Design and implementation of interactive virtual runway system based on Unity

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Abstract. The sustainable concept of virtual shows has brought a turning point for improving the extravagance and waste of fashion shows, but as far as the current technology is concerned, most of the virtual shows on the market are still single shows, and the information of multiple shows cannot be flexibly and unified management. Based on this, the author jointly developed an interactive virtual runway show system through Unity3D and MySQL, carried out scientific analysis and design of the system function and database structure of the virtual runway, standardized production of the model, and realized the runway function. At the same time, the display method of combining the model and the dynamic model of clothing was proposed. Enhance the simulation effect of different fabrics, and provide more abundant reference materials for its professional design.

Keywords: fashion runway, Unity, MySQL, UI interaction

1   Introduction

As an important scene and foil for costume display, costume performance shows often abuse device props on a large scale in order to achieve gorgeous visual effects, which is very unfavorable to the environment[1]. Later, with the development of network digital technology, substituting virtual objects for physical objects has become an emerging trend and is widely used in all walks of life. People spend more time, money and energy in the virtual world, and physical display virtualization has become an inevitable trend[2]. At present, the successive emergence of virtual exhibition halls and virtual museums of clothing also provides a good start for virtual display of clothing, which not only stimulates the upgrading of the show mode, but also helps enterprises reduce the cost of clothing display and improve economic benefits.

Limited by personal devices, watching shows on mobile phones is one of the most common viewing methods at present. However, most of the shows presented by enterprises are single shows, that is, only one series of product information is displayed on the show. If users want to obtain multiple series of product information, they need to

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search again and repeatedly, which is a tedious operation. The lack of systematic management of the existing shows will also reduce the flexibility, scalability and data reuse of the shows. In view of the above situation, this paper designs and implements a virtual fashion show system based on Unity, which can manage models, clothing and show information in a unified way. At the same time, the method of separate simulation and combined display of clothing and models is also proposed to more truly restore the wearing effect of different fabrics and reduce the consumption of the system in fabric simulation.

2   SYSTEM DESIGN SCHEME

This system is developed by Unity2021 platform integrating Android sdk and MySQL plug-in, and uses C# to write scripts, and finally demonstrates on the mobile terminal.

2.1   System Structure

The system as a whole is divided into three modules: storage module, user module and production module, as shown in Fig 1.
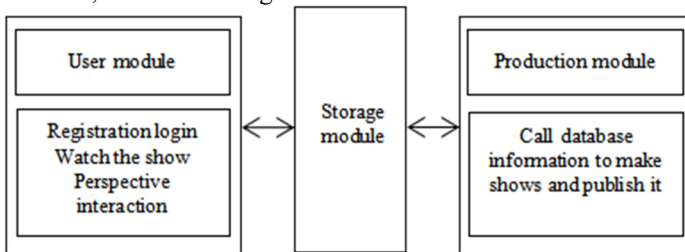

Fig. 1. System structure diagram

2.2   Database Design

Clothing, model and scene are the three major elements of show performance. The database design of this system is based on the information of the above three elements respectively, Clothing is divided into static clothing information table (NA_cloth) and dynamic clothing information table(A_cloth), dynamic clothing information table contains dynamic clothing ID, illusion and storage path, static clothing information table contains clothing ID, illusion, static clothing storage path and corresponding dynamic clothing ID. The model database is similar to clothing, it is divided into static model information table (NA_model) and dynamic model information table(A_model), of which the dynamic model information table is used to store dynamic model ID, illusion, storage path and dynamic clothing ID; The static model information table contains the model ID, illusion, storage path, and corresponding dynamic model ID. The scene information table is mainly used to store the scene ID, illusion, dynamic model ID and model storage path. In addition, users must register and log in before viewing, so a user

information table containing user ID, user name and password is set, and the database physical model diagram is shown in Fig 2.
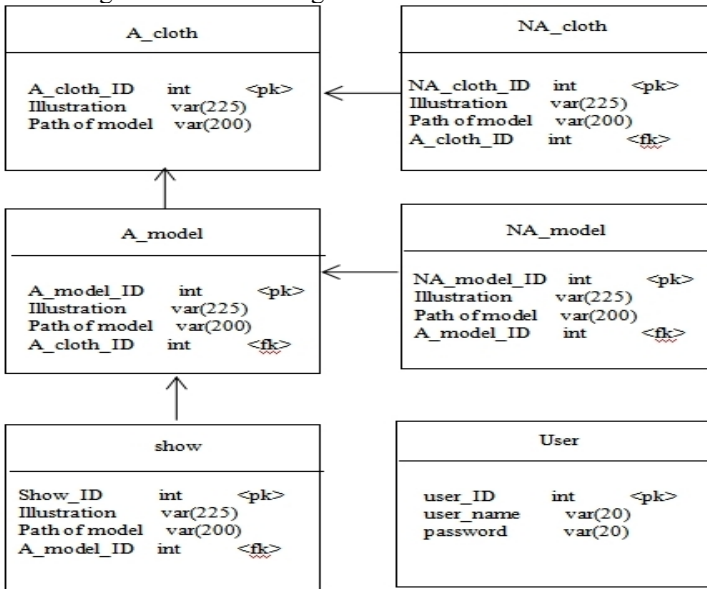

Fig. 2. Database physical model diagram

3 Model Making

3.1 Make runways

The virtual scene is composed of geometric surfaces. Generally, the more surfaces there are, the finer the model will be and the more resources will be occupied[3]. In order to save system resources, the combination of low mode and mapping is adopted to achieve realistic display effect of high mode [4]. The effect diagram of the show is shown in Fig 3.
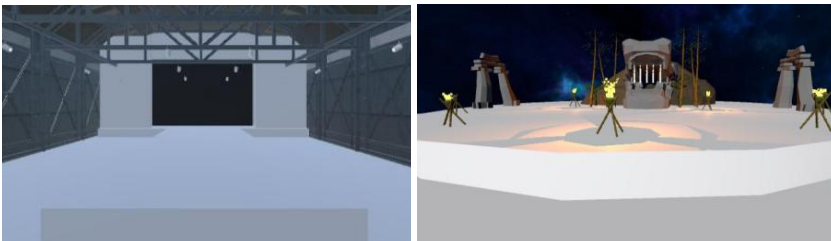

Fig. 3. Scene effect diagram. This system has produced two virtual scenes, the left picture is the indoor show of scene 1, and the picture on the right is the outdoor show of scene 2

3.2 Design and production of virtual models

Height is the first condition of the model, the current international fashion female model height standard is 178cm, up and down 2cm, so the height between 176-180cm female models are in line with the standard. Three dimensions refers to the model's bust, waist and hip circumference, usually the eastern female model's bust circumference is 83-90cm, waist circumference is 60-62cm, and hip circumference is 88-90cm. In addition to height and three-dimensional, head-body ratio is also a direct factor in determining human beauty. Generally, the head-body ratio of a model is 1/8[5]. According to the above conditions, the model produced in this paper has a head-to-body ratio of 1/8, a height of 177.67cm, a chest circumference of 84.75cm, a waist circumference of 61.60cm and a hip circumference of 89.58cm, which meets the national standard and can be used.

3.3 Animation production of virtual model runway show

Model walking display is a very important aspect of fashion performance. As a general rule, when the model walks, the upper body is straight, the arms swing naturally, the fingers are close to the outer thigh, the lower body is the crotch as the fulcrum, and the two feet step on the center line in turn, the left foot steps on the center line to the right, and the right foot steps on the center line to the left[6].The resulting effect is shown in Fig 4.

Fig. 4. Rendering of the model's steps

3.4 Virtual clothing production

In this paper, a professional virtual clothing production software Marvelous Designer is used for production. Combined with the height and circumference data of models, clothing samples are drawn in the two-dimensional sample area and simulated stitching is performed in the three-dimensional area. At the same time, parameters such as transparency, warp and weft strength, diagonal tension, bending strength, deformation rate and deformation strength can be set according to the target fabric material to further improve the authenticity of the fabric[7]. After completing the production of the virtual clothing model, you can switch to the animation interface, simulate the dynamic effect

of the virtual clothing combined with the dynamic virtual model, and store the simulated model in the database.

4   RODUCTION OF VIRTUAL SHOWS

4.1   Connecting to the Database

In order to ensure the security of database information, operators can not directly change the database information, and then adjust the model after importing the model into Unity. The client sends the port number, password, target access database name and other information to the database through the MySQL plug-in. After confirming the correct information, the database will establish a connection with Unity. The operator can then view and invoke the database contents.

4.2   Realize the runway show

Because of its unique softness, clothing fabrics have always been resource-intensive during simulation. Usually an important condition for people to judge whether the clothing is worn on the human body is whether the clothing can follow the movement of the human body to show the corresponding swing form, so when the same animation of the model and the clothing are placed in the same position to play, the visual effect of the human body driving the movement of the clothing can appear. Based on this, this paper proposes an improved method for clothing animation simulation, first create an empty object named mode in the scene, adjust the position of the object, and then create a list of models and clothing one-to-one, add C# script to mode, set the coordinates of the model appearance through the Instantiate function, and display the animation of virtual people and costumes in turn at 15-second intervals to achieve the effect of the model performing in the runway.

4.3   Setting of lighting animation and background music

Lighting and music are important props to set off the show atmosphere, as far as music is concerned, in order to achieve the stereo surround effect, Audio Source components can be added to the ground and the surrounding walls of the show, and background music Audio can be added to the Audio Clip to adjust the appropriate volume for users to listen. In addition, the show environment in this paper is illuminated by the combination of parallel light and spotlight, and the spotlight effect is highlighted by reducing the intensity of parallel light. At the same time, Animation is used to make corresponding lighting transformation animation combined with music drumbeats.

4.4   Design and implementation of interactive functions

Users need to register and log in to the account before entering the show, log in successfully before entering the main interface, view the operation method in the main

interface, and select the favorite show to watch, the show will automatically jump to the main interface after the show is played, the user can select other shows to watch at this time, when the user has watched all the shows, you can click to exit the show to close the system, the specific operation flow chart is shown in Fig 5. Therefore, the user interaction behavior is divided into the interaction between the user's perspective and the scene in the show and the interaction between the user and the UI interface, where the perspective interaction includes the rotation and zoom function of the camera perspective, and the interaction between the user and the UI interface includes the user registration and login, the call of the interface and the jump function of the scene.
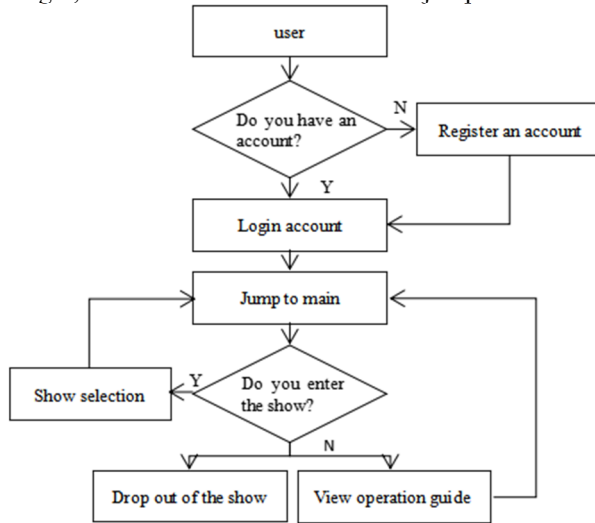
Fig. 5. User operation flow chart

UI interface design and production.

According to IVD, the UI interface of this system includes two categories: registration and login interface and main interface, whose function settings and UI components are shown in Table I. The rendering pictures are shown in Fig 6.

Table 1. UI design of virtual runway system

UI interface	function	UI components
Registration and login interface	User Information Login and Registration	Image：Background image Button：Log , register Text: System name, username, password Input Filed：User name, password input field
Main interface	Show selection, system operation instructions, exit from the show	Button：Enter the show, exit the show, and invoke the operation guide Text：Operating instructions Image：Background image

Fig. 6. UI interface renderings. The left picture shows the UI effect of the registration and login scene, and the right picture is the UI effect of the main scene

Implementation of the registration and login function.

For the convenience of management, the audience entering the show must register a personal account in advance, and can watch the show after logging in the account. After the user's name and password are filled in the input Filed area, the user clicks the register button, the Register function information will be sent to the database, which will automatically compare the information. If the user's name already exists, the

registration failure information will be returned, and the user can change the user's name and submit again. After the user registration is completed, click 'Login' to call the login function, you can jump to the main interface.The code is as follows:

```
public void Register()
{
    string username = InputUsername.text;
    string password = InputPassword.text;
    string query = "INSERT IGNORE INTO user(user_name, user_pass-
word) VALUES (@username, @password)";
    MySqlCommand cmd = new MySqlCommand(query, connection);
    cmd.Parameters.AddWithValue("@username", username);
    cmd.Parameters.AddWithValue("@password", password);
    int rowsAffected = cmd.ExecuteNonQuery();
    if (rowsAffected > 0)
    {
        hinttext.text = "Registration successful!";
    }
    else
    {
        hinttext.text = "Registration failed!";
    }
}
public void Login()
{
    string username = InputUsername.text;
    string password = InputPassword.text;
    string query = "SELECT COUNT(*) FROM user WHERE
user_name=@username AND user_password=@password";
    MySqlCommand cmd = new MySqlCommand(query, connection);
    cmd.Parameters.AddWithValue("@username", username);
    cmd.Parameters.AddWithValue("@password", password);
    object result = cmd.ExecuteScalar();
    int count = Convert.ToInt32(result);
    if (count > 0)
    {
        hinttext.text = "Login successful!";
        SceneManager.LoadScene("startScene");
    }
    else
    {
        hinttext.text = "Please confirm that the user name and password are
correct!";
    }
}
```

Implementation of the scene jump function.

The scene jump function of this system occurs in the three cases of login, show selection and show return to the main interface. All the three cases can be realized by clicking the corresponding button and calling the click function, the program code is shown below. At the same time, after the show is finished, it can automatically return to the main interface. The realization of this function can use the if conditional sentence to jump. When the program runs to a specific time, the jump function is executed to realize the scene jump.

```
public void click(){
    SceneManager.LoadScene("The name of the target scene")}
```

Realization of perspective interaction function.

Generally, the roaming of scenes in Unity is divided into first-person perspective and third-person perspective[8]. In order to enhance the sense of immersion, the first-person perspective is selected for interaction in this show. At the same time, combined with human eye habits, the user's active field of vision is limited to 160° to improve the sense of reality [9]. The system's Angle of view interaction is divided into two functions: rotation and scaling. The rotation function is mainly realized by rotating the camera, as shown in Fig 7. When only one finger touches the screen and displacement occurs (for example, the position moves from point A to point B), the camera should rotate according to this change. That is, the Δy deviating from the X-axis and the Δx deviating from the Y-axis can be calculated through the coordinates of two points A and B, and the rotation value of the current camera can be obtained by increasing the offset on the basis of the camera position of the previous frame, and then the rotation is completed. At the same time, it should be noted that this method can only realize rotation in the horizontal axis direction. For rotation in the vertical direction, the rotation direction of the parent object of the camera can be adjusted in the same way, and the rotation in the vertical direction of the camera can be realized by the way that the parent object drives the child object [10]. The zoom of the camera is equivalent to the increase or decrease of the distance between the camera and the target object. When two fingers touch, the change of the distance between the fingers determines whether the camera moves forward or not. When the distance increases, the scene of the camera moves forward will be enlarged; when the distance decreases, the field of the camera moves backward will be narrowed.
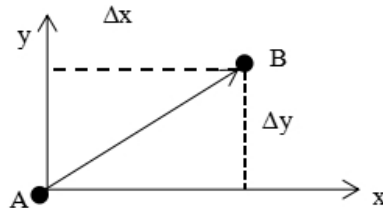
Fig. 7. Schematic diagram of camera rotation

4.5   Exiting the System

When the user finishes watching the show, the interface will automatically return to the main interface, which contains a button to exit the show. After clicking this button, the execution of the program will be terminated. The code is as follows:
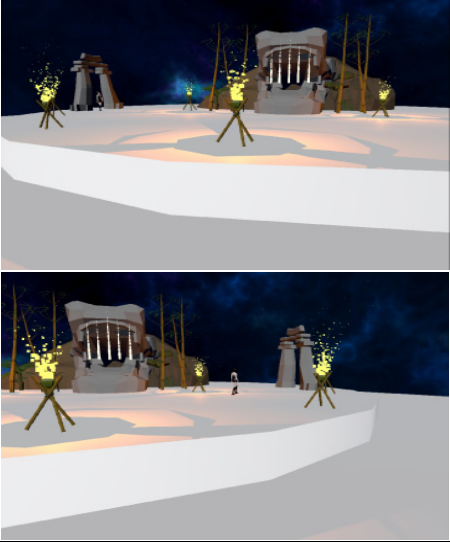
```
public void OnExitGame()

    {
#if UNITY_EDITOR

        UnityEditor.EditorApplication.isPlaying = false;

#else

        Application.Quit();

#endif

    }
```

5   RUN THE EFFECT TEST

After setting the system functions, switch the Game in the effect interface to simulator to simulate the running state of the mobile terminal. After testing, it is found that he system successfully achieved the target function. The test process and results are shown in Table II.

Table 2. System function test table

System function	effect	results
user registration		The registration function is successfully implemented
User login	After successful login, the user automatically jumps to the main interface successfully.	The login function is successfully implemented

See the operation guide		The operation guide is successfully retrieved and viewed
Choose show		Successfully realized the jump corresponding to the show
The perspective rotation		View rotation successfully implemented
zooming of perspective		View zoom successfully implemented

Return to the main interface	After the model's performance, users will automatically be redirected to the main interface	Successfully realized the automatic jump of the show
quit the show	The program finishes running	Successful exit program

6   Conclusions

Limited by venues and resources, the traditional physical runway runs counter to the needs of global green and low-carbon development, while the virtual runway technology follows the sustainable development and is more attractive to the public than the traditional runway model, with good prospects. This paper designs and produces an interactive virtual runway show system based on Unity engine and MySQL database. The system has a good visual viewing effect and can also manage the show information systematically, providing a valuable reference for the research of this type of runway show.

Acknowledgment

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