Flex Based Interactive Courseware for Teaching
“Principles and Applications of Single Chip Microcomputer”

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Abstract. Multimedia courseware is helpful for modern education. In this paper, virtual simulation is proposed for teaching “Principles and Applications of Single Chip Microcomputer”. Flex technology is utilized to perform the interactive functions of the courseware. The characteristics of Flex technology and the main process of establishing the interactive courseware is described, and an example of the Flex based interactive courseware is shown. Flex is powerful for animation and application development, so that any interactive function of teaching can be easily implemented through it.

Keywords: courseware; interaction; virtual simulation; Flex

1 Introduction

With the technological advances of modern education, the methods of teaching have been great changed. Due to the development and popularization of computer technology and multimedia technology, electronic courseware in teaching plays an increasingly important role, and is used widely. Multimedia teaching can bring sound, text, images, animation and other elements together, and give students diversified information with strong expression. Multimedia courseware is a necessary element of the multimedia teaching, thus, how to combine it with the teaching practice and exploit its teaching potential to improve teaching efficiency is an important issue.

There are many tools to create multimedia courseware. Flash is a classic production of the two-dimensional animation software produced by Macromedia. The effect of the animation made by it is varied, with strong interactive features. Its biggest feature is the generated file is small to carry and easy to transmit through network, so that it has become the standard of interactive vector technology. Flash technology has been used to create multimedia courseware [1-3]. But most Flash courseware focuses on animated features, interactive features are weak. With the development of network technology, the technology of Rich Internet Application (RIA) emerged. Flex is a complete integrated RIA technology based solution. Based on Flash platform, it uses mxml to design the user interface, and ActionScript to create client logic. There are some teachers who adopt the Flex technology to create electronic courseware. For example, Zhao Z. et al. utilized the Flex technology to
achieve vector bitmap and drag effect [4]; Cao G. et al. used Flex technology to form state transition and data drag effect [5].

In the actual teaching process, the interaction between teacher and courseware is often necessary to explain the problem clearly. In the Electromechanics teaching, the use of simulation can provide students with a learning environment closing to real system. This requires the teacher and the multimedia courseware to interact each other, to control the simulation effect. Flex technology is very suitable for such interactive courseware.

2 Features of Flex technology

Flex is an efficient RIA development product set based on the standard programming model. The most notable feature of Flex is that it is based on the global popular online animation platform - Macromedia Flash. Flash Player has become an indispensable plug-in for most browsers. Through Flex, developers can compile the RIA program to a Flash file, which can be accepted by Flash Player. In other words, the programs developed on Flex do not need to install additional client support for most browsers. This is a unique advantage.

The main features of Flex technology are as follows:
(1) Good operability. The user interface and the operability of Flex client are the same as those of the traditional C/S (Client/Server) client.
(2) Clear structure. Flex based system structure is a true MVC (Model-View-Control) architecture. This makes the application development very clear.
(3) Strong scalability. As a client component, Flex is very easy to combine with various technologies, such as AMF, PHP, Java, .Net, and ColdFusion.
(4) Convenient execution. The program developed by Flex can run in a browser, and can also run outside a browser. This greatly expands the using of an application.
(5) High efficiency of development. Flex user interface programming techniques are similar to VB or Delphi, which adopt WYSIWYG (What You See Is What You Get) in development. The ActionScript used by Flex is an object-oriented language, so that learning and overall maintenance costs low.
(6) Can be combined with video, audio and other multimedia. Flex has built-in video, audio and other multimedia components, and therefore provides convenient, easy-to-use APIs for programmers.

3 Teaching of “Principles and Applications of Single Chip Microcomputer”

“Principles and Applications of Single Chip Microcomputer” is a strong theoretical and applied course. It has many concepts, and its commands are difficult to be remembered. The students often feel dull when learning it, particularly for non-information specialty students. For example, the students of industrial engineering
often feel difficult in understanding the concepts and principles of the single chip microcomputer (SCM) because they lack the basics of electronic technology.

Assembly language is the main language in SCM programming teaching. Assembly language is closer to machine language compared with other high-level languages, and its readability is relatively poor, so that it is not easy to understand for most students. Furthermore, assembly language programming is closely related to the hardware structure, thus, if a student does not grasp the structure of computer hardware, he does not learn assembly language programming well.

The structure of SCM is complex, and the content of SCM is abstract. Traditional instruction of SCM is based on the structure of the main line of SCM, from hardware structure to commands and programming, till the SCM system expansion. The teaching methods of SCM lack the vivid and intuitionistic aids. This will result in boring and lack of interesting in learning SCM.

Theoretical teaching with traditional methods is ineffective. Therefore, it is needed to reform the teaching methods. Virtual simulation teaching is a good method, which uses simulation tools to simulate a SCM and its peripheral devices, so that case projects can be demonstrated in the teaching. In the simulation, abstract concepts and boring theories in textbook can be visualized by texts, sounds, tables, graphics and animations. In this way, the teaching is vivid and the students' interest in learning can be enhanced, the teaching effects can be greatly improved.

4 The creation of interactive courseware

By using Flex technology to create interactive courseware and achieve simulation teaching, the manifestation of the teaching content can be enhanced through the interaction between the teacher and the courseware.

The creation of interactive courseware should follow the main processes:

(1) Determining the teaching programs. Determine teaching programs according to teaching purposes and students' characteristics, define what need the interactive functions, and what does not need, in order to play the role of the interactive courseware in teaching, and breakthrough key and difficult points of teaching. In the teaching of the "Principles and Applications of SCM", assembly language, timer/counter, interrupt system, interfaces, and serial communications are very important, but they are also difficult for students to grasp. So these contents can be designed to utilize interactive courseware.

(2) Interactive functions design. Design interactive functions in the courseware according to the teaching content. Determine the contents, methods, steps, inputs and outputs of the human-computer interaction, to detail the interactive functions of the courseware. For example, for the teaching of SCM interrupt system, the courseware can be designed to make use of switches to control the states of lamps. The SCM responds to the switches’ on and off through interrupt mode, and the lamps are turned on and off correspondingly. Teachers in the teaching process need to operate the switches, and the corresponding states of the lamps are displayed through the courseware. Assembly language programs involved in this process can also be displayed to explain. This is actually a virtual simulation of a SCM application project.
(3) User interface design. A good Flash courseware can not only fully express the teaching content, but also have a good originality to express the static text in the books in a vivid way. Flash's powerful multimedia functions, such as colors, images, animations, and sounds, can be used to express the teaching content in the user interface. At the same time, Flex provides a lot of controls to help the layout of user interface. For the teaching of the aforementioned interrupt system, the SCM, input switches, output lamps, and so on, should be drawn by the controls of Flex during the user interface design, and laid properly.

(4) Flex Programming. According to the requirements of interaction and user interface design, develop Flex programs to achieve the interactive functions of the user interface. For the interactive courseware design of the interrupt system teaching, develop Flex programs to simulation assembly language functions. That is, when the switch is on or off, the states of the output lamps will change accordingly.

(5) Combination of interactive courseware and other form courseware. For teaching convenience various forms of courseware should be combined together in order to maintain the continuity of the teaching process. For example, the interactive courseware created by Flex can be embedded into the courseware created by PowerPoint, so that the teacher can switch from one courseware to another in the teaching process in accordance with the pre-arranged order.

5 Applications

For teaching the students of Industrial Engineering in School of Electromechanical Engineering Department in our university, an interactive courseware about SCM is created based on Flex technology. The courseware is used to explain the 8051's interrupt system and interrupt service program. The output of 8051 P1 port controls eight light-emitting diodes which form circulating lamps. When the switch is pressed, the light-emitting diodes are extinguished for some time, and then return to their original states.

In order to show the teaching content, the user interface utilizes animation to reflect the circulating lighting of eight light-emitting diodes, which is implemented by a timer program of ActionScript. The switch is expressed by a button. In the teaching process, the teacher presses the button to turn off all diodes, and after some time, the eight diodes return to their circulating lighting. This is done by developing ActionScript program to simulate the interrupt service routine of SCM. The user interface of the courseware is shown as Fig. 1. In order to facilitate explaining the interrupt service routine, a button is put on the user interface, through which the interrupt program can be shown. The user interface of the interrupt program displaying is shown as Fig. 2.
6 Conclusions

Flex technology not only has rich multimedia functions, but also has powerful program development capability. Thus, it can achieve interactive functions that any other computer software can implement. Besides, it utilizes the widely used Flash Platform and Flash Player, so that the application developed by it can be used widely, even on Internet.

There are many difficult concepts and principles in the teaching of “Principles and Applications of Single Chip Microcomputer”. Virtual simulation based teaching is a good method to enhance the students’ learning interests. Flex can easily achieve virtual simulation based courseware which usually involves interactive functions. The courseware created by Flex can play a unique role to support teaching.
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