finger Gertures Initializer presets" into the Unity 3d project panel for monitoring the appropriate gesture events, then create a virtual object in response to gestures, and finally write C # script that will write the script on the corresponding virtual object, or any other virtual objects to start receiving information.

Because this plug-in is through the c # proxy form to receive the news events, so we need to use script to register for these events and thus to receive the message.

The implementation of the system

The key to realize the system is scene modeling and scene drive. The real degree of virtual object, the effect of the system determines the immersion of the training, but we can not be one-sided pursuit of the effect of the picture, and do not consider the smooth operation of the software on the plate. Therefore, in the use of Max 3DS for modeling, needs detailed modeling for the virtual object parts which needed interactive operation, for unrelated parts are relatively rough, the texture of the virtual object is completely collected and processed, can let the trainees feel very real.
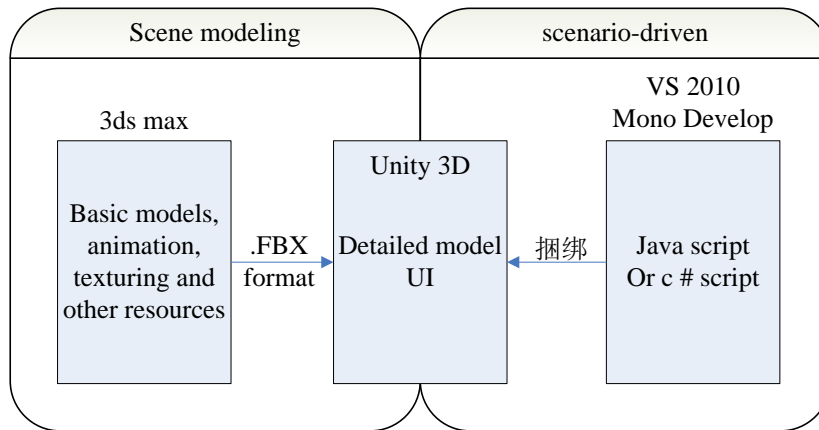
Figure.4. system development processes

After completing the establishment of a virtual object, the virtual object, animation, map resource are exported to the FBX file by 3ds max's FBX plug-in unit, then import to the Unity 3d for scene configuration, choose shader which is suitable for the flat system version support . The interface design of the system, using the NGUI plug-in and its simple and friendly interactive interface which can easily to created, as shown in Figure 4.

Scenario-driven mainly refers to the writing of script language, which is the function code writing and the structure design of the program frame. In the development of this system, the main use of the development language is C#, and also use some plug-in that are helpful to writing the script, mainly include the NGUI (UI plug-ins, used to make interface), FingerGestures3.0 plug-in. We use the Visual Studio2010 and Unity with Mono Develop for c # or Java Script Script programming. The script is bound to the operating object or GUI to achieve the scene of the driver, editing, that can be deployed to Web, PC or mobile terminal through Unity. Figure 5 is the running effect of the system to be released as a APK installation to Android 4.2 Tablet PC.

Figure 5 training system operation screens

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