

# Application of Multisim in the Course of Electricity and Electronics Technology of Internet of Things Application Technology in Higher Vocational Colleges

Li Qiuyue<sup>1,a</sup>, Shi Jizheng<sup>1,b,\*</sup>, Cui Jun<sup>1,c</sup>

<sup>1</sup>Department of Network and Information Security, Chongqing Vocational Institute of Safety Technology, Chongqing, China

<sup>a</sup>liqyll@yeah.net, <sup>b</sup>419204274@qq.com, <sup>c</sup>detections77@163.com

\*Corresponding author

**Abstract:** The course of Electricity and Electronic Technology (EET) is in a key position in the professional knowledge structure of Internet of Things (IoT) application technology in higher vocational colleges, and learning this course well is crucial to the understanding of the content of the subsequent hardware-based professional courses. However, over the past few years, the wide range of students in higher vocational colleges and the uneven mathematical and scientific foundations of students have led to a great deal of resistance in the process of course delivery. In order to solve this problem, Multisim software is applied to the actual teaching of EET to change the traditional mode of instruction, task arrangement and assessment system, which makes theoretical learning more interesting, enhances the practical ability, stimulates the desire to explore the electrical courses, and at the same time improves the teaching quality of EET course, and vigorously promotes the cultivation of students' craftsmanship.

**Keywords:** Teaching reform, Multisim, Vocational IoT, Electricity and Electronic Technology

## 1. Introduction

As the core driving force for the cultivation of technical and skilled talents in the journey of The Chinese Dream for the great rejuvenation of the Chinese nation, craftsmanship is of great significance to the quality development of contemporary higher vocational students. It is clearly pointed out in the Plan for the Construction of Modern Vocational Education System (2014-2020) that the craftsmanship should be integrated into the higher vocational education, that is to say, to cultivate new-age craftsmen with theoretical foundations and practical skills in specialized fields, and with the ability to migrate knowledge, create independently and other applications in solving practical engineering problems [1]. In recent years, the exploration of craftsmanship adapted to the characteristics of different higher vocational specialties is constantly entering the vision of educational researchers. Taking the higher vocational IoT application technology specialty as an example, the training program requires that students should master the professional knowledge and skills for the software and information technology service industry, computer, communication and other electronic equipment manufacturing industry, etc., and be able to engage in the operation and maintenance of IoT system equipment, IoT project management and application software development and other work of high-quality technical and skilled personnel. Among them, the EET course is the first electrical quality professional course contacted by the IoT application technology students in their study career, which has strong practical value, focuses on engineering applications, and is in a key position in the academic system [2].

With the expansion of enrollment in higher vocational colleges and universities, many liberal arts students have joined the class of science and engineering majors, and the knowledge base of students is not the same [3]. However, the course EET is highly theoretical and practical, requiring students to have certain skills in reading and drawing, and to have a basic foundation in mathematics and physics. In such a context, there are usually two problems in the implementation of the teaching process of the EET course [4]. The first is the indoctrination teaching method. The traditional teaching mode only focuses on the mechanical memorization of theory, lack of teacher-student interaction, and it is difficult to fully take into account the individual characteristics of each student. Especially for students with poor foundation, passive acceptance of knowledge will only increase the academic burden, and continuously reduce the

sense of participation in learning, which greatly reduces the learning effectiveness. Secondly, the theory and practice are disconnected from the single teaching content. EET course design involves circuitry, analog electronics and digital electronics and other parts of the teaching content, in order to pursue the completion of the teaching task, sometimes greatly compressed the number of hours of laboratory experiments, and even do not set up the practical aspects of the course. This kind of teaching content will make the teaching process too boring and monotonous, and the students' understanding of knowledge only stays on the surface, it is difficult to improve the hands-on practical ability, and ultimately unable to ensure the quality of teaching. Therefore, in order to stimulate students' interest in learning, reflect the students' main position, enhance students' electrical and electronic literacy, combined with modern information technology teaching tools, it is crucial to explore the innovative reform practice of EET lectures. To this end, we applied Multisim simulation tools to the EET course, breaking the traditional teaching methods and teaching content, fully mobilize the students' subjective initiative, so that they can master the solid basic knowledge of electrical and electronic, and lay a good foundation of electricity for other hardware-based professional courses.

## 2. Multisim

Computer simulation software Multisim is a basic simulation software tool introduced by National Instruments, through the virtualization and simulation of electronic components and instrumentation, to provide development and design for electrical developers and scholars, simulation platform, with a friendly development interface, powerful, simple and easy to learn and other characteristics of the development has been widely used [5].

- Visualization and intuitive development interface

Multisim menu bar is similar to the Windows application, the toolbar in addition to the standard toolbar, but also has a component toolbar, virtual instrument toolbar, simulation buttons, status bar, the middle part of the project management area, the circuit editing area, the user can easily create, edit, debugging simulation.

- Powerful component library and simulation function

Multisim software built-in a large number of components, including from the basic components to integrated modules, after a number of versions of upgrades, but also add microcontrollers and LabVIEW virtual instrumentation, can provide a more comprehensive design need. At the same time, with a powerful simulation function, can meet the circuit, analog circuit, digital circuit and hybrid circuit simulation and design.

- Easy to learn

The design of components and instruments in Multisim software adopts physical simulation, which is similar to the appearance of the real thing and is easy for users to recognize, understand and use. In addition, the file creation, editing, components and instrumentation placement, editing, wiring, circuit simulation and results of the output operation is simple, very suitable for new users without any basic use.

- Low-limit and high-efficiency

As a virtual simulation software, Multisim does not require other hardware equipment support except for computers, and is not subject to the limitations of the number and types of components, as well as the limitations of time and space, and has the advantages of low-cost, low requirements, and high efficiency, which can provide users with a convenient simulation design environment.

Based on the above characteristics of Multisim, it is proposed to be used as a teaching aid for the course EET. Through computer simulation, students can reproduce theoretical knowledge in real time, stimulate learning interest and enthusiasm, help to cultivate students' practical habits and innovation ability, and promote active learning. This teaching mode plays an important role in promoting the improvement of teaching quality and stimulating students' enthusiasm for learning.

### 3. Application Exploration

#### 3.1. Multisim Teaching Sample

Multisim software creates a wealth of learning situations, can be transformed into more vivid content, intuitively presented in front of the students, to help students understand and absorb new knowledge. Take the capacitor characteristics as an example, in the explanation, although it is only a simple knowledge point, but for the students is abstract, Multisim can transform this into a visual representation, thus deepening students' understanding. From Figure 1 and Figure 2 can be seen, the direct current (DC) signal did not pass the capacitor, while the alternating current (AC) signal through the capacitor.

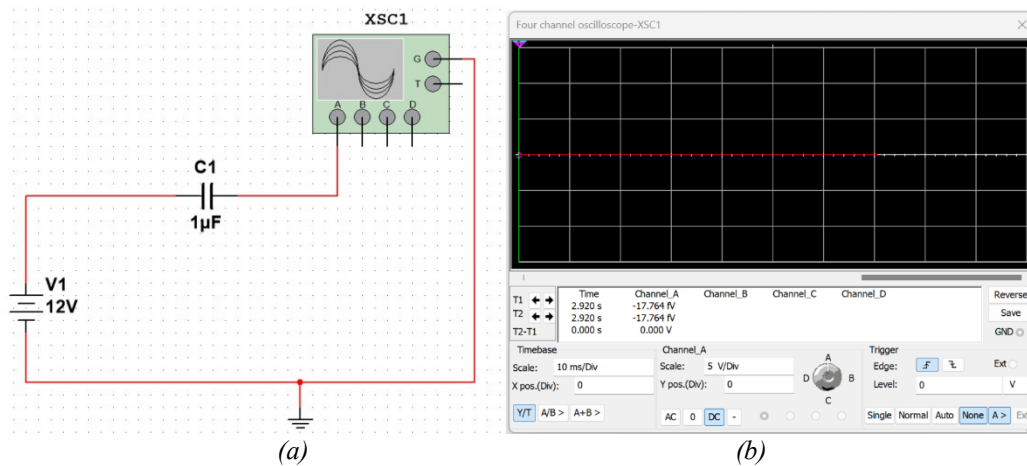


Figure 1: Multisim simulation of Capacitor "Isolated DC" Characteristics. (a) Sample Circuit Diagram; (b) Oscilloscope Simulation Results.

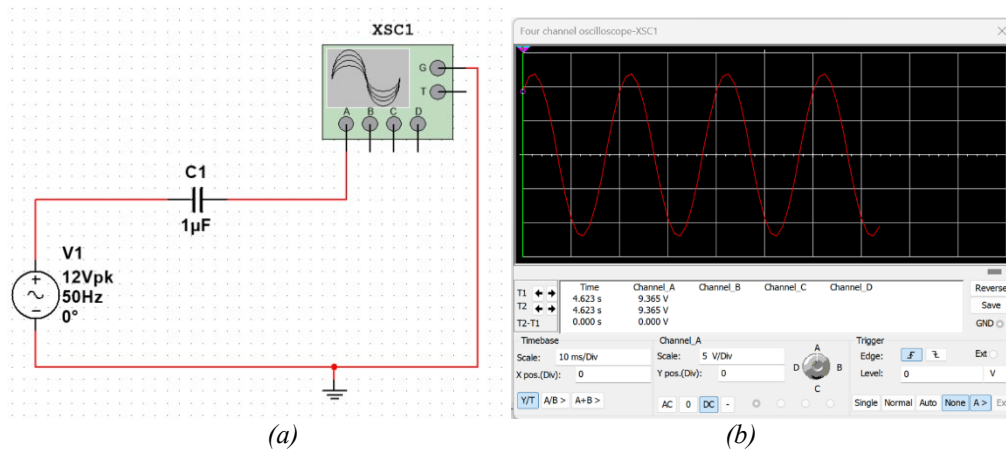


Figure 2: Multisim simulation of capacitor "Through-crossing AC" characteristics. (a) Sample Circuit Diagram; (b) Oscilloscope Simulation Results.

#### 3.2. Simulation tasking

Vocational education requires the cultivation of skilled and applied talents, so the teaching of EET must be combined with theoretical and practical classes. For the problem of disconnection between theory and practice, Multisim can be used as a carrier for combining theory and practice, applying the theoretical knowledge and testing the theoretical knowledge with practice at the same time. Due to its advantages of time and space, this software overcomes the problems of venues, instruments, class hours and funds, and realizes the connection between theoretical and practical classes.

In conjunction with the standards and teaching materials of the course EET for the specialty of IoT Application Technology, the simulation practice session of this course can be divided into the following ten tasks, as shown in Table 1. In each task, students are required to complete the operations of component and instrument selection, parameter setting, circuit connection and performance testing. The simulation project closely combines the knowledge objectives and skill objectives of the course, arranges the

specific content of the practical training in accordance with the step-by-step procedure, takes the students as the basis, and fully mobilizes the students' subjective initiative, so as to stimulate the students' interest in learning, cultivate their independent learning ability, and improve their ability to analyze and solve problems.

*Table 1: Simulation task content.*

<b>Task No.</b>	<b>Simulation Task</b>
1	Test of Resistor Voltage Division, Current Limiting Characteristics
2	Test of Superposition Theorem
3	Test of Capacitor Characteristics
4	Test of Inductance Characteristics
5	Test of Diode Characteristics
6	Test of Triode Characteristics
7	Simulation Test of Single-stage Amplifier Circuit
8	Test of Combinatorial Logic Circuit Analysis
9	Test of Combinatorial Logic Circuit Design
10	Simulation Test of Multi-Harmonic Oscillator with 555 Timer

### **3.3. Reform of forms of operation**

Generally speaking, EET coursework is the textbook of the post-course exercises, which is a relatively abstract form of knowledge gap filling. Many students will find it boring and tedious, and there is resistance to the course work, thus failing to achieve the effect of after-school consolidation. Combined with the characteristics of students, i.e., the relatively strong hands-on ability, completing the homework assignment through Multisim software can not only help students to complete the mastery of knowledge, but also improve the skills of students. Specifically, students can be assigned to the practice problems after class, requiring students to use the theoretical knowledge to answer this topic, and then use Multisim software to complete the verification. This program allows students to feel the fun of homework, but also at the same time to deepen their understanding of the knowledge.

### **3.4. Diversified appraisal system construction**

In order to adapt to the needs of higher vocational colleges for the cultivation of skilled talents, a diversified course evaluation and assessment method should be constructed to form a feedback and incentive mechanism for the teaching activities of EET. Specifically, in the process of Multisim-assisted teaching, the assessment structure should be determined around the teaching difficulties of the course EET and the characteristics of the simulation software, and the specific examination content should be supplemented according to this framework. At the same time, it should focus on the whole process of assessment of students' learning, and cultivate the quality of continuous improvement and positivity. For the implementation index of assessment, three modules such as usual performance, Multisim tasks and theoretical examination can be set as the basis of assessment, and the final grade of students can be calculated by the formula:

$$\text{Course Grade} = \text{Daily Performance Grade} \times 0.2 + \text{Multisim Task Completion Grade} \times 0.4 + \text{Theoretical Examination Grade} \times 0.4$$

The weighting of the two modules of usual performance and Multisim tasks is set to 0.6, which aims to emphasize the process evaluation of students and not to take the final theoretical examination results as the important basis of learning effect.

## **4. Conclusions**

In this paper, on the basis of exploring the problems in the teaching of higher vocational EET course, Multisim is proposed as an auxiliary teaching idea. First of all, through the capacitor characteristics of the application example proves that the Multisim software vivid and intuitive, and then put forward the improved and perfected practical tasks, forms of course work and assessment system, effectively breaking the traditional mode of instruction, for students to explore the mysteries of electrical knowledge, improve hands-on practical ability as well as cultivate the spirit of craftsmanship to provide strong support.

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