Application of Virtual instrument in demonstration experiment of Electronic Technology

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Abstract. Virtual instrument has the advantages of high openness and flexibility, short development period and low development cost. It has epoch-making significance compared with traditional instrument. With the development of electronic and electrical technology and network communication technology, as well as computer technology and software technology, virtual instrument will be more widely used on the wings of network. Virtual instrument is a kind of computer instrument system whose function is designed and defined by user, has virtual panel, and its testing function is realized by testing software on the hardware platform with computer as the core. The paper presents application of Virtual instrument in demonstration experiment of Electronic Technology.

1. Introduction

Under the background of the rapid development of science and technology, with the deepening of educational reform, how to realize the modernization of educational technology, teaching.

The modernization of means has become an important subject in the educational reform of our country. At present, in the field of experimental teaching of electrical and electronic technology, most colleges and universities in China still mainly use physical components for hardware connection testing. Most use bread boards or all kinds of ready-made test boxes. Because of the limitations of laboratory conditions, this traditional experimental method will encounter difficulties in providing students with expanded, designed, and integrated experiments, especially new devices. The new equipment is expensive, and the electronics labs of general colleges and universities cannot afford it [1].

With the development of electronic design automation (EDAA) technology, a new method of electronic circuit design and experiment using "virtual instrument" and "virtual device" has been created. In this kind of simulation software, "virtual electronic experiment bench" (MultiSim) is excellent, its application is popularized step by step. This new virtual electronic experiment technology, when creating experimental circuit, components and test instruments can be directly selected from screen graphics. Moreover, the figure of the test instrument in the software is similar to that of the physical object.

The experiment teaching of electrical and electronic technology with MultiSim simulation software can not only make up for the shortage of experimental instruments, components and components, but also the non-conformity of specifications and other factors. It can also make use of the various analysis methods provided in the software to help students master the teaching content faster and better, deepen their understanding of concepts and principles, and be familiar with the common measuring methods of electrical and electronic instruments [2]. Further develop students' comprehensive ability and innovative ability.
In the last century, the most rapid development of technology, the most far-reaching impact on the human world is the technology of computer, now the human society has entered the information age, people's work, life, learning, Entertainment and other activities have undergone earth-shaking changes. Computer simulation technology (hereinafter referred to as simulation technology) is based on a variety of disciplines and theories, using computers and their corresponding software as tools, A comprehensive technique for analyzing and solving problems through virtual experiment is a new technology developed with the development of computer technology.

Vocational education serves the social production directly, undertakes the mission of cultivating high-quality skilled personnel for the society, and further improves the teaching quality. It is the greatest wish of every vocational education worker to serve the society better. It has been proved through teaching practice that simulation technology is introduced into the process of vocational education and widely applied.

It is a very effective way to improve teaching quality. Among the many professional courses in vocational education, the difficulties in electronic circuit teaching are representative. Now take the teaching of electronic circuit course as an example to discuss the introduction of simulation technology in the teaching process. At present, there are many kinds of software which can realize the simulation of electronic circuit, but the protel 99se and ni multisim 10 introduced by altium and ni company are the most used in teaching. This paper takes ni multisim 10 of ni company as an example.

When the master-slave flip-flop triggered by the negative jump edge works, the input signal must be added before the forward jump edge. If an interference signal occurs at the input end during the CP high level, The edge trigger allows the input signal to be added at the moment before the CP trigger edge. Edge D flip-flop is also called maintenance-blocking edge D flip-flop [3].

At present, computer aided simulation design has been widely used in electronic circuit, especially in the simulation technology of electronic design EDA ((Electronic Design automation. MAX plus2 simulation and analysis software is the software package of computer digital circuit and logic design simulation and simulation. MAX plus2, as one of the most famous electronic design automation software in the world, can not only be used in circuit analysis and optimization design. In combination with printed plate design software, electronic design automation can also be realized. It is recognized as one of the best software in general circuit simulation program. This paper uses MAX plus2 as a tool. A quaternary addition counter composed of double D flip-flop 7474 is simulated and some valuable conclusions are obtained.

Virtual experiment is an experiment carried out in a virtual environment. Virtual experiment is a relatively real experiment, and the experimental equipment used in the experiment, the experimental object, and the experimental environment are all in the form of real objects. In the virtual experiment, these experimental equipments and objects exist not in the physical form, but in the virtual form.

The experiment process of the virtual experiment is mainly the operation of the virtual object, which can be controlled partly or completely by the experimenter. The results of the experiment can be stored, processed and reproduced, so that the virtual experiment can be repeated repeatedly. Through the virtual experiment, the experimenter can be familiar with the whole experiment before the real experiment. In order to improve the efficiency of the experiment and reduce the unnecessary loss of experimental equipment.

Virtual experiment exists in virtual laboratory. The experimental environment, experimental object and experimental equipment are provided by virtual laboratory. Virtual laboratory is supported by computer software and hardware technology. A virtual experimental environment realized with software development tools. By developing a series of virtual experimental components to simulate and reproduce the real experimental environment, the experimental equipment and the experimental process, the experimenter can get rid of the bondage of the actual experimental conditions. Under the more convenient and fast conditions, the interactive experience experiment information is carried out through an experimental environment with rich interface information, friendly interaction ability and powerful data processing ability.
2. Development and Research of Electronic Virtual Laboratory

The virtual instrument platform panel is realized on the computer screen by the communication between LabVIEW software and FPGA. The virtual instrument platform includes a function signal generator, a storage oscilloscope and a frequency meter instrument. Switch and key, switch the function of the instrument and set all kinds of working parameters, The measurement and analysis results can be read from the virtual instrument panel. The user can operate the instrument on the screen through the virtual instrument panel as intuitively and conveniently as on the real instrument [4].

Using virtual instruments to set up comprehensive and innovative experiments can make the teaching of theory more vivid and vivid, improve the students’ engineering quality, and stimulate the students’ interest in experiment. The experimental skills and innovative abilities of the students are greatly improved. As the platform has the function of many instruments, the area of the instruments required for the experiment is reduced, and the corresponding experimental preparation process is greatly simplified.

![Function signal generator, frequency meter and storage oscilloscope are the necessary experimental instruments in the experiment course.](image)

Function signal generator, frequency meter and storage oscilloscope are the necessary experimental instruments in the experiment course. The design of virtual instrument platform is more flexible than the traditional one. Cost saving. Teachers do not need to operate in front of a real instrument in the teaching process, only need to complete the demonstration of the instrument on the computer.

The teaching of virtual instrument is better combined with theory and practice. The software and hardware skills of students can be improved simultaneously. The modularization design of virtual instrument software and hardware makes students more flexible and easy to master in the way of learning. The virtual instrument teaching is feasible in terms of the course offering and the students’ actual situation. The design of the virtual instrument platform is of certain significance to our teaching in the future.

With the progress of science and technology, the society has put forward higher and higher requirements for college students, not only require students to have solid theoretical knowledge, But with the continuous expansion of the enrollment of colleges and universities in recent years, the number of students in the school has increased exponentially.

The traditional experimental instruments are based on the experimental field, experimental equipment, As a result, the actual experimental training of students cannot be satisfied, especially for science and engineering students, without experimental training. Abstract theoretical knowledge is very difficult to understand. Virtual instrument technology provides the possibility to solve this contradiction [5]. Virtual instrument combines computer technology, electronic technology, sensor technology, signal processing technology, software technology, etc. In addition to inheriting the common functions of traditional instruments, it also adds many advanced functions beyond the reach of traditional instruments.
Virtual instruments are characterized by their flexibility and the ability to make full use of the rich resources of software and hardware of computers.

The user can add or delete the functions of the instrument according to the need to meet different experimental requirements. It combines the powerful computing and processing power of the computer with the measurement and control ability of the hardware of the instrument. It greatly reduces the cost and volume of instrument hardware, and breaks through the limitations of traditional instruments in data processing, display, transmission and so on, so that users can easily maintain, expand, upgrade and so on. These characteristics are unparalleled by traditional instruments.

Digital electronics technology has been widely used in television, radar, communication, computer, automatic control, aerospace and other fields. For example, in communication systems, digital communication systems using digital electronic technology, It not only has better anti-interference ability than analog communication system, but also can use computer to process and control information.

Figure 2. Digital electronics technology has been widely used in television

Digital circuit is one of the main technical basic courses of electronic information specialty. Its importance is self-evident. Its practice is especially important, the number of digital circuit experiments is large, and the type of circuit and the choice of devices vary greatly. The virtual experimental platform of digital circuit constructed with LabVIEW can completely meet this requirement. Based on the platform of LabVIEW, a real time and interactive platform is constructed in this paper. The virtual experiment system of digital circuit, which is convenient and flexible and cost saving, not only overcomes the limitation of traditional teaching that only theory can not do experiment, but also reduces the investment of hardware. It is a low cost and high profit experimental system. It is of great practical significance.

Virtual instrument is the result of the deep combination of modern computer technology and instrument technology. Virtual instrument makes full use of computer operation, storage and operation. The intelligent functions such as playback display and file management, and the professional function of traditional instrument and the software of panel control are combined to form a function that is identical to the traditional hardware instrument and shared at the same time. This paper introduces a new virtual instrument system with computer software and hardware resources [6].

The panel of virtual instrument is all kinds of panels of virtual instrument and all kinds of controls on the panel are realized by software.

The test function of virtual instrument is controlled by software and hardware. Compared with traditional instrument, the biggest characteristic of virtual instrument is that its function is defined by software, which can be written and selected by users according to the need of application. Different applications can form different virtual instruments.

Virtual instrument technology is essentially an integrated software and hardware concept. As the product becomes more and more complex in function, engineers usually need to integrate multiple measurement devices to meet the complete test requirements. And connecting and integrating these different devices takes a lot of time. NI’s virtual instrument software platform provides a standard
interface for all I/O devices, helping us easily integrate multiple measurement devices into a single system. The complexity of the task is reduced.

3. Design and implementation of Electronic Technology Virtual Laboratory based on LabVIEW

According to the investigation of some schools, the construction of virtual laboratory in colleges and universities has the following characteristics and problems.

1. The development of virtual laboratory depends on the limitation of the traditional experimental teaching mode, which fails to play its full role. As a result of the shackles of traditional concepts, many teachers may still be on the wait-and-see stage and have become accustomed to seeing. Tangible instruments that can be felt, negative ideas such as skepticism and wait-and-see about virtual laboratories. Then we must publicize virtual laboratories, make teachers familiar with them, and update our understanding of the experimental means of information technology and the experimental teaching model. In order to realize the integration of information virtual experiment and "traditional" experiment.

2. The relatively concentrated application of virtual laboratories in certain disciplines is largely determined by the nature of these disciplines, many of which are based on experiments. Many of the experiments are often limited by the experimental equipment, experimental sites and experimental funds, and some of the experiments are dangerous, so these subjects have chosen the virtual laboratory first.

3. Software development should become the focus of the construction and development of virtual laboratory, and it should be attached great importance to "in the construction of the laboratory, it is easy to reach a consensus on the input of tangible assets, while the input to intangible assets is insufficient." In the investigation, we found that many virtual laboratory software platforms are made from foreign products or secondary processing on the basis of similar products from abroad. For example, many of the electrical and electronic virtual laboratories which are popularized in domestic colleges and universities belong to this situation. Different from the traditional laboratory construction, the construction of virtual laboratories requires very high requirements for laboratory software [7]. If we do not pay attention to the investment in software development, but only rely on the purchase of foreign software, we should not only invest more funds for the same software upgrade, but also limit the improvement of our laboratory and scientific research level.

Figure 3. The experimental teaching in colleges and universities under traditional instruments has lagged behind the needs of the information age

The experimental teaching in colleges and universities under traditional instruments has lagged behind the needs of the information age and engineering practice. The delayed experimental equipment can not meet the requirements of the modern testing technology, such as fast speed, good real time and good man-machine interface. It is difficult to implement function extension and resource sharing.

Since 1990s, the development of electronic information products has two obvious characteristics: first, the complexity of the product deepening; However, circuit level design is essentially a single-level design based on gate level description (mainly digital circuit), and all the work of design (including design input, simulation and analysis). It is obvious that this design method can not adapt to the new
situation. Therefore, a high-level electronic design method is introduced, which is also called system design method.

High-level design is a kind of "concept driven" design. The designer does not need to describe the circuit through the gate diagram, but describes the function of the design objective, because of getting rid of the shackles of the circuit details. Designers can focus on creative solutions and conceptual ideas, and once these conceptual ideas are entered into the computer in a high-level description, the EDA system can automate the design in a rule-driven manner. The new concept becomes a product quickly and effectively, greatly shortening the product development cycle. Moreover, high-level design only defines the behavioral characteristics of the system and can be supported by the manufacturer's comprehensive library without involving the implementation process. Using the integrated optimization tool, the high-level description can be transformed into a network table for some process optimization, and the process conversion becomes easy and easy. The high-level design steps are as follows:

The system is divided according to the design method of "from top to bottom".

(2) input VHDL code, which is the most common input method in high-level design. In addition, MAX plus2 graphic simulation input is used in EDA laboratory. This method is intuitive and easy to understand.

For large scale design, code level functional simulation should be carried out, mainly to verify the correctness of the system function design, because it takes several hours for large-scale design to synthesize and adapt. (3) to compile the input of the above design into a standard VHDL file. For a large scale design, we need to carry out functional simulations at the code level, mainly to verify the correctness of the functional design of the system. The number and time of design repetition can be greatly reduced by simulating the source code before synthesis. In general, this simulation step can be omitted.

Because the above scheme is chosen, that is, to control the FPGA to send information in the form of sending control command, it greatly reduces the transmission burden of the serial port, and makes the transmission rate of the serial port meet the design requirements to achieve real-time. The specific design process is to encode each keystroke, and the rules of encoding are as follows: table 2-4 (8 bits high in "10", low in eight bits in "00", frequency in "0", and duty cycle in "1"). There are three control parameters respectively, eight bits lower. Transmitting high 8 bits, transmitting frequency, transmitting duty cycle, sending 8 bits of control information in 1 bit, sending 8 bits of control information in 1 bit, transmitting frequency and duty cycle in one bit. The three digits above are combined to form a frame that is sent to the serial port at a certain baud rate, and the new data is sent to the serial port whenever the three digits change. Then a serial port receiving module is used to decode it according to the set baud rate and encoding method, and the control instruction is obtained to send the corresponding numbers when it works.

4. Application of Virtual instrument in demonstration experiment of Electronic Technology

LabVIEW is the only compiled graphic language in the world at present. Time-consuming language programming is simplified to a function of selecting by menu or icon (graphic, a simple graphic program in which functions are connected by lines. LabVIEW, a block diagram program written in. LabVIEW), very close to the program flowchart. Like C and BASIC, LabVIEW is also a general programming system, there is a huge function library to complete any programming tasks. The function library includes data acquisition, serial port control, data analysis, LabVIEW also has the traditional debugging tools, such as setting breakpoints, displaying the results of data and its subprograms (sub-VIs) in animation mode, single step execution and so on, which is convenient for the debugging of programs [8].

The program in LabVIEW does not need to compile first. If there is a syntax error, LabVIEW will tell the user immediately. As long as you click the mouse two or three times, you can quickly find out the type of error, the cause and the exact location of the error. This feature is especially convenient when the program is large.
LabVIEW is a graphical programming language that uses icons instead of text lines to create applications. Traditional text programming languages determine the order of program execution according to the order of statements and instructions, while LabVIEW uses data flow programming. The flow of data between nodes in the block diagram determines the execution order of VI and functions.

LabVIEW provides many controls similar to those of traditional instruments such as oscilloscopes and multimeters. User interface can be easily created. The user interface is called the front panel in LabVIEW. With icons and wires, the graphical code for controlling objects on the front panel by programming. LabVIEW is somewhat similar to a flowchart.

![LabVIEW diagram](image)

Figure 4. LabVIEW provides many controls similar to those of traditional instruments

Therefore, it is also called the program block diagram code. Its main features are as follows: 1) the general hardware is used as far as possible, and the difference of various instruments is mainly in software / software 2) it can give full play to the ability of the computer and has powerful data processing function. Users can define and manufacture various kinds of instruments according to their own needs. Compared with traditional programming language, using LabVIEW graphic programming method can save about 80% program development time. And its running speed is almost unaffected.

Virtual instrument is an organic integration of computer hardware resources and instrument hardware on the hardware platform with computer as the core, and the powerful software function of computer is used to realize the operation, analysis and processing of signal data. The use of virtual instruments instead of traditional instruments can not only meet the needs of experimental teaching of electronic information, but also greatly improve the utilization rate of equipment and realize the sharing of resources. To reduce the cost of laboratory construction, users can also define the new functions of the instrument according to their own needs.

Power electronics technology is a new and high technology subject, it is the technology of electric power conversion using power electronic devices. In recent years, power electronics experiment plays a very important role in teaching. It is an effective means to improve students' practical ability, creative ability and comprehensive diathesis. Many subjects are based on experimental courses and lack the support of experiments. The teaching and research activities of engineering subjects cannot be carried out. Only through sufficient confirmatory experiments and a certain number of comprehensive design experiments can students deepen their understanding and master the theoretical knowledge and applied technology they have learned, and only through experiments, Only then can the theory and the practice be well combined.

GPIB technology is the early development stage of the virtual instrument of IEEE488 standard. Its appearance makes the electronic measurement independent single manual operation develop to the large-scale automatic test system. The typical GPIB system is made up of a PC. One GPIB interface card and several instruments in GPIB form are connected by GPIB cable. Under standard conditions, a single GPIB interface can carry up to 14 instruments, and the cable length can reach 40m. GPIb technology can realize the operation and control of the instrument by computer. Instead of the traditional
manual operation, many instruments can be easily combined to form an automatic measuring system. GPIb measurement system is simple in structure and command. It is mainly used in desktop instruments and is suitable for those with high precision. But does not require to the computer high-speed transmission condition when the application.

5. Summary
The basic composition of virtual instrument includes computer, virtual instrument software, Among them, hardware interface module can include DAQN, serial / parallel port IEEE488 interface card VXI controller and other interface card. At present, the more commonly used virtual instrument system is data acquisition card system. GPIb instrument control system VXI instrument system and any combination of the three. The hardware is only to solve the input and output of the signal, the software is the key of the whole system, so when the basic hardware is determined, you can use different software, such as for data analysis, Virtual instrument application software integrates all functions of the instrument, such as collection, control, data analysis, result output and user interface. Some hardware and even the whole instrument of traditional instruments are replaced by computer software. According to their own needs, users can design their own instrument system with abundant software and hardware resources. In order to greatly break through the limitations of traditional instruments in data processing, expression, transmission, storage, and so on, it meets the requirements of various applications. It is not only used in the fields of measurement, testing, analysis and measurement, but also used to monitor and control equipment. Industrial process automation, etc.

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