

# Design and Implementation of Online Virtual Experiment Lab

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## Abstract

*During the last several years, E-learning has emerged as one of the fastest-moving trends in education and is booming. Thanks to the widespread access to the Internet, on-line education is enabling students and professionals to learn from afar, keeping pace with technological and managerial changes. The paper expatiated to the virtual experiment tuition environment application in the long-distance education based on construct theory. And introduced online virtual experiment environment model, scene modeling and particular design and implement, Designed and implement the virtual experiment environment flat and within the users and the administrators and users can share to utilize key scene data more advantage and faster, And overpass the emluator on the Internet to test the integrate circuit experiment, Constructed a new and open virtual experiment teaching mode.*

## 1. Introduction

The collection of computers forms a virtual experiment laboratory because the machines can be located in different buildings and even at different campuses. It facilitates resource sharing among different schools and overcomes the limit of geographical distances[1]. The online virtual experiment lab system design includes an agent-based client side functions and interface, the structuring of Lab servers, the mechanisms to locate user requested software packages/services and to present various forms of data and information, and the interfaces to various education and experiment software packages. Technologies such as virtual reality, Java Applets and Servlets, XML, and Web/HTTP servers are used to implement the underlying mechanisms and facilities of the virtual Lab, such as software resource locating and interfacing, real-time interaction, and information presentation[2]. Using these technologies allows the system to achieve high-performance, scalability, and disconnected operation through reduction in network

bandwidth and delay, load balancing, and code mobility.

In this paper, the proposed long-range experimental teaching model of its long-range goal is to change the current existing in the education of the fundamental problems in building a constructivist learning theory as the theoretical basis of the experimental three-dimensional virtual learning environment is the goal of our design, the creation of three-dimensional virtual experimental environment is a three-dimensional space situational teaching environment, using VRML virtual online laboratories integrated circuit test system as a virtual learning environment, through the Internet to provide distance learning platform, which provides knowledge acquisition tools, virtual experiment operation, and supports the exploration of the experimental teaching, collaborative experiment teaching, the experience of the experimental operation of constructivist learning theory based on the concept. The main features are as follows: First, in order to vector in the form of virtual space that the experimental teaching model of the relationship between shape and location relative; Second, real-time roaming support, and explore learning, experiential learning to provide support; Third, to provide real-time feedback information; Fourth, support for hypermedia Supplementary information (such as online voice, animation, etc.); five experiments is to provide a wealth of knowledge of teaching theoretical study with practical teaching and learning materials targeted at the design of the experiment modules, providing learners with knowledge acquisition tool for the formation of experimental construction of meaning.

## 2. Online teaching model of virtual experiment

Learners in the event of the process of knowledge acquisition activities, contexts, collaboration, conversation, the meaning of the four elements of construction plays a decisive role, constructivism of learners in line with the basic interpretation and analysis of learner learning psychology, education

scholars have been many recognition, as well as online teaching model of virtual experiment designed to provide a theoretical basis.

Virtual experiment teaching and learning environment is a rich knowledge base to reflect the experimental teaching materials for teachers and curriculum ideas[3]. Each environment is a virtual space situational learning environment experiments, the teaching model of the relationship between shape and location relative to the form of three-dimensional virtual space vector expressed support for features such as real-time roaming. The environment provides a wealth of experimental knowledge of theoretical study, experimental teaching materials to the actual design of experiments targeting modules. Experiments through the activities of learners from the virtual experiment environment, access to experimental resources and access to knowledge through the construction of meaning. User interface for the learners of the experimental activities to provide technical support. Experimental curriculum design interfaces to help teachers design visualization virtual experiment environment, and real-time interaction with the teachers to revise and improve teaching and learning environment of virtual experiment design. Virtual experiment contains elements of teaching and learning environment are as follows: First, a virtual entity, in kind, using three-dimensional modeling software to establish the experimental teaching model, such as IC test-bed scenario experiment, devices and measuring instruments, such as virtual objects; Second, the abstract entities, it is difficult to observe in real life to the object, such as electronics, voltage, current, etc., an abstract entity modeling experiments can give the object of an intuitive concept and build a conceptual model; three sports entity, the three-dimensional simulation based on the movement to achieve movement in the current process, such as materials physics experiment on the value of various sports, such as energy Shou, sports entities contribute to the performance of the modeling teaching thinking, reflecting experimental knowledge, experimenter stage in the construction of meaning will be more substantial; four art processing entities, the virtual entities and abstract entities on the basis of the way to beautify the performance of the entity; Fifth, information entities, entities that factor analysis evaluation system, guiding instructions, supporting knowledge, experience and other relevant information; addition The virtual experiment environment adaptive auxiliary functions, such as operation of the experimental information prompted, FAQ query mechanism, experiments in favor of the correct and effective completion of the experimental activities [4].

### **3.Design and application of learning environment of virtual experiment**

Experiment the contents of computer integrated circuits targeted at the experimental design of interactive Web-based three-dimensional virtual experiment platform for teaching and learning environment. Learners in the experimental environment, capable of reading materials and interactive virtual environment to operate the experiment. Platform for virtual system can support multimedia computer browser running on the desktop environment. Learners access the server through the Internet directly into the virtual experiment studies the experimental operation of the virtual field experience. Mature current VRML technology is the use of three-dimensional virtual environment for the development of experimental, VRML applications with a mature basis, and we constructed a virtual circuit through the ASP laboratory emphasis on the release of a web page and application[5]. VRML is a description of HTML-like language, by installing a specific explanation of VRML plug-ins can be directly in the browser show the scenes of virtual circuit laboratory experiments and interactive operation.

Here, we integrated circuits to build online virtual laboratory as an example, the experiment focuses on the online scene data to VRML scenes of virtual laboratory technology for modeling process, as well as ASP to XML technology and a virtual scene of the exchange of critical data and applications[6]. VRML itself is the structure of the tree node hierarchy. This structure of integrated circuits for the realization of the virtual laboratory is more appropriate, but the tree-level nodes in the difference between the various large organizations do not facilitate the unification. Therefore, by constructing a unified external interface nodes, all components of the same node (node model with user control of the relevant nodes, control node animation) into the same target node, so easy development, respectively, for each object to build the unity and the final integration[7]. All of the interactive nodes related to the package are a unified node object, so to facilitate the achievement of clear complex interactivity. At the same time, the use of VRML itself provided mechanisms for human-computer interaction and animation can be a good experiment in the realization of the need to control all the interaction.

XML through the web site of the existing database systems to provide an interface, the outside world can make use of XML on any platform to achieve under the existing online database access, and the outcome of

the visit in the form of XML output for calls to other platforms in order to achieve heterogeneous systems collaboration between the data. Research in this subject will have a creative way by constructing virtual reality (VRML) characteristics of the XSL style sheet to the XML document this way the data in the query, call, remodeling, etc., which is designed and implemented a virtual laboratory and between its users or the administrator and users can be more convenient, quick to share the use of a key scene data. Experiment to follow certain steps. Therefore, to increase the interaction between the steps of the control experiments, that is, certain interactive or animation of the experiment only at specified steps in order to be activated. Completed a step in the interaction and animation to enter the next step after the operation. The purpose of this there are two, one to facilitate the course of the experiment the current state of the record, if they do not adopt this approach it is difficult to determine in what is now state of the experiment. Second, the experimental subjects have a clear understanding of the process to facilitate the results of experiment and verification records. Virtual experiment design of the components needed to be divided into two types: one model is a static scene, and the other is the interactive control node. In essence, these are all in the VRML scene node.

Interactive control in two aspects: First, the process on the experimental realization of a virtual animation; Second, human-computer interaction interface. Control of the former prototype through animation (Animation) to provide for all of the same animation control, and the latter by redefining the public's access to detector (TouchSensor) prototype provides the user control interface TouchSensorX. All users to trigger events to the script node (Script) approach to control, is about to enter a user after the control script into some sort of code, and then the controlled output to a specific object, the process of the realization of interactive control. Taking into account the need to control the design code used VRMLScript (Javascript) to prepare. Experimental steps for the control of user interface control state TouchSensor to realize that when a step in the experiment on the activation of specific TouchSensor, without the need for other steps of TouchSensor, allows users to be a step in the complete contents of all the experiments in order to enter the next step.

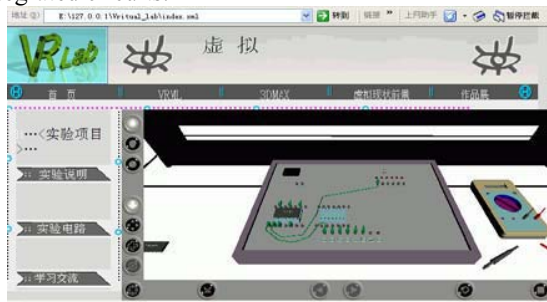
It is precisely because most of the virtual three-dimensional technology to the performance of the network applications described in this paper for the convenience of a web page will use the framework to express the link between the various languages so that problem can be brought out more clearly. Page for the

virtual environment scene around the framework structure, the left side of the framework (known as VRML) for the realization of three-dimensional virtual scene browser; the right framework (called DATA) the use of ASP back-end database for dynamic query user activated the corresponding scenes of the data items. VRML in the left side of the page embedded in a VRML browser components, to link ASP file. As for the whole building a virtual experiment environment has been briefly described above is available from many third-party companies to develop rapid modeling tools (such as Russia ParallelGraphics's Internet Space Bulider by vrmlpad). Scenes in the database to preserve the most important key data, the purpose of practical application when the composition of large and complex scenes can store large amounts of data, taking into account the many still remain in the server-side platform for direct access to the database and system status, the requirements that the data can be well preserved copy, reuse, to avoid redundant data storage to optimize. Comprehensive, large-scale scenes of the VRML code that corresponds to tens of thousands of lines at every turn, it saved from the database using the database to generate XML documents, XML documents to re-use of documents easy to generate scenes in terms of interoperability, the more feasible of the virtual scene local code, the key information processing. However, correct, complete VRML scenes to generate essential code. Here there is virtual reality by constructing (VRML) characteristics of the XSL style sheet to the XML document this way the data in the query, call, such as remodeling.

Here on the circuit elements to generate, at best, only as a complete scene of an object, which is often used to make changes to an object - that is to say, the revision of a local scene is usually an object model for the (This includes articles in itself has been on a modified and complete replacement of the goods, in fact, complete replacement of items is also very simple, as long as we kept in the storage medium on the replacement of items used as address to the main scene file, and then changed by the inline node items into the scene of the address). Corresponding to the above-mentioned embedded in the ASP page document WRL virtual scene, a scene in order to modify the properties of items in turn affect its performance in the scene, the same can be virtual reality modeling language in the realization of the anchor node. Other details are no longer limited to the length of the detailed design of the prototype code.

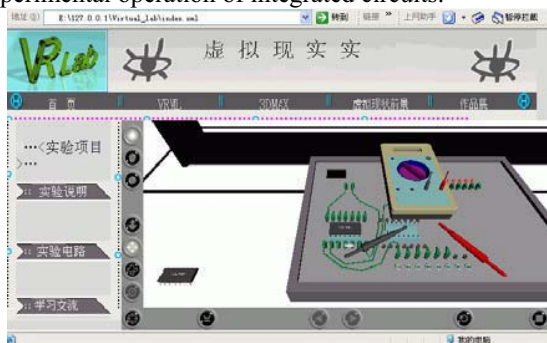
#### 4. The virtual lab application example

First, users of integrated circuits into the online virtual laboratory web site, register and become a user. Understanding of the relevant features of the system to detect and install the VRML plug-in; then click on the virtual circuit laboratory hot, by the user to create an integrated circuit design, the user can click or drag the mouse circuit board visual elements (such as the socket , multimeter,etc.), the wire connections between components can be hot or mouse clicks to complete the painting line. Figure 1 shows an experimental model of integrated circuits.



**Figure 1. a virtual model of integrated circuits**

End of a chip during the experiment, it will switch to close, all the output of small light bulbs have been shut down. At this time all the inputs are maintained at the normal end of the previous experimental condition. After the experiment with another chip, wire connected, open the switch, all output immediately in accordance with previous results showed that input. Multimeter in a fixed period of time (10 seconds) can be activated, and the normal connection. Multimeter to test the left has been designated a small light bulb output value of the output voltage when the output of small light bulbs 5, to eliminate output 0. T in the table when not connected, the output will remain at 0. In accordance with changes in input, output multimeter can do the appropriate changes, as shown in Figure 2 for an experimental operation of integrated circuits.



**Figure 2. Experimental measurement of an integrated circuit to operate**

## 5. Applications and conclusion

In this paper, we have described the design of a Web-based virtual lab software system, which allows distant students to gain access to various circuits lab software by using a standard Web browser such as Netscape and Internet Explorer. The research described in this paper improves the existing work on distance teaching and learning which lack some of the important features that are associated with traditional education activities such as laboratory exercises. By doing so, we are developing special software and laboratory materials designed to facilitate students access to a wider range of information and educational services. Using the online virtual experiment lab, students can use experiment lab facilities which they otherwise might not be able to access due to the incapability to be present in the lab or shortage of laboratory time. Furthermore, our design of the virtual experiment lab takes into consideration of integrating facilities from several labs, which enables more resource sharing and offsets the high cost in developing virtual experiment lab materials by wider usage of the lab materials across different campuses.

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