Design and Application of VR Lab Based on Unity

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Abstract. In order to realize the interactive design of the VR laboratory based on unity. The first experimental building of Southwest Petroleum University (Nanchong Campus) is taken as the foundation environment, and the scene interaction is deeply studied. Based on C# and js language, Photoshop is the image processing software, based on 3d max three-dimensional modeling and virtual interaction technology. Finally, it connects the HTC Vive device to realize the roaming function of the laboratory and some experimental functions, and completes the production of VR laboratory. The VR laboratory is based on the background of "VR+education", which is of great significance to the development of experimental teaching in schools. It is beneficial to promote the development of virtual reality technology in education and teaching, and has application value.

Key words: VR Lab, Virtual reality technology, 3D modeling, Virtual interaction.

1. Introduction

With the continuous maturity of VR technology, as well as the rapid development of computer image processing technology and network technology. Many key universities have established their own "VR+education" campuses using different technologies. Tsinghua University Launches "VR Dream Lab". The lab will be open to all institutions in the VR field to collaborate to promote the development of VR in China. China Academy of Art opened a 3D virtual exhibition platform based on web technology and 3d max technology. Zhejiang University and 51VR [1] jointly build "Zhejiang University-51VR Joint Laboratory of Intelligent Virtual Simulation", which will carry out in-depth research in the cross fields of virtual reality and artificial intelligence. The virtual laboratory has achieved certain results in some domestic universities. It is mainly embodied in the three aspects of 3D modeling, simulation laboratory and panorama. Some platforms cannot give users a more immersive experience because of the rough modeling of these interactive systems, insufficient code functions, substandard quality of related equipment, blurry text and distortion of imported images. Facing the new goals of education development in the new era. The "Thirteenth Five-Year Plan for the Development of National Education" puts forward the requirements of education planning for the active development of in-depth integration, open and shared "Internet + education" [2]. This paper takes the laboratory of the first experimental building of Southwest Petroleum University as the background. Based on 3D modeling and unity technology to write scripts to realize experimental interaction, so that users can understand the rules and functions of laboratory-related equipment in the scene. And use VIVE wireless control handle, click the relevant button to interact and roaming the scene. It not only increases the sense
of immersion and experience of the media, but also enables users to understand the use of experimental equipment more vividly. Arouse students’ curiosity and gradually change from "teaching to promote learning" to students taking the initiative to learn and want to learn. It is of great significance to the development of experimental teaching in universities.

2. Status quo of project construction

College laboratory is an important way to cultivate students' practical ability and improve students' innovation ability. COVID-19 outbreak in 2020. In response to the call of the Ministry of Education to “suspend classes without suspension”, all the original courses were transferred to online teaching. Experiments and practical courses are subject to equipment and space conditions, and are generally postponed until after the epidemic. This will cause a backlog of courses and increase the burden on students.

But with the development of VR technology, the production of VR Lab has solved these problems. VR technology is interactive, multisensory and immersive. When students are placed in such an environment, they can feel the charm of VR technology immersively. It is easier to stimulate their desire to explore knowledge, so as to improve the quality of students' experiments. Unity virtual reality development standard course is the core course of digital media technology major on campus, with strong practicality. Since there is only one interactive device in the school, the course can only implement related functions in unity, and then connect to the HTC VIVE device to connect to achieve interaction. On this basis,

3. Construction of VR Lab

3.1. Build ideas

This article selects the first laboratory building as the environmental foundation. Interactive classrooms mainly include electronic technology laboratory, digital electronic technology laboratory, computer technology laboratory, digital media technology laboratory.

![Flow chart of VR laboratory design](image-url)
The workflow of Unity-based VR Lab is as follows. (1) Preparation and setting of the hardware environment. The hardware mainly includes HTC VIVE equipment, SLR cameras, and tripods. The main components of HTC Vive include Vive Headset (HMD), Vive Wireless Control Handle, Vive Locator and 3-in-1 Connector. (2) The use of SLR camera and tripod for the field shooting of the laboratory building. In order to make the VR laboratory present a more realistic effect, a multi-plane and all-directional shooting is carried out on the laboratory environment. (3) According to the laboratory specifications and layout, use the software 3d max for three-dimensional modeling, attach the texture to the model, use real-time rendering technology to calculate the screen output display, and finally generate the fbx model for export. (4) The generated fbx model is imported into unity to realize the scene roaming function.

The following is a free-view roaming laboratory picture.

![Free-view roaming the laboratory](image)

**Figure 2.** Free-view roaming the laboratory

3.2. 3d max modeling and rendering

3.2.1. Application data adjustment. In the design of the VR laboratory, the application data includes virtual characters, image information, text information, audio, video, etc. The image information includes scene pictures and detailed pictures of equipment in the scene. This article uses Canon 90D camera for image information collection. Using Photoshop to adjust the image to adjust the brightness and resolution. In order to reduce the distortion rate and aspect ratio after importing unity software in the later stage. Text information is used for the introduction of the scene. It includes the main functions of each laboratory, instruments and equipment, supported experimental items. The audio and video information includes the operation steps of the main experiment and animation explanation.

When the picture is imported into unity3D for display, the picture is set to a power of 2 by default [3]. It can automatically compress. It provides higher performance in order to reduce the memory usage of the game at runtime. In the case of Max Size, the default maximum is 2048, and the panoramic scene is several times of this parameter, which will cause image distortion. Modifying MaxSize to 8192 or 4096, and modifying the Compression parameter to Hight Quality can solve the corresponding problem.

3.2.2. Model establishment and optimization. The modeling idea is to build the overall framework one by one, and then build walls, windows, curtains, doors, lights, computers and other experimental equipment. The main modeling commands used are extrusion, loft, turning, pick, twist, etc. After the integration of a frame, attached to the map. After the map is attached, it needs to be rendered in real time.
After the modeling is completed, the overall model still cannot meet the needs of the effect. Firstly, some models have too low accuracy to better restore laboratory scenes. Modeling software can be used to complete higher-precision production. Second, there are gaps between some models, such as dislocations between walls and walls, and between tables and legs. You need to carefully examine the positional relationships between the models to optimize the details. For the simplification of the number of model faces, the number of height faces and the number of sections can be reduced, thereby reducing the total number of faces, without affecting the final effect. Execute the Attach [4] command to the objects of the same material, and the Collapse command to reduce the number of models, and the objects are spliced together. After the model is established, the optimized model is generated and exported in fbx format.

The optimized model is generated and exported in FBX format.

### Figure 3. Digital media technology laboratory establishment model

#### 3.3. Implementation of interactive technology

After the model is imported into Unity, C# and JS languages are used as the basis. Finally, HTC Vive devices are connected to realize the scene interaction function and complete the production of VR laboratory. The VR laboratory has designed multiple scene navigation bars, instrument and equipment hotspots, and scene characters. Scene navigation can insert buttons and graphics of your own design. Make a map that can be used for laboratory roaming navigation [5]. Equipment hotspots are used to introduce experimental equipment and experimental operations. Scene characters are used for user laboratory roaming. This provides users with a convenient browsing virtual roaming experience.

#### 3.3.1. Camera tracking technology

By creating a virtual camera, add a control script to the camera virtual camera to make the virtual camera move with the character[6]. The set tracking objects and the tracking scripts are as follows.

```csharp
public class follwCam : MonoBehaviour
{
    // what to track
    public Transform VRman;

    // Realize camera tracking
    void LateUpdate()
    {
        tr.position = Vector3.Lerp(tr.position, VRman.position - (VRman.forward * d) + (Vector3.up * height), Time.deltaTime * damp);
        tr.LookAt(VRman.position);
    }
}
```
3.3.2. Realization of interactive functions. The realization of VR interaction needs to be based on the plug-in tool Steam VR Plugin [7] to realize the connection between the VR headset and Unity. The interactive function is mainly reflected in the conversion of the scene, displaying the text introduction related to the laboratory and its equipment. The main code for clicking the button for text introduction is as follows.

```csharp
void OnCollisionEnter(Collision col)
{
    // Press the button to control display and hide
    if(col.gameObject.name.Equals("button"))
    { // Text display
        die.text.SetActive(true);
    }
}
```

The following is the relevant information window of the Digital Electronic Technology Laboratory.

![Figure 4. Information Window of Digital Electronic Technology Laboratory](image)

4. Conclusion
The design of the unity-based VR laboratory is a supplement and optimization to traditional offline teaching. It sets up multiple modules such as the introduction and display of experimental scenes, experimental instrument operation demonstrations, and experimental demonstrations. Using VR panoramic shooting technology, combined with unity to achieve interactive functions, scene conversion functions, and roaming functions. Finally, it is displayed through the virtual reality display, which brings a different experience to the students' boring study. The VR laboratory mobilizes students' enthusiasm for learning, and provides solutions for the construction of virtual laboratories.

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