Computer Aided Instruction of Electronic Components Based on Altium Designer

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Abstract. There are various kinds of products, such as resistance, capacitance, inductance and so on in the theory teaching of electronic components. The traditional textbook teaching method is not image and vividness enough. Using electronic products are not only many categories and buying tedious, but also the amount is very large in the practice teaching of electronic components. It is difficult to control wastage during distribution, use and recovery. This paper puts forward a new teaching mode of computer aided electronic components, introduces the software Altium Designer of Electronic Design Automation (EDA), and directly finds a corresponding 3D model of electronic components through software, which brings students a clear understanding and better accepted theoretical knowledge. Students design printed circuit boards (PCB) through software and could see 3D drawings of finished products in the experiment. It can further make processed board and put theoretical knowledge into practice when the design of the electronic circuit has specific applications, laying the foundation for innovation and entrepreneurship.

Introduction

Electronic components are general term for electronic elements and devices. Electronic elements refer to products that do not change the molecular structure of raw materials in production and processing, such as resistors, capacitors, inductors, etc. Because they do not generate electrons themselves and have no control or transformation effect on voltage and current. Electronic elements do not require external power supply when they are working, so they are also called passive devices. Electronic devices refer to products that change molecular structure of raw materials during production, such as triode, field-effect transistor, thyristor, integrated block and so on. Because they can generate electrons themselves and have control and transformation effect on voltage and current. Electronic devices usually need external power supply when they are working, so they are also called active devices.

Electronic components are smallest cells that constitute electronic circuits and products. The related knowledge of electronic components is the basic knowledge that electronic majors must possess, and their practical skills are throughout the whole professional study. With the rapid development of electronic technology, the demand for knowledge, ability and quality of students is getting higher and higher. Knowledge teaching of electronic components must be constantly reformed to keep pace with the times and guided by modern teaching philosophy.

Current Situation of Electronic Component Theory Teaching

Electronic component which has strong practical characteristics is a specialized course for electronics majors in universities. The knowledge learning of electronic components has a direct impact on the study of follow-up courses. However, there are many problems in the actual teaching process. In the first place, it is that the knowledge capacity is large, it involves a wide range and the system is not strong. There are a wide variety of electronic components, such as resistance, which can be divided into many categories for different classification, function, packaging, making material and so on.
Under each category, it can continue to be continued to subdivide. In the next place, it is
backwardness of textbook, most of the textbooks are only introduced to the traditional components.
Speed is very fast, that of electronic product updates. Almost new electronic components come out
every day. Teaching materials can’t follow speed of electronic products updating. They do not well
reflect principles of practicality and practicability compared with current electronic products usually
choosing some new components. Once more, it is widespread phenomenon that cramming education
is existing everywhere, time to catch up is common in the context of compression theoretical class
hours, which affects the quality of teaching and decreases students’ interest in learning. In the end, the
teaching organization form is single, it is very difficult to arouse students’ initiative in boring
theoretical class. Organizational form of practical class is not easy for students to learn. Even if
relevant electronic components are prepared for the students to watch and use by teachers themselves
in the teaching of theory, which can make students better understanding electronic components for
convenience. But electronic components are generally small, not convenient to pass through and easy
to lose and increasing teacher’s class cost. Students are likely to cause damage in the process of
watching and reading. Many electronic components will not be able to see from appearance whether
they are damaged. However, traditional methods for analysis and design of electronic circuits are
difficult to adapt to actual requirements in terms of analysis accuracy, cost of manpower, material,
time and so on.

**It Is Difficult to Carry out Experimental Teaching of Electronic Components**

Experimental projects need to be equipped with various electronic components, such as resistance,
capacitance and integrated chips in the experimental teaching of electronic components and electronic
technology related courses. These devices are of many kinds, small size and easy to damage, so
management is very difficult, which costs experimental teachers much time and energy. Although
general price of components is not high, cost of practical teaching will increase due to large amount of
usage and no loss control. At present, following problems are commonly encountered in the
management of laboratories. Firstly, it is difficult to screen quality of components. Secondly,
students’ consciousness of protection are weak. Thirdly, it is low efficiency of component
management. Finally, experiment preparation work is passively.

A computer aided instruction is put forward in this course in view of a series of shortcomings,
especially new curriculum development based on EDA software, Altium Designer, and a series of
discussions are carried out on teaching methods. Altium Designer can simulate circuits according to
structure of circuit and parameters of components. It can obtain technical index of circuits, so that can
quickly, conveniently and accurately evaluate correctness of circuit design, and save a lot of time and
cost. At the same time, Altium Designer can also carry out electromagnetic interference and thermal
distribution analysis, which are difficult or impossible to carry out by traditional methods. Altium
Designer, as an advanced industry software, has been included in the compulsory course of students in
many universities with the rapid development of electronic technology. It is very necessary to apply it
to the teaching process in time.

**Introduce Altium Designer in the Teaching of Electronic Components**

**Learning for Common Electronic Components**

Electrical components are widely used such as resistors, capacitors, inductors, diodes, triode and other
electronic components in actual electronic system design. Different electronic components are needed
for different circuits and uses. Therefore, there are a wide variety of electronic components. It is not
economical and infeasible to buy all kinds of electronic components if teachers want to show students
in the form of physical objects, facilitate students to understand and deepen their impression.

Introduction of Altium Designer as an auxiliary tool in teaching can not only save cost but also
enable students to vividly understand electronic components in this context. For example, capacitance
is selected and there are many kinds of packaging, including commonly used C0805, C2225, 1812 and 1825 in Altium Designer. Corresponding 3D model below is more convenient for students to understand. Example of common electronic components is described in Figure 1. Even without the purchase of a concrete object, students have a deep understanding of capacitance through operation of software by the teacher, and can be used for further electronic circuit design.

![Schematic diagram of capacitance](image1)

![Different packaging of capacitance](image2)

![3D model of C2225](image3)

![3D model of C0805](image4)

Figure 1. Example of common electronic components.

**Learning for Uncommon Electronic Components**

This type of electronic components is not easy to buy in market, can be used by the EDA aid tool to enable students to deepen understanding and how to use it. Examples of uncommon electronic components are described in Figure 2 and Figure 3.

![3D model of INDC3225](image5)

![3D model of USB-MOLEX-67503](image6)

Figure 2. 3D model of INDC3225.  Figure 3. 3D model of USB-MOLEX-67503.

**Altium Designer Is Introduced in Further Experimental Teaching**

Teachers simply introduce all kinds of electronic components to students in traditional teaching process. Students will recognize electronic components when they see them but can’t use them flexibly. Students can design PCB according to their own design ideas in Altium Designer, specifically to actual hardware circuits, to deeply understand specific purposes and use methods of each type of electronic components, and why they should be placed in this position in circuit. Production cost of PCB is very high. As far as electronic component is concerned, there is no support for each student to make a PCB, but Altium Designer has 3D simulation effect diagram that is consistent with completion of produced and welding PCB. Examples of PCB 3D effect diagram are described in Figure 4 and Figure 5. Students can better understand what PCB will look like through 3D effect map and further study design of hardware electronic system and lay a good foundation for future work of hardware engineer.

Educational work of innovation and entrepreneurship is paid much attention and foundation of entrepreneurship is offered as a compulsory course for the senior students in many universities. It means that graduates of universities must learn independent innovation design to a certain extent, so
as to acquire relevant professional knowledge and skills and to accumulate preliminary work experience in order to achieve goal of scientific and technological innovation oriented and independent entrepreneurship. Innovative thinking is well reflected in Altium Designer. Not only specific electronic circuits can be applied to certain work situations by software simulation, but also foundation for subsequent work and even independent business will be laid by processing and welding of PCB. For example, 3D engine real-time presentation design model and multi-board assembly can be realized in connection management and enhancement of multiple boards, and display is faster, more intuitive and realistic in Altium Designer.

Figure 4. The flat view of 3D model of PCB.    Figure 5. The side view of 3D model of PCB.

Summary

Students’ learning and practice are directly linked through design of EDA aided curriculum teaching for electronic component. Application of software simulation and discussion teaching method in the classroom make teachers transform from simple knowledge initiator to organizer, guide, participant and evaluator of classroom activity. Teachers should advocate transformation of roles between teachers and students and arouse students’ subjective consciousness in teaching process. Students can familiarize themselves with design of electronic components and circuits through this teaching mode and method. Learning is no longer a simple study but a design. Design of circuit is no longer a form of graphics, but a model that can be seen to arouse enthusiasm of students.

In a word, students’ interest in learning has been improved and hands-on ability has been exercised through reform. However, there are still some problems in implementation of existing reform programs in course of teaching and research, and we hope to improve teaching process in the future.

References