Preliminary Study on the Construction of Electronics Courses Virtual Laboratory

Ying ZHU\textsuperscript{a}, Yong-xing JIA, Yuan WANG, Chuan-zhen RONG and Yu YANG

College of Communications Engineering, PLA Univ. of Sci. & Tech. Nanjing, Jiangsu, China
\textsuperscript{a}zying\_0425@163.com

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Abstract. Because of the limitations on time and space of traditional experiments, this paper proposes the building idea of the electronic virtual laboratory based on network. Starting from the student demand, according to the characteristics of the course, by detailed analyzing on the construction of virtual laboratory, design methods, and experimental settings, a preliminary construction of virtual laboratory was completed, presented the function modules of the system and experimental design. At the same time, this paper illustrates the use of virtual labs through concrete experimental operations. By logging on the virtual laboratory through the network, students can do the experiment in anywhere, at any time, without the limitation of space and time, and teachers can also intersperse virtual experiment while teaching, to provide students with a more intuitive introduction, to help students better retain knowledge.

Introduction

As a professional electronic professional foundation courses, like the principle of circuit analysis, signals and systems, electronic circuits and other courses, generally start high numbers of students involved. Traditional experimental teaching of basic courses in electronics, due to experimental environment, equipment limitations, students need to experiment in batches. Because of financial strain, laboratory construction scale seriously lags behind the rapid expansion of the scale. If we are still using the traditional teaching method, then not only the school must consume huge amounts of money to expand laboratory construction scale, add a lot of equipment, but also to expand the laboratory managers to strengthen management, to avoid the loss of equipment and also to ensure experimental teaching in good order. While traditional experimental teaching should be completed the experiment within the specified time. It is hindered students' personality development by its limitation on independently design, modify the parameters, and convenient replacement of components. With the development of the Internet, seeking a new experimental way to compensate for the shortcomings of traditional experiment has become a top priority. Construction of network virtual laboratory uses software instead of hardware and programming simulation of the entire process. Network virtual experiment will greatly simplify the experiment operations, and save the cost of various instruments used in the experiment, implement electronic data delivery. You can break the traditional laboratory in geographic space and time constraints.

1. Virtual Experiment

With the emergence and development of modern advances in computer technology, virtual experiment becomes a popular experimental model. However, compared to the traditional computer simulations, it has enough advantage on the ontological reality of experimental application and universality, as well as on experimental site in real time and effectiveness. Virtual experiment technology based on virtual reality technology and virtual instrument technology, in fact, is an extension of computer science and technology. By virtual laboratory simulation, users can get more comprehensive understanding of the use of laboratory equipment, skill experimental operation and data analysis of the results, deep in the theoretical knowledge and digested. Similar to the real, virtual experiments can be adjusted for students to do it themselves and use laboratory instruments and equipment. Teachers can also take advantage of virtual equipment and typical cases to reproduce the entire experimental process on computer.
Compare with reality lab, virtual lab is one of the most important areas of application of modern education technology. It has many advantages and features. First is the openness. Virtual experiments can completely break the space limitations, to provide any learner to learning, work and experimentation in any time, any place and any experiment. Virtual laboratory is more conducive to the conduct of scientific research. Second is the economy. The traditional experimental needs in specific laboratory equipment, loss, costs are higher. But virtual devices, which have no wear and tear, damage problem, can be used repeatedly, not only meeting the demands of experimental but also saving expenditure. Three is the interactive. The subjects, according to their own needs with virtual equipment provided by virtual lab, can build and design experiments in the virtual experiments. Four is the reusable. According to their own experiments need, the user can construct new experiment modules, add new instrument or improve, combine or mix methods to build a new module on the basis of the already existing function modules.

2. The LabVIEW

LabVIEW is launched by United States NI a g-based language (Graphics Language, a graphical programming language) software development tools of virtual instruments. It mainly used for data acquisition and analysis, instrumentation and control, test and measurement, and process monitoring and control fields. With tight combination on hardware, LabVIEW enables rapid application on development, data collection, analysis, preparation of the user from the tedious code freed, shorten the software development cycle. LabVIEW integrates with a lot of graphic user interface template, and there is a wealth of numerical analysis, digital signal processing, and a variety of hardware device driver functions. Use LabVIEW to realize computer control for programmable instruments, to a large extent, improve the efficiency of programming, so the program also known as a virtual instrument, ideal for instrument control and signal analysis of transmission and so on. While LabVIEW has good openness, using its network tool package provides of network development function, the VI program can be released to internet very conveniently. With the CGI, and TCP, and FTP interface for remote browser and local server provided by LabVIEW, using which can fast effective to put LabVIEW program of front board released to online, user can access remote server of virtual instrument page, dynamic control of remote servers for testing in client. So it is the right tool for building virtual laboratories.

3. Virtual Laboratory of Electronic Course Design

In the electronic professional foundation courses, many courses, more closely associated with math, more abstract concepts, is difficult to understand. Many design and comprehensive test is not easy to set up, even if the part can open, it also has a lot of difficult problems on modify parameters in the bench, replacing components, measurement operations and so on. Construction of virtual labs, realization of experimental network share, students can be carried out by using a browser experiment, visualize abstract concepts, but also easy to experiment platform extensions, upgrades and maintenance to address the shortage of laboratory equipment, models backward, slow replacement difficulties and other problems.

A complete set of network virtual laboratory system should include three parts at least: network services module, database system, and virtual lab module, seen in Fig.1

Figure 1. The Structural of Visual Lab.
3.1 Network Services Module

The partial implements the network functionality of a virtual laboratory. It's primarily responsible for customer information management, experimental module loading, and data processing and so on. User information management including user registration and login, choose to experiment, complete the online learning on principles, procedures and experiments related to the theoretical basics, simulation and experiments and experimental reports submitted. Experimental management section is responsible for the data processing. The module administration section is responsible for downloading the experiment module from the server, loading or unloading experiment module to the client program, and switching between modules, and so on.

3.2 Database System

Primarily responsible for the create and modify of user, database system provide different permissions to different users, manage personal information of students and student jobs, maintain system security. Using Microsoft SQLServer database, formed through the IIS Web site that uses ADO.NET data access software on the server and the database.

3.3 Virtual Experiment Module

Virtual experiment module is the core of the client. It is not only for building a virtual experimental environment, the provision of specific design interface, but also responsible for the analysis of experimental data received from the server in order to curve or graphics and other visual feedback to the user in the form.

4. Example of Virtual Laboratory System

Based on the above analysis, a virtual lab of Signals and Systems course was developed and used. After login website, student can select actions to be undertaken into concrete experimental interfaces, and understand the theoretical principles of experiment. Then proceed to experiment, different settings to different functions, students can modify the relevant parameters at any time and results changes were observed.

For example, like the convolution integral points in the course of the Signals and Systems, the knowledge contents are abstract, not easy for understanding. It cannot be shown through physical experiment, and pure programming experiment, can only get results, could not understand the calculation process. While doing virtual experiment, students can easily operate and see the complete process of convolution results by parameter adjustment. It has a great role in promoting the theoretical knowledge.

By virtual experiments, many abstract concepts or no physical simulation experiment, can be visual display, and can greatly improve the learning results.

Fig.2 to Fig.5 show the specific experimental operating procedures.
Figure 2. Experiment Select.

Figure 3. Principles Learning.

Figure 4. Operation Schematic (1).

Figure 5. Operation Schematic (2).
Conclusion

LabVIEW Virtual laboratory based on network provided teachers and students with a new experimental method. It is not limited by space and time, and it saves the loss of components to a certain extent, pioneering experiments that can help students better retain knowledge. Due to its various advantages, for a wide range of applications, virtual experiment system can be widely used in a variety of real time simulation of processes and industrial production. Virtual laboratory studies should use a wide range of knowledge and experience, and the research is still in the beginning stages. We will further improve the system, experimental effects, to provide students with more learning AIDS.

References


