Design and Implementation of Virtual Experiment System Platform for Electrical and Electronic Engineering in Vocational College

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Abstract. Under the influence of modern vocational education, virtual simulation experiment teaching is widely used as a new teaching method. The traditional electrical and electronic virtual simulation experiment teaching platform has low sensitivity and poor interaction. In this paper, a new kind of virtual simulation experiment teaching platform of electrical and electronic in Vocational College is built by LabVIEW. Through the analysis of the experimental effect, LabVIEW software can realize the virtual simulation of electrical and electronic experiments and the establishment of virtual instruments. The integrated teaching can be easily realized through LabVIEW. It provides a certain reference for the virtual simulation experiment teaching in vocational colleges.

Keywords: Teaching mode, Vocational education, Virtual reality environment, Experiment teaching platform

1. Introduction
In secondary vocational schools, "electrical fundamentals" and "electronic technology" as basic courses are offered in related majors [1]. In the actual teaching, the contradiction between the number of hours and the teaching content of electrical and electronic teaching is prominent, which generally exists the problem of "the class hours are gradually reduced, but the course content is increased"; the teaching progress of teachers is fast, and students have certain difficulties in learning; there are certain differences between theory and practice in teaching, which leads to poor teaching effect [2].

The integration teaching can realize the better connection between theory and practice, and integrate theory teaching with experimental teaching. The electrical and electronic course has strong practicality and technicality. It emphasizes the students' application ability and practical ability, and cultivates the students' innovation ability and creative skills. The theoretical knowledge in the course often needs to be verified by experiments [3]. Through practical operation, students can strengthen the understanding, mastery and application of knowledge. However, in most of the secondary vocational schools, the lack of experimental facilities and the old equipment lead to some difficulties in carrying out experiments to a great extent. Electrical integration teaching can break the traditional subject system and teaching mode, and integrate theoretical knowledge and practical operation into one, which is currently advocated as a teaching mode.

The integrated teaching of electrical engineering combines theory class with virtual software, and
alternates the teaching of theoretical knowledge with students' computer operation in one place, so as to form an organic whole of teaching and training [4-6]. This teaching mode can not only save time, but also stimulate students' interest in learning and innovation ability, enhance students' practical operation ability, so as to improve teaching quality and students' learning efficiency.

2. The characteristics of LabVIEW and its application advantages in Teaching

The virtual instrument realizes the intelligence, modularization and diversification of the instrument, and embodies the advantages of multi-function and low cost [7-8]. Compared with traditional instruments, virtual instrument has a wider range of applications, so it has become an important direction of the development of the instrument industry, and many countries have attached great importance to it. LabVIEW is a graphical programming language development environment. Using G language to develop graphical programming, the result is block diagram, which has been widely accepted by all walks of life and research laboratories.

LabVIEW is an excellent virtual instrument and software development platform. LabVIEW's rich library functions are very suitable for the analysis and application of electronic communication. Powerful data function analysis library is suitable for the teaching of data measurement principle; Hardware and software applications can be well combined, and many experiments of electrical and electronic can be completed. A configurable virtual instrument is composed of single chip microcomputer, inserted hardware module and LabVIEW platform to complete the experimental task.

At present, LabVIEW uses modular programming language, the software design form is flexible, easy to understand, can fully reflect the realization of each step of electrical and electronic experiments, and the wave-forms and parameters of each point are vivid and vivid, which is especially suitable for the application in electrical and electronic teaching in secondary vocational schools.

3. Application of LabVIEW in Teaching

LabVIEW has powerful functions. It has good teaching effect for virtual simulation experiment of electrical engineering foundation and electronic technology. At present, LabVIEW is mainly applied in two aspects: virtual experiment and virtual instrument.

3.1. Virtual experiment

The virtual experiment teaching of electrical and electronic in secondary vocational school is realized by LabVIEW software, which effectively improves the teaching effect. Using LabVIEW to complete virtual experiment is a method without device loss and easy to implement. Users can achieve the purpose of the experiment by setting the front panel. Based on LabVIEW software, the experiment of amplitude modulation (AM) simulation experiment and voltage series feedback circuit simulation experiment in electrical and electronic experiment is carried out, which makes teaching more convenient.

3.1.1. Amplitude modulation (AM) simulation experiment. The modulation of analog signal is very important in communication knowledge. It is a process of converting analog signal into waveform suitable for transmission in channel. In the following, the virtual simulation of LabVIEW is carried out by taking the amplitude modulation (AM) of analog signal as an example.

As shown in Fig. 1, run the program, set the frequency of base-band signal as 20kHz, the amplitude of 1.2V, the initial phase of 0, the frequency of carrier signal of 2MHz, the amplitude of 4V, the initial phase of 0, and the DC offset of 2V. As can be seen from Figure 1, the amplitude modulation effect of AM wave obtained by LabVIEW simulation is very obvious, and the spectrum distribution is reasonable and the display is clear. The block diagram of AM modulation program is shown in Fig. 2. An analog base-band signal is generated by a multi harmonic generator, which is added with the DC offset and multiplied by the cosine carrier generated by a multi harmonic generator to obtain AM modulation signal.
3.1.2. Simulation experiment of voltage series feedback circuit. Negative feedback circuit is an important part of secondary vocational electronic technology, which has an important impact on improving the performance of amplifier circuit. The negative feedback in the amplifier is to send part or all of the output of the amplifier circuit back to the input circuit in a certain way to affect the input signal and realize the automatic adjustment of the amplifier circuit. The negative feedback has the following effects on the amplifier: reducing the amplifier magnification, improving the stability of the amplified signal; reducing the nonlinear distortion; broadening the frequency band.

Set circuit parameters on the front panel, including sine signal amplitude of 1V, frequency of 1kHz, Re of 5kΩ, Re2 of 2kΩ, Rf of 5kΩ, Rb1 of 4kΩ, Rb2 of 2kΩ, Rb3 of 4kΩ, Rc1 of 3kΩ, Rc2 of 2kΩ, R1 of 5kΩ, and magnification of two triodes of 50 times. Set the above parameters in the front panel diagram as shown in Figure 3. Fig. 6 is a program block diagram of voltage series feedback circuit.
As shown in Fig. 3, this is a two-stage amplifier circuit. The former stage is the resistance capacitance coupling common emitter circuit, and the latter stage is the base stage divider emitter bias circuit. A voltage series negative feedback circuit is constructed by using the feedback resistor $R_f$. For AC signals, the voltage $U_f = R_e \frac{U_o}{R_{e1} + R_f}$ on $Re1$ is the feedback signal. In the circuit, the actual input voltage satisfies $U_{id} = U_i - U_f$. When the output resistance $R_2$ decreases, $U_0$ decreases, then the feedback signal $U_f$ decreases; when $U_0$ increases, the feedback voltage $U_f$ increases. Because $U_{id} = U_i - U_f$, the circuit can reduce the output voltage. Affected by the output resistance $R_2$, it has a good output voltage characteristics.

3.2. Virtual instrument

In the secondary vocational education of electronic and electrical engineering, measuring instruments are often scarce because of their high price. Virtual instrument is a comprehensive computer system which uses software simulation to complete some hardware equipment. Users can control the virtual instrument panel through the input device to achieve the purpose of simulation. Using LabVIEW to design virtual instrument is a low-cost and easy to implement method, which can effectively improve the efficiency of experimental teaching. Based on LabVIEW software, the register and single channel oscilloscope commonly used in electrical and electronic experiments are designed to provide experimental basis for teaching.

3.2.1. Four bit shift register simulator. Shift register is a flip-flop based device that works under several same time pulses. Data is input to the device in parallel or serial mode. Each time pulse moves one bit to the left or right in turn and outputs at the output end. In the following, the virtual simulation of LabVIEW is carried out by taking the four bit shift register composed of D flip-flop as an example.
As shown in Figure 5, it is the front panel of four bit shift register simulation. Through the front panel, the shift register is configured, and the appropriate clock frequency and duty cycle are set to obtain the corresponding waveform. As shown in Fig. 6 is the program block diagram of four bit shift register simulation.

![Figure 5](image)

**Figure 6** Block diagram of simulation program for four bit shift register

When running the program, click the switch of D flip-flop to start the shift register. In this example, the binary code 1111 is sequentially input from input Q in serial mode. The initial state of each trigger is 0, that is, Q0Q1Q2Q3 = 0000. After the simulation, we can see that Q0Q1Q2Q3 = 1111 through the waveform.

Run the simulation, open the oscilloscope interface, and select the appropriate configuration options as required. The sound sampling frequency is 44100Hz, the channel is 1, and the bit of each sample is 16. Set the calibration ratio, data duration and offset, and the front panel can display the collected signal waveform.

The simulation of single channel virtual oscilloscope is to collect sound signal through sound card and display its waveform in waveform diagram. As a complete software system, virtual oscilloscope is cheaper than traditional oscillograph in price, and has the unique advantages of waveform trigger, display, measurement, waveform data analysis and processing. When used in teaching, it can save time and facilitate students' learning.

It is not only simple and easy to create virtual instrument on LabVIEW development platform, but also has strong interactivity and operability. It can be easily applied to integrated teaching, make up for the shortage of experimental equipment, improve the quality and efficiency of teaching, and cultivate students' understanding of LabVIEW and interest in programming.

![Figure 7](image)

**Figure 7** Single channel virtual oscilloscope simulation front panel
4. Conclusion
In conclusion, the application of lab view virtual simulation technology in electrical and electronic comprehensive experiment can not only realize the virtual instrument technology based on LabVIEW, but also carry out virtual simulation experiment. LabVIEW is a good tool for electrical and electronic experiment aided teaching. It can not only help students learn in operational experiments, but also complete other experiments by using designed virtual instruments. This enables students not only to master the skills of electrical and electronic aspects, strengthen the understanding and learning of electrical and electronic instruments and principles, but also contact with advanced technology.

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