SYSTEM OF PREVIEW AND DETECTION BASED ON NETWORK VIRTUAL EXPERIMENT

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ABSTRACT

As an important supporting means for teaching in university, virtual experiment makes up the lack of resources in experiment teaching. Network virtual experiment is a new development direction following the virtual experiment, it has inherited and carried forward the concept of virtual experiments, extending and expanding the resources of virtual experiments. It realizes the preview and detection of experiment by the networked virtual experiment, which ensures the reality of experiment process and data, and reduces teacher's workload, so that it provides a firm base for automated management of experiment teaching.

Keywords: *Virtual Experiment (VIREXP), Internet Technique, System of Experiment Preview, Network*

1. INTRODUCTION

Concept of virtual laboratory is firstly proposed in 1989 by William Wolf, a professor at the University of Virginia in the United States [1]. Recently, with the rapid development of network information technology and increasingly perfect of related technology, the computer network represented by Internet has been widely applied in more and more fields. On the basis of the development of this, teaching based on network VIREXP, as an effective complement to traditional experiment teaching, has become an important means to strengthen the practice and improve the quality of teaching [2]. In te paper, we design a network VIREXP platform using JAVA language, and build a system of preview and detection for experiment based on WEB by using the network VIREXP platform. The system would Monitor the experiment process and detect the experiment data by using Client-Side-Validation and server-side security policy, and it implement automated management for experiment preview link.

2. ANALYSIS ON SYSTEM OF EXPERIMENT PREVIEW BASED ON WEB

Currently, systems of preview and detection for experiment based on WEB which are commonly used are basically has the following kinds shown in Figure1- Figure4.

2.1. Demonstration Experiment System Based on WEB
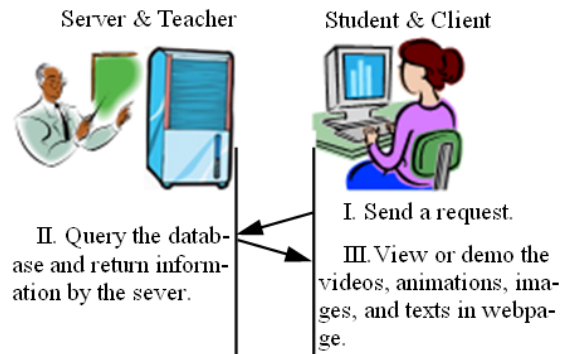

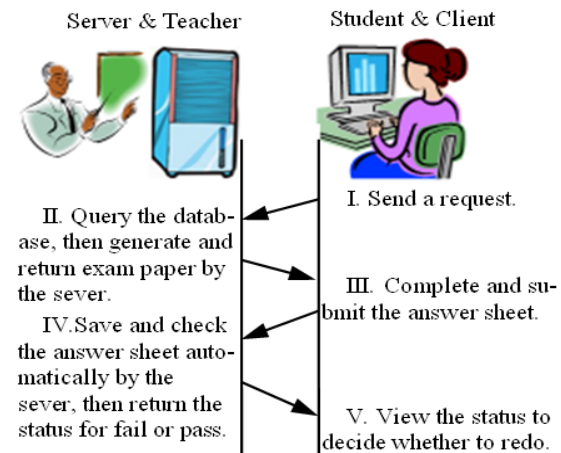*Figure 1 Demonstration experiment system based on WEB*

Figure 2 System Of File Upload Based On Desktop Simulation Software

This kind is shown in Figure1. It can take advantage of the large number of off-the-shelf animations, videos, pictures, PPT, texts and so on. However, due to being lack of the interaction and feedback between teachers and students, teachers are unable to grasp the situation of experiment preview by the students.

2.2. System of File Upload Based on Desktop Simulation Software

By using desktop simulation software (such as Multisim), students can simulate the process of entire experiment. This kind, such as shown in Figure2 can make interactive feedback between teachers and students. The problem is: Students can easily copy results to deal with the preview check perfunctorily without effective monitoring at the state I and teacher's workload of checking the preview is very heavy at state III. This system is mainly used in large-scale or complex experiments and with a few students.

2.3. System of Preview and Detection Based on Network Respondents

This kind, such as shown in Figure3 can implement the check of preview results completely by computer and prevent corrupt conduct by using technical means(such as to generate random questions and answers every time). The main problem is that it does not provide the training and testing of the experiment operating, which is one of the most important parts of the experiment teaching.
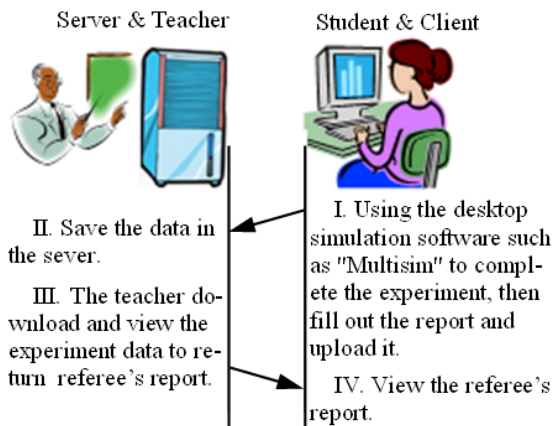

Figure 3 System Of Preview And Detection Based On Network Respondents

2.4. System of Preview and Detection Based on Network VIREXP

As shown in Figure 4, the system can implement the simulation of the experiment process in the environment of network VIREXP. By using client-side and server-side validation, not only it can ensure the authenticity of the experiment process and experiment data, but also greatly reduce the workload of teachers, which is the ideal solution at present.

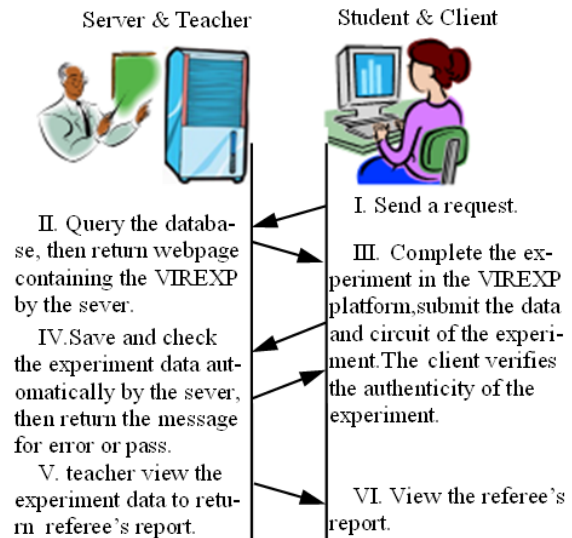### 3. TECHNIQUES OF NETWORK VIREXP

Figure 4 System Of Preview And Detection Based On Network Virtual Experiment

The network VIREXP means to build a visual environment in the WEB, where every visual object represents an experiment object. Users can carry out the virtual experiments by clicking or dragging mouse. The bases of realizing network VIREXP are the combination of multi-media computer techniques and network techniques.

The low cost and high efficiency are the biggest advantages of the virtual laboratory. Because "the software is the instrument", it can solve the problem of being unable to provide the physical experiments due to the inadequate funding or lack of high-grade and high-priced equipment. It also avoids the phenomenon of instruments damaging or components lost caused by the improper use, mismanagement and other factors. Furthermore, VIREXP can also simulate the equipments which cannot be afforded in laboratory. In conclusion, the students can easily carry out experiments in the virtual laboratory free from the restrictions of time and space.

Virtual laboratory should have some basic features: consistency of the reality (or extension of the reality), highly interactive, real-time feedback, etc. [3]-[4]

4. DESIGN OF THE SYSTEM

4.1. Design of the Network VIREXP Platform

The techniques to bring about VIREXP are usually include Java, ActiveX control, VRML (Virtual Reality Modeling Language) ,etc.[5]-[8]

Since different component models need to be built for different experiments, they generally require a separate design. In the paper, we take the analog circuit experiment for example.

In the design, the Java aplet developed in Java is running embedded in webpages through the tag of "<aplet>". The state of the circuit in VIREXP is represented by which consist of all the components in the circuit, their location and parameters, and the connections between the components, etc. , just as the netlist in "Spice". In order to exchanging information between the VIREXP and the browser or other softwares, the variable of "CircuitStatus" adopt XML-compliant text format. In VIREXP, it gets the initial state from the variable of "CircuitStatus" in webpage and initializes the VIREXP by using the function of getParameter("CircuitStatus") in Aplet-Class. It also defines a Public method of "getCircuitStatus()" to return the state of current circuit in the VIREXP.

4.2. Design of the System Background

The server adopts ASP.NET+SQL Server2005. Relying on the original Open Experiment Management System (referred OEMIS), We need only to implement the corresponding modules and make them associated with the original OEMIS.

4.2.1. Design of the server-side database

Three new tables were created in the original database. Their relation is shown in Figure 5.
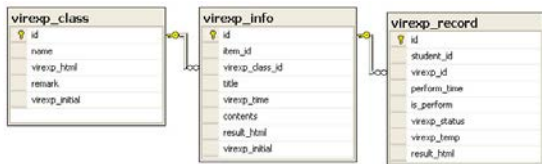

Figure 5 Relations Of Server-Side Database

The "virexp_html" field in "virexp_class" table records the codes of VIREXP.

In "Virexp_info" table, the "item_id" field is associated with the item number in the "course" table, the "contents" field contains the contents and requirements of experiment, the "result_html" field contains experiment report, in which the data needed to be filled and the circuit states needed to be saved are instead of the placeholder of "{$$$@@@}CIRCUIT_STATE{@@@$$$}", the

"virexp_initial" field contains the initial state of circuit.

The "Virexp_record" table records the situation of doing virtual experiments by students. Circuit states and experiment data which are separated with "{$%@#$%@#}" are respectively saved in "virexp_status" field and "result_html" field. The "virexp_temp" field saves the last state of the circuit.

4.2.2. Design of the management page

The Management Page mainly implements the establishment and management of the three tables in Figure 5, and saves the experiment situation in the table of "virexp_record". The Management Page of publishing virtual experiments is shown in Figure 6. In Figure 6, the data needed to be filled and the circuit states needed to be saved are instead of the corresponding placeholder. The initial circuit state in VIREXP will be set in Figure 7.
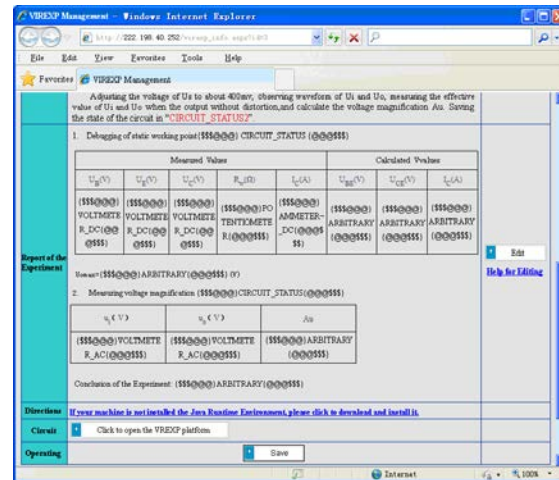

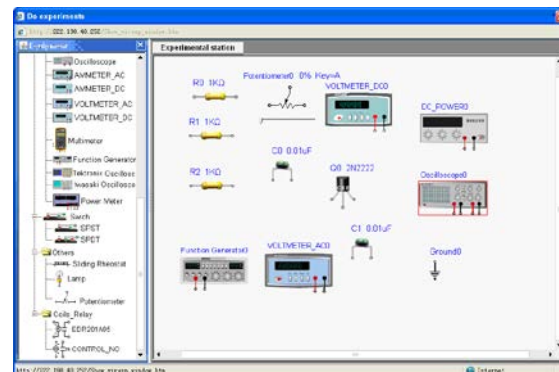*Figure 6 Virexp Management Page*

Figure 7 Setting Initial Circuit In VIREXP

4.3. Design of the Javascript in Client

Since students doing experiments through running VIREXP in client browser, in order to ensure authenticity, it must monitor the experiment

process and test the experiment data by Client-Side-Validation. It is realized by using Javascript in the system.

The page of students doing VIREXP is shown in Figure 8. Data are stored in variables of Javascript instead of form fields, and to be exchanged in an asynchronous manner with the server via AJAX technique. In the page, all of the data and placeholders are shown in Figure 6 are instead of the correspond-ing data or buttons by using the function of "InitalResultHtml()".
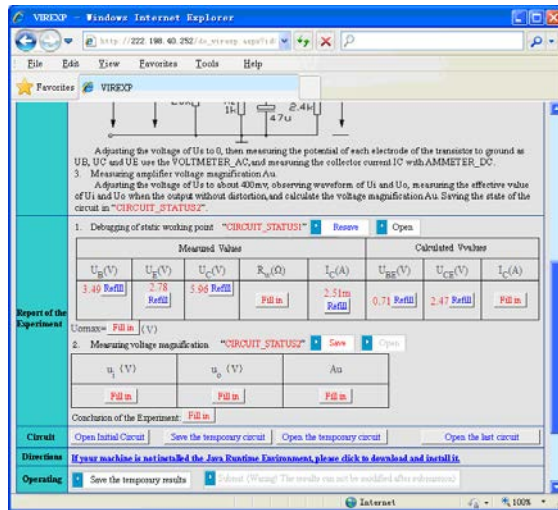

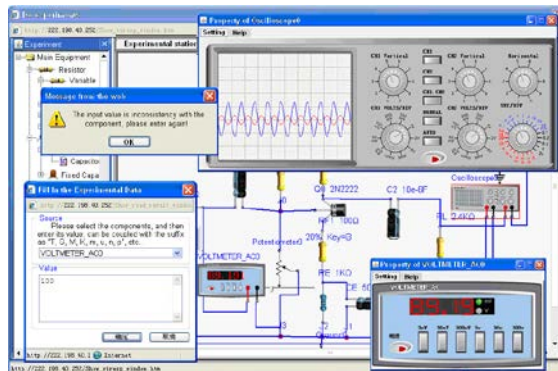*Figure 8 The Page Of Doing VIREXP*

Figure 9 Connecting Circuit And Testing Experiment Data In VIREXP

The experiment data may not be filled in directly, it must be controlled by Javascript through calling the function of "ReadResult(ResultAttrib,n)" when click the button. The parameter of "ResultAttrib" means the data source (such as "VOLTMETER_AC"), and the parameter of "n" is the serial number of the data in the same type of data. The function of "ReadResult" gets the current circuit state as the variable of "CircuitStatus" by calling the mothed of "getCircuitStatus()" in

VIREXP, and discover the data sources and list them for selecting. All of the data except being marked as "{$$$@@@}ARBITRARY{@@@$$$}" must be compared with the components in the VIREXP. As it's shown in Figure 9, because of the inconsistency of the value between input and being shown in the equipment of "VOLTMETER_AC", the data can not be input successfully.

5.   REALIZATION TECHNIQUES OF THE SYSTEM

5.1. Java

Java is a widely used object-oriented programming language. First of all, as a programming language, it has excellent characteristics of simplicity, portability, security, and supporting for concurrent programming, etc.[9]. Secondly, it maximizes the application of the network in which a Java applet can be run on the network free from constraints on CPU and environment. In addition, Java provides a rich library, so that programmers can easily build their own system, and this feature is very critical to build online virtual lab system.

5.2. Client-Side-Validation Based On Javascript

Client-Side-Validation means to detect error or illegal information using the scripts or other techniques before the form is submitted, so that the users can discover the error message earlier, and to avoid the waste for waiting time because of the submission of incorrect data. It not only can improve the user experience, but also reduce the burden on the server.[10]

The system use Javascript for Client-Side-Validation, its major role is to monitor experiments process in client and ensure the validity of the input data.

From the perspective of system security, the client cannot be trusted. However, we can make counterfeiting become very difficult through rational design and coupled with server security policy, so that the system has enough availability.

5.3. Server-side Security Policy

A key in the design is how to prevent various forms of cheating. Because of monitoring experiments process and verifying data are both rely on client-side Javascript, the server mainly ensures the data being submitted from the "correct" page.

5.4. AJAX

AJAX is the abbreviation of "Asynchronous JavaScript and XML". It's a technique which powerfully combines the several existing techniques of "XHTML", "DOM", "XMLHttpRequest", "Javascript". [11] AJAX can be easily used to realize timely and partly updating of the webpage, and asynchronously submitting data, so that it greatly improves the user experience.

6. CONCLUSION

Network VIREXP platform provides a solid foundation for automated management based on WEB in preview and detection of experiment. This system combines a variety of network programming techniques to ensure authenticity and reliability of experiment process and experiment data by Client-Side-Validation and server-side security policy, and greatly reduces the workload of teachers, so that it has a strong practicality and ease of usability. The main deficiency of the system is that network VIREXP platform has a certain gap in model support of the components compared with desktop simulation software, and it needs to be solved in the further study.

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