Design and Realization of Multimedia Teaching System of 3D Mathematical Model Based on Virtual Reality Technology

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ABSTRACT

With the development of science and technology, the ways of multimedia teaching become more and more intuitive, vivid and rich. With the gradual maturity of VR technology and the improvement of related gesture operation equipment, it is possible to develop the multimedia teaching system based on virtual display technology. This paper describes a process that is developing a multimedia teaching system applicable for virtual reality and Leap Motion gesture recognition, based on Unity3d platform which combines C# and JavaScript language to realize the interaction process. The result of practices shows that HTC Vive and Leap Motion in Unity3d platform can work well together.¹

INTRODUCTION

Multimedia Teaching Software Used in Virtual Reality

With the development of modern science and technology, the application of multimedia technology in education makes the teaching concept and form change. The multimedia teaching software applied to the virtual reality, will make users feel a more intuitive and vivid virtual world.

Virtual Reality

Virtual reality (VR) is a computer technology that uses virtual reality headsets, sometimes in combination with physical spaces or multi-projected environments, to

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generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary environment.

**Unity3d Platform**

Unity3D is a cross-platform game development tool that has an intuitive game editing environment and is a fully integrated professional game engine. Unity3D supports a variety of script language packages JavaScript, C#, Python, compatible with a variety of operating systems, the real realization of the cross-platform.

**Leap Motion**

Leap Motion is a somatosensory controller released by Leap on 27 February 2013 for somatosensory controller manufacturing company for PC and Mac, tracking all 10 fingers with up to 1/100 millimeters. It is far more accurate than the existing motion control technology.

**SYSTEM COMPOSITION**

**Development Process**

During the development of multimedia teaching software which is applicable for VR and Leap Motion, we firstly need to acquire and master the use of VR device’s SDK and gesture recognition device’s SDK. Then import the two SDKs into Unity3d platform, and configure its properties so that the two SDKs can work together. The development process is shown as figure 1.

**Key Technologies**

![Development process diagram]

Figure 1. Development process.
CALCULATION AND DISPLAY OF FUNCTIONS

The calculation part of the function is mainly realized by the stack of data structure and the operation of four operations add power and root. Sections of the program mainly includes:

① class OPTR and class OPND, respectively, store operators and arithmetic numbers.
② basic operation methods of stack of class OPTR and class OPND.
③ the main methods of function calculating:
  void AlltoPart (char [] InAll, ClassOPTR TR, ClassOPND ND, int Length);
  void Calculate (char [] In, ClassOPTR TR, ClassOPND ND);
  float StringToFloat (char [] c);
  int ExistNum (char a);
  int ExistTR (char a);
  float Operate (float a, float b, char ope);
  char Compare (char a, char b);
  void Insert (int pos, float data);
  DrawFunction ();

The above methods is to achieve the functions that obtain the user’s input function expression, and the entire expression will be split (All to Part method).

And then Calculate method will be executed. The calculate method will execute String To Float(), Compare(), Operate() and other methods. Finally the system will draw the function which user just input. Shown as figure 2.

GESTURE DRAWING

Figure 2. Model drawn by functions.
Realized by LeapMotion. After the user turn on the drawing button, by judging the distance of user’s right hand’s index finger and thumb, the system can determine whether to regard user’s index finger as a brush to draw lines. In addition, the user can also choose a variety of colors of the brush to make different labels. A triangle drawn by gesture drawing is shown as figure 3.

![Figure 3. A triangle drawn by gesture drawing.](image)

**STEREO GEOMETRY MOVEMENT AND STRETCHING**

The movement and stretching of the stereoscopic geometry is also manipulated by the Leap Motion gesture recognition. If user’s fingers contact the geometry and grasp it, the geometry will follow the user's finger’s movement. So the user can control the movement of geometric in one hand to achieve the function of grasping. If user’s fingers of both hands touch the geometric’s opposite sides and grasp it, you can stretch and compress the geometry. Shown as figure 4.

![Figure 4. Move and stretch the geometry by user’s hand.](image)
MASTER DESIGN

The menu interface is divided into 3 sections, direction interface, function menu, drawing menu. The menu structure is shown as figure 5.

![Menu structure diagram](image_url)

① Direction interface includes 6 buttons which are respectively, up, down, forward, back, left and right. This part of buttons is used to control the user's view’s movement rotating.

② Function menu is divided into functions menu and the geometry menu. The functions menu is used for the input of functions, and the geometry menu is used for creating new geometry which the user chooses to create.

③ The drawing menu is divided into the drawing enable button and the drawing color menu.

CONCLUSIONS

With the rapid development of information technology, today, multimedia teaching has been widely used. A lot of teachers and students have seen the intuitive and convenient that Multimedia teaching brings. The multimedia teaching software applied to virtual reality, Integrate multimedia with virtual reality. Through realistic interaction, it can create a new teaching experience, and has a lot of positive significance.

The brief descriptions of the different devices is presented in the Introduction, where Virtual reality refers to an encyclopedia [1] and books on virtual reality technology [3] [4]. The part of Unity3d refers to an encyclopedia [2] and Hu Wei's books [5]. The introduction to LeapMotion is partly from Hu xiaojian's book [3].
REFERENCES