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Design and Application of Handheld Handle Interaction Based on Unity 3D

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***Abstract*—With the development of virtual reality technology, various kinds of virtual interactive devices appear continuously. The currently widely used handheld handle device uses an infrared tracking device to monitor the handheld handle and convert it into position and rotation information through fast and accurate conversion methods, which allows the users to directly access the 6DoF information of the handheld handle device. This paper will design the interaction of HTC VIVE, CAVE, zSpace and other handheld handle devices on the basis of Unity 3D. First of all, obtain the position and rotation information of each handheld handle virtual interactive device, and enhance the interaction experience of the handheld handle by adding ray collision detection, hierarchical detection and label detection, so that the user can quickly and accurately interact in the virtual space.**

***Keywords*—Unity 3D; handheld handle; 3D scene; collision detection; virtual interaction**

I. INTRODUCTION

Virtual reality (VR) is the latest technology in the computer field that integrates various computer technologies, such as computer graphics technology, multimedia technology, sensor technology, human-computer interaction technology, network technology, stereo display technology and simulation technology. It is also a comprehensive application of various disciplines such as mechanics, mathematics, optics, and mechanism kinematics. At present, the research and application fields involved include: military, medical, psychology, education, scientific research, business, film and television, entertainment, manufacturing, engineering training, etc.. Virtual reality has been recognized as one of the important development disciplines of the 21st century and an important technology that affects people's lives[1,2].

With the continuous development of virtual reality technology, various virtual interactive devices have sprung up, such as HTC VIVE, CAVE, zSpace, etc., all using the helmet or glasses and hand-held handles to let users immersive and interactive experience. The currently widely used handheld handle device uses an infrared tracking device to monitor the handheld handle and convert it into position and rotation information through fast and accurate conversion methods, which allows the users to directly access the 6DoF(degree of Freedom) information of the handheld handle device. DoF is the degree of freedom, which is mainly containing orientation degrees and position degrees of freedom. Orientation degrees of freedom, support for direction tracking, generally supported by sensors such as gyroscopes, accelerometers. Position degrees of freedom, support for position tracking, general it is divided into infrared-tracking technology for outside-in (outbound tracking) and SLAM technology for inside-out (inbound tracking). For example: HTC VIVE uses Lighthouse laser scanning positioning technology [3,4], WoridViz uses a precise position tracking system to achieve 6DoF real-time tracking, zSpace uses tracking camera to achieve real-time tracking of the stylus [5,6]. But how can we make good use of these handheld handles in Unity 3D?

Based on this situation, this paper will design the interaction mode of HTC VIVE, CAVE, zSpace and other handheld handles based on the Unity 3D. Firstly, obtain the position and rotation information of each handheld handle virtual interactive device, and enhance the interaction experience of the handheld handle by adding Ray collision detection, hierarchical detection and label detection, so that the user can quickly and accurately interact in the virtual space.

II. THE DESIGN OF THE HANDHELD HANDLES INTERACTION

A. Software and Hardware Requirements

This thesis is based on the unity 3D virtual engine, using 3dMax for scene construction, using HTC VIVE, CAVE, zSpace handheld handles for virtual interaction.

B. The Main Function

The main functions of this paper are as follows:

(1) Three-dimensional software design for handheld handle applications

a. Control of the handheld handle simulator in Unity 3D

b. Use the simulator of the handheld handle to select any object

c. The picked object can be placed in the specified position

d. The object can be zoomed in and out using the simulator of the handheld handle

e. The object can be panned and rotated using the simulator of the handheld handle

(2) Design and implementation of hand-held handle interaction

a. Get the position information and rotation information of the handheld handle (6DoF data)

b. Sending rays from the camera to the handheld handle simulator

c. Use ray detection, level detection, label detection to obtain the first detected object

C. The Main Technical Route

The specific technical route is to first obtain data through the API provided by the handheld handle hardware device, then send rays in the direction of the camera and the handheld handle simulator, and then obtain all the information of the detected object through Ray detection, hierarchical detection, and label detection. And use the distance attribute to obtain the first detected object and feedback the results. The specific technical route is as Fig. 1.

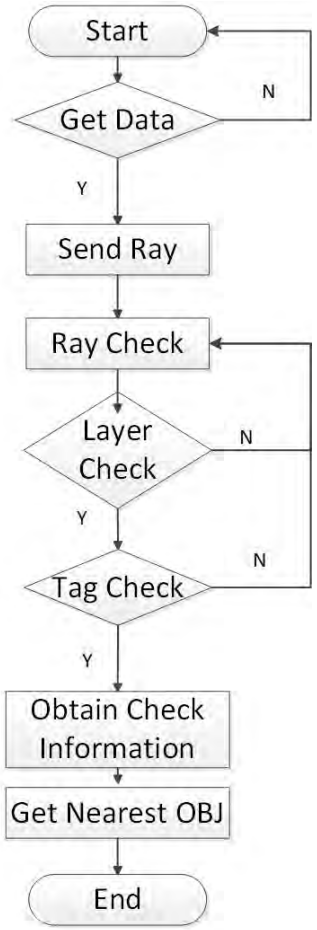

FIGURE I. HE SPECIFIC TECHNICAL ROUTE

III. The Application of Handheld Handle Interactive Design

This method can be applied to the virtual interaction of various handheld handles, such as: HTC VIVE, CAVE, zSpace, Gear VR, Storm Mirror, etc. The following will show its application cases in HTC VIVE, CAVE, and zSpace, Fig. 2 is this method using in HTC VIVE.

FIGURE II. THE APPLICATION OF THIS METHOD IN HTC VIVE

Fig. 3 shows the button selection in CAVE using this method.

Fig. 4 shows the application of this method to grab any object in zSpace.

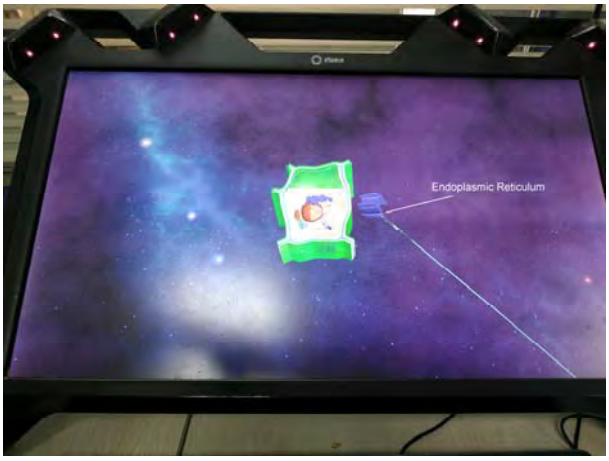

FIGURE III. APPLICATION OF THIS METHOD IN ZSPACE

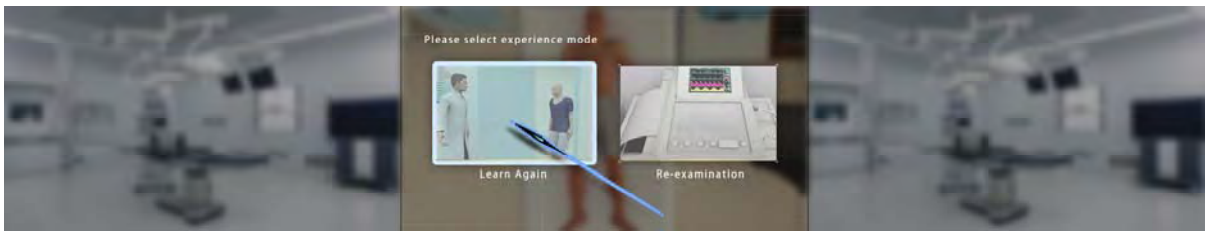

FIGURE IV. THE APPLICATION OF THIS METHOD IN CAVE

IV. Summary

This method can be applied to many kinds of handheld handle devices, at the same time users can quickly and accurately get any virtual objects in the virtual world, and have a better virtual interaction experience.

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