

Research on Teaching Method of Electronic Technology Course Based on EWB

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Abstract—Electronic technology course is theoretical and practical, while traditional teaching methods are difficult to arouse students' interest in learning, and the experimental efficiency is low. In order to improve the teaching effect of electronic technology course, EWB simulation software is applied to the teaching of theory and practice of electronic technology. Case teaching can stimulate students' interest in learning and improve the quality of teaching. In this paper, the application methods of EWB in theory teaching of analog electronic technology, theory teaching of digital electronic technology, experiment teaching of digital electronic technology and course design of digital electronic technology are expounded by examples. The practice shows that the application of EWB in electronic technology teaching can turn abstract theoretical conclusions into intuitive experimental phenomena, and help students understand and master the teaching content.

Keywords—*Electronic Technology; EWB; Simulation Software; Teaching Methods; Electronic Technology*

I. INTRODUCTION

The course of electronic technology mainly includes analog circuit technology and digital electronic technology. Analog circuit technology and digital electronic technology are both theoretical and practical, and students' interest in learning is not high. Some students give up the course because they cannot understand it, so the teaching effect is poor.

Electronic technology course is a basic professional course. Students' mastery of the course will directly affect the subsequent study of professional courses. In order to improve students' interest in learning electronic technology courses, on the one hand, abstract theories and intuitive experimental phenomena should be closely combined in theoretical teaching, so that students can draw theoretical conclusions through observing experimental phenomena by themselves, so as to deepen their impression, understanding and memory. On the other hand, students' practical ability and ability to find, discuss and solve problems should be cultivated in practice. The flexible application of EWB simulation software in theory and practice teaching can turn abstract theoretical conclusions into intuitive experimental phenomena, which is convenient for students to understand and master knowledge points, and also helpful to improve students' interest in learning.

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II. INTRODUCTION TO EWB TECHNOLOGY

EWB stands for Electronics Work bench, is a circuit analysis and design software developed by Interactive Image Technologies in Canada in the 1990s. Compared with other electronic design automation software, EWB simulation software is relatively small software, only ten megabytes, but the simulation function is very powerful. EWB software can be used to design, test and demonstrate electronic circuits including electrical engineering, analog circuits, digital circuits and computer interface circuits. EWB has a rich library of circuit components and provides a variety of analysis methods, which are very suitable for teaching and practice of electronic courses. Compared with experiment box experiment, EWB is convenient to use for circuit simulation, which can display measurement results in real time, and can also directly output experimental data, test curve and circuit schematic diagram by means of printer [1].

Experiments can improve students' cognitive ability and practical ability. Experiments conducted in experiment boxes may be tortuous or even fail due to the aging or damage of experiment box components. Therefore, there are some problems such as low experimental efficiency, large error of experimental results and difficulty in realizing comprehensive projects when conducting experiments with experimental boxes [2]. If EWB simulation software and experiment box are combined in the practice of electronic technology course, the two kinds of experiment methods complement each other, good teaching effect can be achieved. Using EWB simulation software in the teaching of electronic technology course can increase comprehensive and designed experiments, not only can improve students' learning and application ability, but also can improve students' learning interest and problem-solving ability, and significantly improve the learning effect.

III. APPLICATION OF EWB IN ELECTRONIC TECHNOLOGY TEACHING

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A. Application of EWB in Analog Electronic Technology Teaching

Many characteristics and concepts in the course of analog electronic technology are very abstract and difficult to understand, such as intrinsic semiconductor, impurity semiconductor, PN junction, diode and Bipolar Junction Transistor. Intrinsic semiconductor, impurity semiconductor and PN junction are micro concepts. Most textbooks suggest that the unidirectional conductivity of the diode is through the volt-ampere characteristic curve shown in Fig.1 [3]. By using curves to explain one-way conductivity, students find it boring and can't get interested in learning. If the unidirectional conductivity can be embodied by a specific circuit, students will not only be impressed, but also be motivated to learn.

In EWB simulation software, the forward diode connection diagram is shown in Fig.2. The light bulb indicates that there is a current in the circuit, so the diode connection is conducted. The reverse diode connection diagram is shown in Fig.3. When the bulb does not light, there is no current in the circuit, indicating that the diode connection cannot be conducted [4].

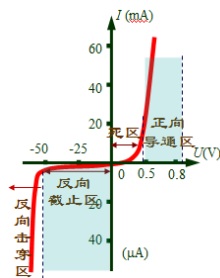


Fig. 1. Volt-ampere characteristic curve

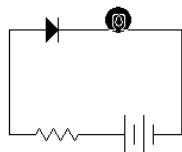


Fig. 2. Diode forward connection diagram

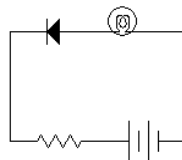


Fig. 3. Diode reverse connection diagram

In class, the teacher first demonstrates the two circuits through EWB software, and then asks the students to think about the difference between the circuits, and finally draws the conclusion of the one-way conductivity of the diode. This method not only enables students to understand the unidirectional orientation, but also enables students to master the normal circuit connection method of ordinary diode, and at

the same time develops students' thinking ability and stimulates their interest in learning. Therefore, the teaching effect of using this method is better than explaining the single conductivity of diode based on curve only.

Operational amplifiers and their linear applications are important parts of analog electronics, and their practical applications are quite extensive. The linear application of integrated operational amplifier mainly includes proportional operation circuit, addition and subtraction operation circuit and integral and differential operation circuit. Proportional operation is the basis of addition and subtraction operation and complex operation. Only when students understand and master proportion computation formula and the superposition theorem, they can master the add and subtract and the calculation method of complex operations. If EWB simulation software is used in teaching, it will help students better understand and master this part of content.

Inverting phase proportional operation circuit is shown in Fig.4. According to the concepts of "false short" and "false break", the relationship between current and voltage in Fig.4 can be listed as in (1).

$$\frac{u_i - 0}{R_1} = \frac{0 - u_o}{R_f} \quad (1)$$

After equation (1) is simplified, the ratio of output voltage to input voltage is obtained as in (2).

$$\frac{u_o}{u_i} = -\frac{R_f}{R_1} \quad (2)$$

The output voltage and input voltage are the amplification multiples of the voltage A_u [5], so the expression of A_u is (3).

$$A_u = -\frac{R_f}{R_1} \quad (3)$$

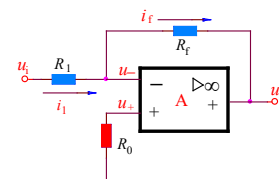


Fig. 4. Inverse phase proportional operation circuit diagram

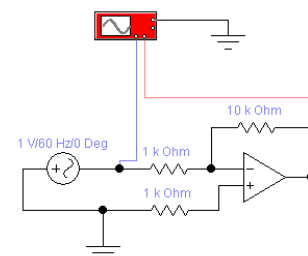


Fig. 5. Inverse phase proportional operation simulation circuit diagram

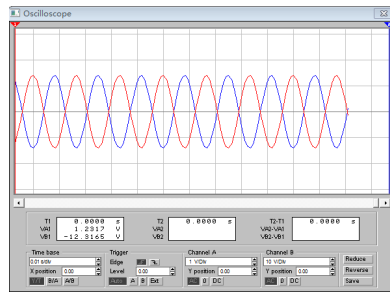


Fig. 6. Waveform of simulation results of inverse phase proportional operation

Students are usually not interested in the derivation of dull theoretical formulas. In the process of teaching, specific circuits and conclusions can be presented to students through simulation, which on the one hand can deepen students' understanding of theories, on the other hand can make students understand the structure and connection method of circuits, and improve students' interest in learning [2].

The simulation circuit of inverse phase proportional operation is shown in Fig.5, and the input and output waveforms displayed by the virtual oscilloscope of the simulation software are shown in Fig. 6.

In order to facilitate students to observe the waveform, the connection line between the input end and the virtual oscilloscope in Fig. 6 is set to blue, and the output end line is set to red. The input signal is set at 1V per grid, and the output signal is set at 10V per grid. Let students calculate the output voltage/input voltage amplitude =10 by observing the waveform, and get $A_u = -10$ because the input and output are in inverse phase. According to circuit parameters and formula (3), the student calculated A_u is also -10. Obviously, the simulation result is consistent with the theoretical calculation result. The simulation software has no element parameter error, instrument error and other factors, and there is no error between the experimental conclusion and the theoretical calculation. Through observation, thinking, hands-on calculation and discussion, students are deeply impressed with the previous theoretical formula, which lays a solid foundation for subsequent learning.

B. Application of EWB in Teaching Digital Electronic Technology

In digital electronic technology, students need to master the logical functions and use methods of many devices. The proper use of EWB simulation software to demonstrate the connection method in teaching can visualize the theoretical knowledge, help students understand and master the teaching content, and improve the teaching effect. In teaching, EWB simulation software is used to display the pins of components and demonstrate the connection method of components, which can visualize the theoretical knowledge, help students understand and master the teaching content, and improve the teaching effect.

The characteristics of gate circuits are easy to understand. When designing combinational logic circuits according to the theoretical design steps, students can easily draw logical circuit

diagrams, as shown in Fig.7. However, the digital electronic technology experiment box is full of integrated chips, so students have no idea how to start the experiment and how to connect the chip pins.

In teaching, EWB simulation software is used to demonstrate the three-person voting instrument. When only one person (A) agrees, the simulation result is shown in Fig. 8. The light-emitting diode does not work, which means that the proposal is not passed. When two people (A, B) agree, the simulation results are shown in Fig. 9. The led lights up, which means the proposal is passed. Using EWB simulation software to demonstrate the teaching method can not only enhance the vividness and intuitiveness of teaching, but also enable students to master the use method of integrated chip, which lays the foundation for experiments using the experiment box.

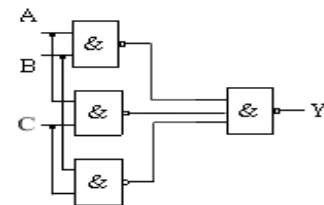


Fig. 7. Logic circuit diagram of three-way voting machine

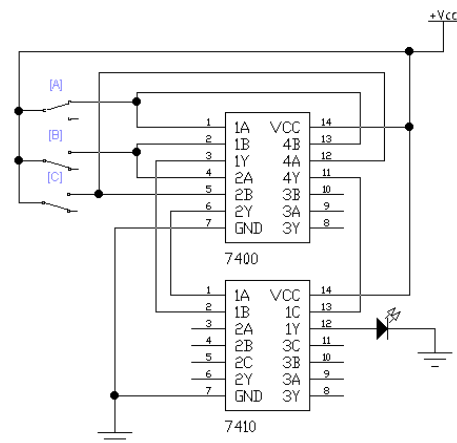


Fig. 8. Diagram of simulation results agreed by one vote

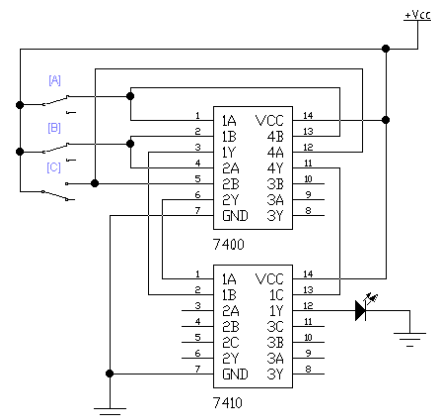


Fig. 9. Diagram of simulation results agreed by 2 people

IV. APPLICATION OF EWB IN ELECTRONIC TECHNOLOGY PRACTICE

The course of electronic technology includes two teaching links: experiment and course design. Although there are corresponding experiment boxes in the laboratory, the hardware on the experiment boxes is fixed, and there are certain limitations in conducting experiments, which are restricted by time and place. Students are required to use EWB to simulate the experiment content before the experiment class, so that students can not only reduce wiring errors, but also avoid damaging components when using the experiment box to do experiments. After the experiment, students are encouraged to use EWB simulation software to expand the experiment content, and the expanded content is included in the bonus points of the experiment. The flexible use of simulation experiment in the experimental link can not only improve the experimental efficiency, improve students' ability to find and solve problems, improve students' self-learning ability, but also expand students' knowledge.

For example, the application of 555 timer experiments include multivibrators, multivibrators with adjustable duty ratio, and Schmitt triggers [6]. The 555 timer can be composed into a multivibrator as the content of the experimental course, and the rectangular wave with a 1HZ frequency is required to be output. The simulation circuit diagram is shown in figure 10, and the waveform diagram of simulation results is shown in figure 11. The duty ratio adjustable multivibrator and Schmitt trigger can be used as extension experiments. The 555 timer constitutes the schmidt trigger simulation circuit, as shown in Fig. 12, and the waveform is shown in Fig. 13.

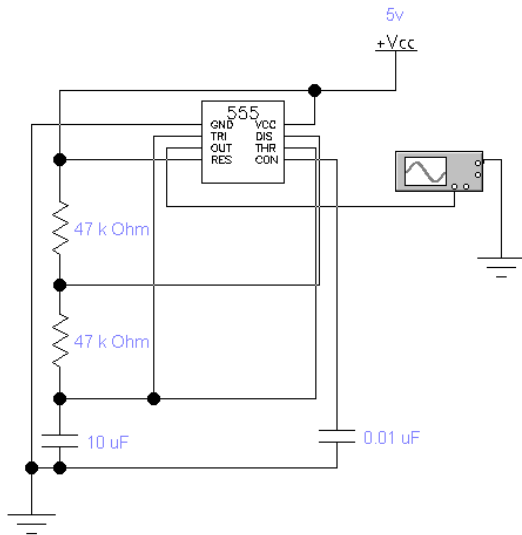


Fig. 10. Simulation circuit diagram of multivibrator

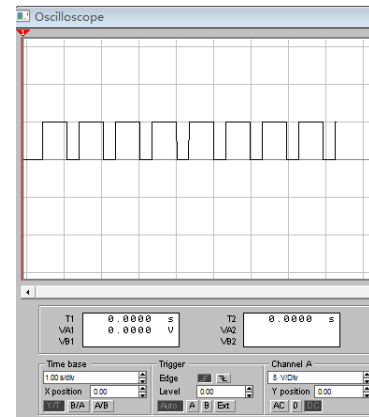


Fig. 11. Waveform of simulation results of multivibrator

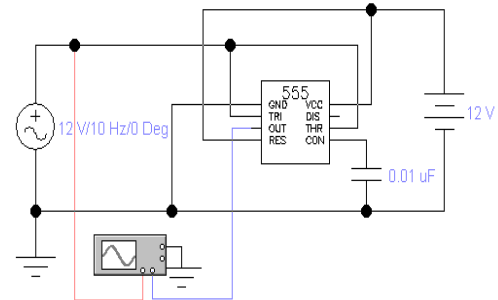


Fig. 12. Simulation circuit diagram of Schmitt trigger

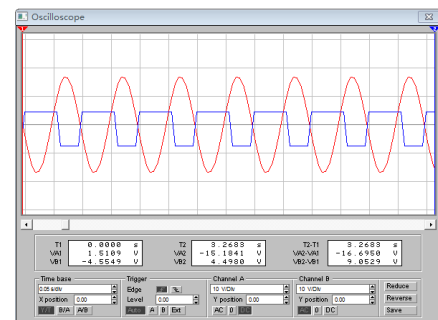


Fig. 13. Waveform diagram of simulation results of Schmitt trigger

In the course design, students are required to complete the design of relatively complex circuits (such as eight-way buzzer, running water colored lights, etc.) and complete the production of real objects. Students are required to use simulation software to debug the designed circuit first, and install and weld components after debugging to realize functions, which can reduce problems in actual circuit debugging and achieve twice the result with half the effort [2].

Combining EWB simulation software with hardware experiment can not only improve the efficiency of experiment, but also improve students' hands-on ability, circuit design innovation ability and independent learning ability [4].

V. CONCLUSION

In teaching of electronic technology, the use of EWB simulation software of auxiliary teaching method, can stimulate students' interest in learning, help students to understand and master the theoretical knowledge, to improve the students' ability of circuit design and software operation ability, to cultivate students' creative thinking, to improve the teaching efficiency, guarantees the teaching quality. Of course, simulation software is only a tool for assisting teaching, which should be combined with practical operation to truly improve students' operational ability and practical application ability [4].

REFERENCES

- [1] Li Yang, Practical course of EDA technology, 3rd ed., Beijing: Higher education press, 2017, pp.1-8. (In Chinese).
- [2] Gu na and Ji xiaofeng, Teaching reform of applied undergraduate microcontroller technology course, China metallurgical education, pp.72-74, January 2016. (In Chinese).
- [3] Luo guie, Practical course of analog electronic technology, 3rd ed., Hubei: Huazhong university of science and technology press, 2009, pp.211-231. (In Chinese).
- [4] Guo ning, Application of Proteus simulation software in electronic technology courses, Journal of science and education, pp.79-80, November 2016. (In Chinese).
- [5] Gu lixin and Qi junping, Electrical and electronic technology, 1st ed, Beijing: Aerospace press, 2013, pp.244-245. (In Chinese).
- [6] Kang huaguang, Fundamentals of electronic technology (digital part), 6rd ed, Beijing: Higher education press, 2014, pp.431-437. (In Chinese).