Research on Interactive Experience of Architecture Scene Based on VR

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Abstract. By the study of the experience of VR technology in architectural design scenarios, the advantages and disadvantages of immersion and touch-based interactive experience in architectural scenarios are analyzed. Based on the principle of contact detection, the multi-touch control schemes are compared. Interactive experience fusion of multi-touch, VR architecture and synchronous triggered verification are carried out. The direction of further improvement and development is put forward to promote the application of VR technology in the field of architecture.

Introduction

VR technology has obvious advantages in architectural scene design, it can create and reflect the virtual world[1,2]. VR technology can apply virtual reality technology to architectural design and can enable buyers to experience the indoor and outdoor environment in the design stage. Through the research on the design and application of the interactive experience system of immersive architecture scene which is based on head-mounted VR equipment, it provides the wearer with immersive experience and is able to interact with scenes. At the same time, new problems have been aroused. Long-term wearing of head-mounted equipment can cause discomfort. Head-mounted equipment is easy to feel lost and dizzy in the external scenes of architecture. It can't be displayed to many people at the same time, and lack of direct human interaction.

Multi-touch control represented by smart phones is the most widely used in the field of human-computer interaction. By using multi-touch technology on large screen, it can support multiple users to use at the same time, and has been widely used in project display, information query, leisure and entertainment, collaborative work and other fields. Compared with head-mounted VR devices, mice and keyboards, multi-touch control supportive users interact with computers in natural ways such as gestures. Especially in VR interactive experience, it can effectively enhance the sense of experience, interaction efficiency and expand the mode of interactive experience.

Advantages and Disadvantages of VR Interactive Experience in Architectural Scenes

Unity3D + HTC VIVE is used in the design of interactive experience system of architectural scene. Based on VR device, the independent roaming immersion experience in architectural scene is realized. In the indoor scene, objects such as furniture and household appliances can be interoperable under immersion experience by VR device. With the help of HTC handle controller, the interaction of picking up and moving indoor objects can be realized. It can also control home TV and music playing, curtains, cameras and the change of indoor lighting through virtual remote control. In the outdoor scene, the HTC handle controller is used to realize the autonomous movement of scene observation position, and observe from different angles to avoid such interactive behaviors as collision, passing through, and so on.

Existence of Immersion Experience.

Existence is also called presence. It refers to the degree of authenticity that users feel as protagonists in the simulated environment. Architectural scenes are designed to simulate the real environment. Through the use of photographs and other materials and textures, a more realistic model is established. In addition, the use of model animation makes the experiencer feel immersed in the experience scene. In the simulated environment, users feel that the virtual world is real[3-6].

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As shown in Figs. 1 and 2, a real estate project in Tianjin was selected for sampling and simulation. The project covers an area of about 165,000 square meters，has 36 buildings, including row villas and high-rise residential buildings. The model base is constructed by 3D MAX software, based on relevant data acquisition and image data processing. The model is optimized by irrelevant surface removal, material selection and Speed-Tree modeling. Through these, the immersion interactive experience of architecture scene based on VR device is realized.

Figure. 1 Overview

Figure. 2 External View

Man -Computer Interaction.

Interaction refers to the user's maneuverability of objects in the simulated environment and the natural degree of feedback from the environment. For example, when driven by a force, the object will move in the direction of the force, which can be overturned or landed on the ground from the desktop. In the indoor environment, users can simulate the operation of the hand by controlling the handle to move and control indoor furniture, household appliances and other items like hands. As shown in Figure 3, the frame can be picked up and displayed with relevant information.

Figure. 3 Indoor interactive Mode

Problems.

(1) Lost Feeling of Immersion Experience

In architectural scenes, because of the experiencer's strangeness to the environment and the large architectural scenes, immersion in the interactive movement process can easily cause a sense of loss and vertigo, just like people lost in a strange environment. It affects the result of experience. Head-wearing devices make it impossible to show for many people at the same time. Lacking of direct interaction between personnel and not fully meeting the needs of enterprises, it is necessary to study the way of human-computer interaction and experience further.

(2) Easy to Feel Tired

It can cause discomfort by using head-mounted equipment for a long time. At present, VR head-mounted equipment still has a certain weight. The weight of SONY PSVR, Oculus Rift and HTC Vive are 610grams, 470grams and 555 grams respectively. Their weights is not light for the head. In the case of long-term wearing, it will inevitably cause a certain degree of fatigue and discomfort to users.

In contrast, multi-touch technology is a new human-computer interaction technology which has been widely concerned and studied. It provides a natural user-centered interface, which conforms to people's cognitive characteristics and behavior habits. According to the physical characteristics of equipment or the theory and technology of computer vision, it builds a hardware platform which can detect multiple contacts at the same time. Users can operate with both hands at the same time, and multiple users can cooperate. An efficient and natural way of interaction is provided

Comparison of Multi-Touch Schemes[7-9]

The construction of multi-touch platform includes two schemes based on the principle of contact detection. One is to design hardware devices with certain characteristics based on physical effects. It enables the device itself to support multi-touch point input, such as capacitive or resistive touch screen, is constructed. The other is based on optical principle and computer vision theory, as well as different sensing principles and configuration schemes, to build an induction platform to achieve multi-touch function.

Comparisons of Pressure Multi-touch in Interactive Experience

Capacitive touch screen is a metal conductive material on the glass surface. It uses the capacitance fluctuation of the metal layer of the finger touch point to bring about the oscillator frequency change, and obtains the touch information by measuring the frequency change. The problem is that in the architectural scene experience, the touch area is usually large because of the requirements of the scene experience. The Touch distance of finger is also relatively large, which can easily cause finger discomfort. The effect of interactive experience will be reduced by the increase of screen surface temperature, the drift caused by wet hands and many people watching for a long time.

Resistance Touch Screen is the change of resistance when the conductive layer contacts. Resistance Touch Screen can be realized directly on the glass surface by using multi-layer composite film. Resistance Touch Screen has the characteristics of low cost, large touch area and sensitive reaction. It can realize touch movement and interaction by using external objects such as stylus. However, there are some problems, such as fewer touch points, poor anti-interference of external objects, and easy wear and tear of the surface for a long time.

Optical Multi-Touch Interaction Scheme

Multi-touch devices based on optical principle usually adopt infrared technology. These technical schemes mainly include suppressed total internal reflection multi-touch technology (FTIR), backscattered light multi-touch technology (Rear-DI), laser plane multi-touch technology (LLP), light emitting diode plane multi-touch technology (LED-LP), scattered light plane multi-touch technology (DSI), etc. The disadvantage is that the volume is relatively large. The advantage is that it is extensible and easy to build, especially for large-scale touch control platform equipment.

Using the advantages of optical perception, touch optimization can be achieved by entity recognition. By scanning the recognition blocks with two-dimensional codes or patterns through infrared scanning, multiple modules can be recognized simultaneously and interactive response can be achieved. In this way, the human touch discomfort can be avoided while increasing the function and efficiency of interaction. For example, in architectural scenes, the function of wallpaper replacement can be set by recognizing different blocks. When the recognition block is placed on the touch controlled surface, it can quickly switch to the indoor scene and replace the wallpaper.

Interactive touch Design of VR Architectural Interactive Experience

Starting from the integration of multi-touch and VR architectural interactive experience.
By comparing the principle of contact detection, the pressure multi-touch requires the interaction between hand and screen, and the optical multi-touch mostly requires the interaction of ID recognition module. Both schemes can meet the needs of VR architecture interactive experience touch. But through the comparison of advantages and disadvantages, there are some shortcomings in the practical use of capacitive screen and resistance screen. Taking experience as priority, the scheme design uses infrared touch screen. The interactive experience is based on the combination of finger touch recognition and recognition module. For the fixed function, the identification module is designed to realize simultaneous operation of multiple knobs, and enhance the experience of operation.

Verification of Synchronously Triggered Touch and Experience under Multi-Touch.

Based on the multi-touch platform, the architecture interactive experience system is constructed. In order to realize synchronous triggering of two-dimensional, three-dimensional touch and VR three-dimensional roaming experience under multi-touch operation, it is necessary to solve the problem of two-dimensional and three-dimensional synchronous experience. Synchronization of two-dimensional operation and three-dimensional demonstration will further increase the pressure of display system. When displaying the two on a split screen, it is necessary to realize the real-time linkage between the two displacements, the interactive operation and the three-dimensional roaming scene on the touch-control platform. When realizing the synchronization of convenient interaction and immersion experience of the scene, we must avoid the problems of lag, vertigo and collision crossing.

Directions for Further Improvement

In addition to VR helmet and touch platform, the interactive experience of architectural scenes can also be combined with naked-eye 3D display system, CAVE virtual reality display system, three-dimensional space interactive ball, data glove and so on[10,11]. In this way, we can change the single experience form and form the touch interaction mode which is beneficial to VR interactive experience. By integrating three-dimensional computer graphics technology, with technology of stereoscopic projection display, multi-channel visual synchronization technology, sensor technology and so on, the virtual architecture scene environment with single immersion experience, multi-participant experience and interactive demonstration function can be realized. The application of VR technology can be effectively promoted by meeting the needs of different occasions.

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