

# *Design and Implementation of Virtual Laboratory for Computer Assembly*

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**Abstract**—The course of computer assembly has many problems, such as the high loss of hardware equipment, the shortage of funds, the slow updating and the potential safety hazards. It is particularly necessary to develop a virtual experimental environment. This paper elaborates the requirements, design and implementation of computer assembly virtual laboratory. Autodesk 3ds max is used to model and animate the computer assembly parts. Adobe Flash is used to build the operation platform, and human-computer interaction is used to realize the multi-angle observation and learning of the assembly parts in the three-dimensional environment. The virtual experiment management platform is developed based on ASP.NET technology. The functions of BIOS setup, hard disk partition, operating system installation, teacher-student interaction and student management are realized in virtual machine environment. Practice shows that the establishment of virtual laboratory for computer assembly has significantly improved students' interest in learning and teaching effect.

**Keywords**—Computer assembly; Virtual Laboratory; 3ds max; Management platform

## I. INTRODUCTION

Virtual experiment is a kind of software and hardware operating environment which can be aided by multimedia, simulation and virtual reality on the computer, partly replacing or even completely replacing the traditional experiment [1]. The vigorous development of information technology has made the design and development of virtual experimental environment a reality, and has been applied to practice under the guidance of certain theory, making it possible to build all kinds of virtual laboratories. Moreover, the research and construction of virtual experimental environment has greatly reduced the cost of the laboratory, alleviated the adverse effect of the financial pressure on the experimental practice teaching, and is beneficial to the cultivation of students' practical operation ability. Therefore, the research of virtual experimental teaching environment has great economic and social benefits.

In the computer assembly experiment, because of the large consumption of the assembled hardware, the excessive number of disassembly and assembly of CPU, memory and other hardware is easy to damage, it cannot be updated in time, the maintenance requirements are also high, and it is difficult to bear the high cost in the long run. The use of 3D technology to develop virtual experimental environment can effectively reduce the consumption of the experiment, but also can effectively solve the problems caused by the shortage of

experimental time, the slow renewal of hardware equipment and the limitation of resources [2].

In this paper, Autodesk 3ds max is used to model the computer assembly parts, and then animation is made to render the three-dimensional dynamic effect. The demonstration of computer assembly is completed by the method of human-computer interaction. The platform can be used to observe and learn the assembly parts from many angles, so that the students can have an intuitive understanding of each part of the computer. Students use mouse drag and drop to realize the operation of computer assembly in 3D environment, to make students understand and master the process of computer assembly by displaying 3D effect video of computer assembly. According to the development of virtual experiment management platform based on ASP.NET technology, students can access the virtual laboratory remotely and complete the functions of computer assembly and teacher-student interaction in the virtual environment.

## II. DESIGN AND IMPLEMENTATION OF VIRTUAL EXPERIMENT SYSTEM FOR COMPUTER ASSEMBLY

### *A. Main Construction Content of Virtual Experiment*

The construction of virtual laboratory is to complete the virtual computer assembly experiment on the basis of three-dimensional modeling, mainly including the following main contents:

First, Display and interaction of each part of the computer realizes 3D effect display of computer components based on 3D modeling. The interaction between the experimenter and the virtual experimental object can be carried out by clicking or dragging the mouse.

Second, 3D video display of the process about computer assembly and human - machine assembly.

Third, Development of virtual laboratory management platform completes the functions including student management, teacher-student interaction and remote access to virtual laboratory and so on.

### *B. Realization Technology of Virtual Laboratory*

Key technologies adopted:

First, 3D modeling technology. 3D max is a powerful 3D modeling software. The establishment of 3D model of object can be realized. The software operation is simple, the

production flow is very simple and efficient, the operation is optimized, the price is low and the expansibility is good, the plug-in is rich, and it can cooperate well with other software, to make the very real effect [3].

Second, Use FLASH to develop, FLASH technology adopts vector graphics technology; the generated animation is small and suitable for spread on the network. The Adobe Flash software has the perfect media support function; it can import the graphics image, the sound, the video, the three-dimensional animation and many other media. In addition, Flash itself is powerful animation software. The action script of Flash provides powerful interactive programming ability, and it is real object-oriented programming software.

Third, .NET technology, the core of .NET technology is .NET Framework. It provides a whole new environment. In this environment, a variety of complex distributed applications running on Windows platform can be developed in many kinds of languages. The virtual laboratory management platform is designed and implemented with Microsoft Visual Studio 2010 development platform, Microsoft SQL Server 2008 database and C# language.

C. System Function Module

System functional according to the requirements analysis requires that the system administrators, teachers and students of the virtual experimental platform assign the function elements to the following modules of the system. They are user management, system environment management, virtual experimental environment, teaching resources module, and forum exchange module. Three types of users assign different permissions to each module according to their permissions. The diagram of the case using in the system is shown in Figure 1:

The virtual experimental environment module mainly consists of three sub-modules. They are display and interactive module of each part of the computer, three-dimensional demonstration module of computer assembly, and virtual machine module [4].

First, Display and Interactive Module of Each Part of the Computer

The 3D model of computer components is built by Autodesk 3ds max. The 3D images are rendered and imported into the operating platform established by flash to realize the human-computer interaction and complete the 3D display and simple introduction of the computer components.

Second, Three-Dimensional Demonstration Module of Computer Assembly

Use Autodesk 3ds max Software to make 3D Animation with the completed 3D Model. And it is rendered and exported to the video, to realize the computer assembly of the three-dimensional display. The user understands the process of computer assembly by watching the video [5].

Third, Virtual Machine Module

Use the virtual machine embedded in the WEB page to set up soft experiments after the assembly including setting BIOS,

partitioning the hard disk, installing the operating system and so on.

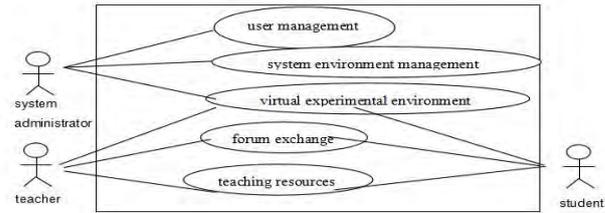


Fig. 1. Diagram of the Case of Computer Assembly Virtual Laboratory

D. Realization of Virtual Laboratory

First, Computer Component Modeling

The collection of materials needed for modeling is simple and quick. It can be obtained by referring to physical modeling, taking pictures of physical objects, or even downloading pictures directly on the Internet. Pay attention to obtain material for modeling when each angle needs to have the reference picture, it has the comprehensive concrete understanding to the physical object; the concrete detail part may take several pictures, it is convenient for modeling. The requirement to the size is not very strict when modeling, just need to know the proportion of each part [6].

After obtaining the material of the physical photograph, the 3D model is built by using Autodesk 3ds max. The parts which need to be modeling of computer assembly include motherboard, CPU, graphics card, CPU fan, memory bar, power supply, CD driver, hard disk, data cable, host, monitor, keyboard and mouse. Figure 2 and 3 is a screenshot of the modeling process of memory and graphics card.

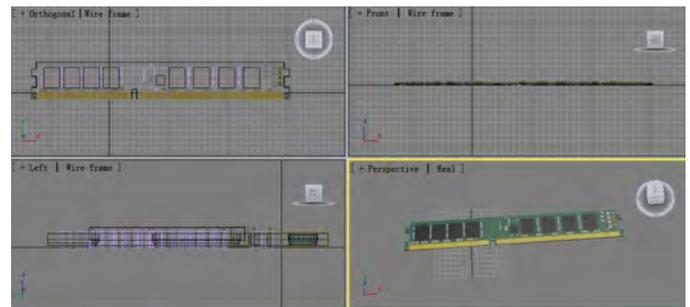


Fig. 2. 3D Model of Memory

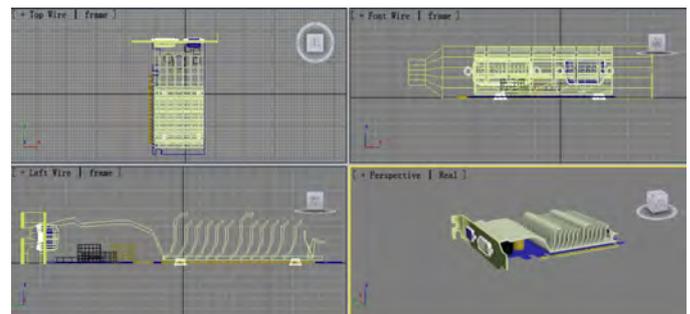


Fig. 3. 3D Model of Graphics Card

For the 3d model, use Autodesk 3ds Max to add and render materials to increase the authenticity of the model. The rendering effect is shown in Figure 4-7.



Fig. 4. Three-Dimensional Effect Diagram of Power Supply

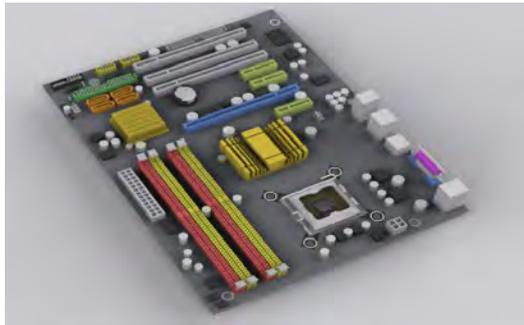


Fig. 5. Three-Dimensional Effect Diagram of Motherboard

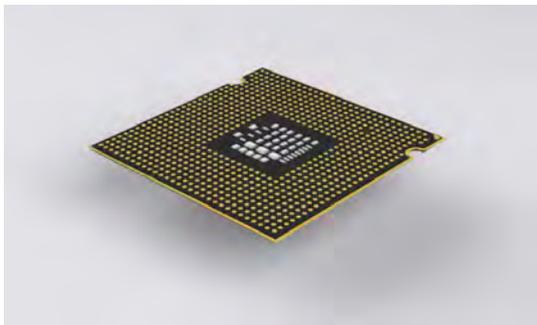


Fig. 6. 3D Effect Diagram of CPU



Fig. 7. 3D Effect Diagram of CD Driver

Second, 3D Interactive Production

Use the previous model to make the animation effect of assembly in Autodesk 3ds max, and the human-computer

interactive demonstration of computer assembly is completed. All dynamic animations are connected together to form a whole computer assembled video, it can show the concrete process of computer assembly with the explanation in sound.

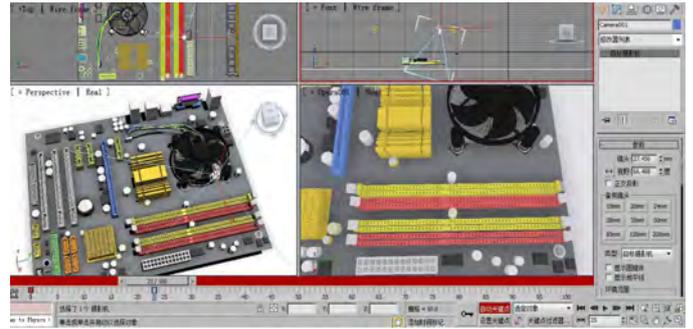


Fig. 8. Animation Demonstration of Fan Installation

Third, Implementation of Computer Hardware Assembly Platform

Use Adobe Flash to make navigation button pages suitable for parts display of computer assembly virtual laboratory. The pictures of all computer simulation parts are arranged on the page as buttons, and the display effect of each analog part is realized through the navigation button page, and the name explanation of the text is added to the enlarged display page, as shown in Figure 9 and 10 [7].

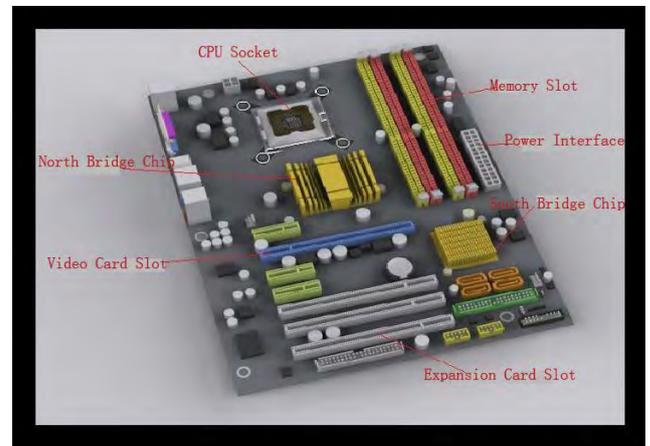


Fig. 9. Navigation Button Page

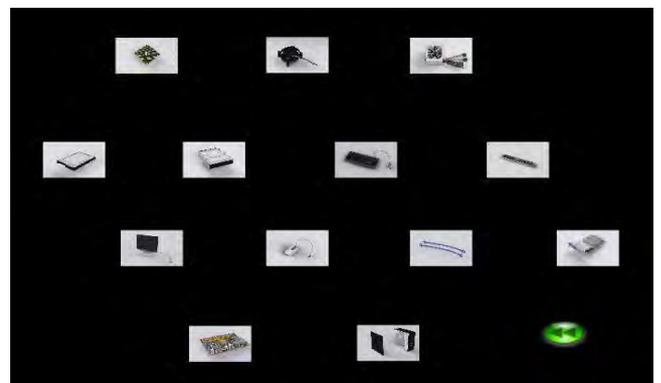


Fig. 10. Text Interpretation of 3D Model

### III. SUMMARY

Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled.

The effect of computer assembly virtual experiment is obtained by 3D modeling. It has higher authenticity, which makes students have an intuitive and stereoscopic understanding of the computer components. At the same time, it effectively alleviates the funds, the venue, the equipment and other difficulties in other aspects. The designed interface is simple and easy to operate, and it has good human-computer interaction design, which basically meets the functional requirements of virtual experiment, and completes the functions of basic management of students, teacher-student interaction, and computer assembly of teaching resources and so on, according to the virtual experimental management platform. Students can also continue to complete the virtual machine BIOS setup, operating system installation and other soft experiment projects on the platform. Carrying out virtual experiment teaching can break the limitation of traditional experiment on "time and space" and increase the flexibility of experiment teaching.

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