Application of virtual reality technology in campus landscape roaming

Xinyi Chen

School of Art and Design Wuhan Institute of Technology University, Wuhan, China

550579002@qq.com

Abstract. With the popularity of the metaverse concept, virtual reality technology is widely used in people's lives, and the emergence of this new technology also brings new development opportunities to environmental design. Using computer-aided design, 3D roaming and other methods to build a virtual three-dimensional space, people can get an interactive and immersive experience. This paper takes the Liufang campus of Wuhan University of Technology as a prototype, and builds a 3D virtual campus landscape roaming based on SketchUp and Unity3D engine. It allows the campus to adapt to the development of digital informatization, and at the same time, through the roaming scene, the experiencer can understand the school style more intuitively and quickly, and help the campus culture to be better displayed.

Keywords: Virtual Reality; Campus Roaming; SketchUp; Unity3D.

1. Introduction

In the past, people were more exposed to the visual effects of the two-dimensional plane and imagined the three-dimensional shape through the brain. Now, based on the development of science and technology, equipment is used to build a three-dimensional form. On this basis, it also pays attention to reduction and authenticity. Nowadays, virtual reality technology has been applied to various fields such as scientific experiments, information technology, construction engineering, medicine, entertainment, etc., which has revolutionized many industries. Campus landscape roaming design is a combination of environmental design and virtual reality technology, adding elements of computer science, and is a product of multi-disciplinary cross-integration. Starting from the campus roaming application, use AutoCAD to draw the floor plan, use Sketchup for modeling, use Photoshop for model texture processing, and integrate the roaming system with unity 3D, and conduct a preliminary study on how to build a virtual roaming space.

2. Research Background

With the continuous development of society, new technologies and industries are emerging. Virtual reality technology has a lot of room for development, and it also creates conditions for campus roaming, so that people's ideas can be put into practice. As the country attaches great importance to education, investment in campuses is also increasing year by year, and the digital construction of higher education has also become a trend. The traditional digital campus is based on plane maps and remote sensing images, and the information is not complete and has a certain distortion. The information campus will bring the campus construction into a new stage, people will no longer be attracted by the information transmission method of video and pictures. Through the three-dimensional effect of the virtual campus, a more realistic image can be constructed [1]. From the integration of campus information to planning the future campus environment design is of great significance. Overview of virtual reality theory.

2.1 The concept of Virtual Reality

Virtual reality technology, referred to as VR, is a means of realizing the digitization of objects. People can obtain physical information corresponding to the space where the object is located through computer operations, and this information is often visualized image information [2]. Using

algorithms and equipment, which provides the experiencer with a scene that blends virtual and reality, giving people an immersive experience. Simply put, it is the development model of "3D model + interactive experience".

2.2 Virtual Reality features

There are three main characteristics: immersion, interactivity, and conception.

1)   Real immersive experience, through equipment debugging, the scene atmosphere is created, so that the experiencer can fully integrate into the space. Use action, language, etc. to communicate with scenes and objects. It gives people a strong sense of substitution through sensory stimulation, visual impact, and stereo surround sound.

2)   Interactivity refers to the degree of manipulability of objects in the scene and the natural degree of feedback from the environment when the experiencer enters the scene. The experiencer puts visual, tactile and other feelings into the three-dimensional space with the help of sensing devices such as helmets and gloves. For example, when an experiencer grasps a virtual object with his hands in the scene, he can feel the weight of the object. Through interaction, the authenticity of the scene can be improved, and the experiencer can have a better sense of presence.

3)   Conceptuality is also known as autonomy. In the virtual space, you can adjust the range and size of the field of view according to your ideas. Being immersed in a new virtual space will give you a different feeling and a new understanding of the world, which can stimulate people's creativity. Immerse yourself in the space you build by adding autonomous imagination.

2.3 Virtual roaming technology

Virtual roaming technology is an important part of virtual reality technology, which can interact with entities in the virtual environment through input devices such as a mouse, keyboards, datas gloves, and electronic helmets. At present, there are three main types of virtual scene roaming, based on the geometric model, real scene image, and based geometric modeling and image rendering [3]. The roaming of the campus scene is a hybrid roaming technology based on modeling and rendering. This technology applies image textures to 3D models to achieve a better experience.

3.   Main technical software applications

3.1 AutoCAD

AutoCAD is a software developed by Autodesk for 2D drafting, design documentation, and basic 3D design. It is a basic drawing tool that designers and engineers can use to create sketches and construction drawings. You can import file formats such as DWG and DXG into other programs to achieve compatibility with other software. The basis of 3D model construction is the floor plan drawn by CAD.

3.2 SketchUp

SketchUp is a 3D modeling software originally developed by Google Inc. It is a design tool for the creation of design plans. The operation is simple so that the designer can quickly demonstrate the concept through the model. A model consists of points, lines, surfaces, and volumes. Connect the dots into a line, connect the lines into a surface, and pull the noodle into a body. The software can be used for the design of architecture, interior, landscape, garden, and other directions.

The operation interface is simple and Many related plug-ins can be downloaded to facilitate the rapid construction of models that can improve user modeling efficiency. Basic elements such as lines, cubes, spheres, etc. can be used in SketchUp. Components can be used to facilitate subsequent batch modifications to the same objects. Combined with the floor plan design, the model can be pushed and pulled, moved, with Boolean operations and other operations [4].

3.3 Unity 3D

Unity 3D is also known as a game engine developed by Unity Technologies, which can realize the visualization of buildings and real-time animation. Unity 3D supports almost all mainstream 3D formats and can run on IOS, Android, Windows, and other operating systems. Comes with a powerful set of plugins and tools. Through the import of resources such as images, sounds, 3D models, etc., complex structural scenes can be simulated. [4] It can also add physical effects, lighting, and other effects. Unity 3D integrates the MonoDeveloper compilation platform and supports C#, JavaScript， etc. scripting languages.

4. Advantages of virtual roaming in campus applications

4.1 Campus showcase

Through the construction and upload of the virtual campus, people can have a comprehensive and intuitive feeling of the campus environment through the network. Show the campus-style, pass the campus culture, and play a publicity role for the school. Display the planning and layout of the entire campus, and it is very convenient to collect information in the system when doing campus-related research.

4.2 Route guide

Learn about the road layout in the school and the orientation of the teaching building. Corresponding labels are set in the system, and information is transmitted by means of introduction during the roaming process, so as to realize the combination of virtual image and text. The name of each building is displayed on the roamer so that the roamer can be familiar with the virtual environment, and the user can use the function to familiarize with the campus environment. [5].Provides guidance on traffic routes on the scene. Enter the arrival point, you can choose to arrive directly. Or automatically walk to the designated place, allowing the user to know the walking route. The shortest route will also be matched from the total, and other routes can be selected by the user. A guide system service is provided for first-time visitors.

4.3 Safety drilling

The virtual system can also be used in safety drills. The platform can preset escape routes when encountering dangerous disasters, simulate moving speed, and calculate the required time. Users can inquire about the escape plans at various locations through the system and learn about the escape routes[6].

4.4 Planning and design

The virtual tour can assist in the design of campus planning. Generally speaking, it is difficult to pre-judge the design concept from 2D images. Let the designed new building or landscape fit into the existing scene. Through 3D, the scene and architectural form after completion can be simulated in advance, and an intuitive preliminary judgment of the completion effect can be obtained, which can reduce some design mistakes. To reduce the waste of time and money. The exploration from the whole to the local details can help the design to be more comprehensive and objective.

5. The process of campus landscape roaming establishment——Taking the Liufang Campus of Wuhan University of Technology as an example

The construction scene roaming is mainly divided into the following parts: The datas research and analysis in the early stage; Drawing the CAD plan; Importing Sketchup to build a 3D model; Importing the Unity3d engine to realize the roaming. Build a mind map (figure1).
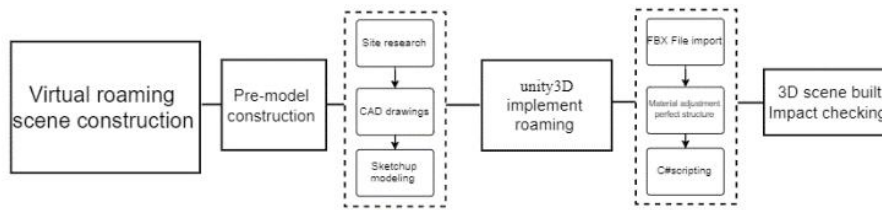
Fig. 1.   Mind map of scene construction

5.1 Spatial datas collection

Data collection is very important for scene construction. On-the-spot survey of campus conditions, taking and recording detailed pictures of the environment, landscape structure, plant configuration, road distribution and building appearance, etc. Use electronic rulers, drones and other tools to obtain images and measure the road width of the campus to determine the geographic orientation. When building the model, we should start from the three aspects of terrain, architecture and landscape, so we should focus on these three aspects during the research process. Hand-painted sketches according to the situation on-site, and record the data, so as to facilitate the later drawing of floor plans.

5.2 Drawing CAD graphics

Combined with the data and pictures of the on-site investigation, determine the spatial relationship, and use AutoCAD to draw the site plan. Wuhan is located in a plain with gentle terrain, and there are no major terrain fluctuations in the campus. The terrain on the campus is relatively simple, with a small number of artificial slopes, and the rest are flat, and the area is divided into large areas according to the characteristics of the terrain. Determine the location of the road, select a reference point to start the positioning of teaching buildings, laboratory buildings and other buildings. After the large building is determined and completed, add the landscape of the structure. When drawing, analyze the lack of places, optimize and transform local landscapes in a targeted manner, add the appropriate amount of landscapes, and enrich scenes to achieve more vivid visual effects. In the process of drawing, pay attention to drawing specifications. In the process of drawing, pay attention to drawing specifications. According to the data record after field measurement, the floor plan of Wuhan University of Technology Liufang Campus is drawn with CAD (figure2).

Fig. 2.   Floor plan of Liufang Campus of Wuhan University of Technology

5.3 Build 3D Models

The 3D model not only determines the visual effect that is ultimately presented to the user, but also determines the operational efficiency of the virtual campus[5]. Save the drawn CAD file as dwg. format and import it in Sketchup. The imported graphics form a surface, delete redundant lines, set an appropriate height according to the dimensional datas, and build a solid model. Observe the real photos, and use plug-ins such as scaling, Bezier Spline, Lines To Columns,etc. to process the details. Completed preliminary model building (figure3). Determine the route of the roaming scene, which can appropriately simplify the unseen area to improve rendering efficiency.

Fig. 3.   SketchUp model building

After modeling, paste a basic material to distinguish the blocks. Preliminarily judge the effect of the entire scene and make corresponding adjustments.（figure4）

Fig. 4.   Preliminary renderings preview

5.4 Roaming implementation

a)   Use Sketchup to get the model and click to export the 3D model. After saving it in FBX format, open Unity 3D and click "Import New Assets" to place the finished model. The FBX format is a static mesh file supported by the Unity3d engine. Model information, material map information, animation information, etc. will be stored in this type of file. FBX is a format used by Autodesk for cross-platform 3D data exchange and is currently supported by many standard modeling software [7].

b)   After the model is imported, choose the live photo you took, or the collected material to grade it through Photoshop. Import various materials and texture files into the Unity3d software, and map the physical model after further adjusting the material of the model in Unity3d. Then add lighting, sky and other elements to complete the construction of the entire 3D virtual scene [7].

c)   After the campus scene is built, select the third-person perspective to interact with the scene. Use the "W, S, A, D" buttons on the keyboard to control the characters to move forward, backward, left, and right, and perform virtual roaming. Write a script in C# to realize the movement of the characters. Create a new script, find the "Character Controller" component, use the

"MoveLikeWow" function, and write it in Update. Part of the program is shown in Figure (figure5) After the script is written, assign the script to the characters in the scene, use the "cinemachine" plug-in to create a virtual camera, and adjust the camera position so that the lens can move with the characters.

```
void Update()
{
    MoveLikeWow();
}
Private void MoveLikeWow();
{
    var horizontal=Input.GetAxis("Horizontal");
    var vertical=Input.GetAxis("Vertical");

    var move=transform.forward*speed*vertical*Time.deltatime;
    controller.Move(move);
}
```

Fig. 5.   Partial C# script interception

d)   After the construction of the campus scene, the collision detection of the 3D scene should be carried out. Its main function is to accurately determine whether any two entities can penetrate and collide, and provide the precise location of the penetration collision. Determine whether the virtual characters in the 3D scene roaming conflict with the ground, buildings, landscapes, etc. [8].

6. Conclusion

Virtual reality can be applied to a variety of scenarios, can be applied to campus roaming, and can also create tourist attractions roaming. It can carry out modern urban architectural scenes, and can also restore ancient buildings. It can realize the renewal of future buildings, and can also protect traditional buildings and so on. Under the development of virtual reality, society will not face the problem of a single discipline, but a comprehensive challenge of the collection of multi-industry knowledge.

Through the virtual reality application derived from this case to the campus landscape environment design, everything designed in the environment design must be built in the end. Once landed, it will be difficult to change. For designers, the development of technology has brought new opportunities to the design industry. Therefore, it is necessary to improve their comprehensive quality and have a strong professional quality in order to combine design and computer science and technology such as virtual reality. It is necessary to deal with the details of each link clearly, integrate it into your own design concept, and build a more realistic scene. The combination of virtual reality and campus roaming is a preliminary development, and the digital campus system is gradually improving. Virtual reality will be popularized in all aspects of people's lives in the future.

References

[1] D.Zhang H.X. Design and implementation of virtual three-dimensional digital campus roaming system based on VR. Tianjin Normal University. University of Electronic Science and Technology of China,2018.

[2] J. Tian G.Q and Wang C.G.Application Research of Virtual Desktop Technology in Library User Retrieval Terminal, 10., vol.31. Journal of Library and Information Science in Agriculture, 2019, pp.69–75.

[3] D.Chen S.G. Design and Realization of Virtual Roaming System in Luxian No. 2 Middle School. University of Electronic Science and Technology of China,2009.

[4] D.Li Y.H. Research on Virtual Campus Roaming System Based on Unity3D. University of Electronic Science and Technology of China,2018.

[5] M.Hu Y,Li J.W. and Han X.Q. Development Based on Unity3D Virtual Campus Roaming System.In: 3rd International Conference on Advances in Energy and Environment Research,2018.

[6] D. Yuan X. Research of the application of virtual reality technology in the university planning. Hebei University of Engineering,2018.

[7] J.Hu M.Y. Campus Virtual Tour Based on Virtual Reality Technology, vol. 1. China Science and Technology Information, 2017, pp.53–55.

[8] J. Chen R. Virtual campus roaming system based on SketchUp and Unity3D, vol.6. Science and Technology & Innovation, 2019, pp.33–34