

# Design and Implementation of Operating System CAI Courseware

Zengguo Sun\*, Jiali Xu, Yuanyuan Li and Chen Yang

School of Computer Science  
Shaanxi Normal University  
Xi'an, China

**Abstract**—In order to overcome the shortcomings of the traditional operating system courseware (such as PPT), the operating system CAI courseware was developed in this paper, which realizes the dynamic demonstration and human-computer interaction of algorithms in the operating system course. Requirement analysis, summary design, and detailed design were provided successively for the CAI courseware. Then, the design and implementation of the courseware were carried out by using Adobe Flash Professional development tool. The operating system CAI courseware mainly contains six chapters of the course content: operating system overview, process management, processor scheduling and deadlock, memory management, device management and file management. The main functions of each chapter of this courseware are course content selection and browsing, algorithm animation presentation, complex content dubbing, chapter summary, job practice and online help. The courseware owns the merits of simple and elegant interface, rich examples of algorithm animation and a wide range of multimedia applications. It is an effective tool for teachers to teach and for students to learn independently.

**Keywords**—operating system; CAI courseware; summary design; detailed design; Flash

## I. INTRODUCTION

In recent years, China's computer industry has been booming. But with the formation there is a strong contrast that the production of CAI courseware is still not optimistic. Though a small number of teachers can independently design CAI courseware which is only used to observe the teaching or for the courseware evaluations, but rarely really in order to optimize the course structure [1]. For the course of operating system in computer major, due to its complex knowledge points and obscure algorithms, relying on traditional courseware has been unable to meet the classroom needs of teachers and students. It is necessary to make a CAI courseware to assist teaching. In view of the fact that CAI courseware is a kind of computer application software, we follow the general steps of software engineering to study in this paper. First of all, the requirements of the operating system CAI courseware are analyzed, followed by the summary design and detailed design. Then the courseware is designed and implemented by using Adobe Flash Professional CS6. Finally, we finish a complete set of operating system CAI courseware that is a fusion of text, sound, animation, video and other means. It is in an interactive way and mixed with a variety of practical examples of use and a metaphorical description of the image on the basis of knowledge and algorithmic presentation [2]. So that even in the situation there is no teacher to explain, students can still easily and efficiently master the operating system course. It is an effective tool for teacher's teaching and student self-study.

## II. REQUIREMENT ANALYSIS

Considering the course content needs, the operating system CAI courseware needs to include the six chapters, which are followed by operating system overview, process management, processor scheduling and deadlock, memory management, device management and file management. In accordance with the order of cover, directory search and the chapter content to arrange, each chapter should include quote, text, summary, exercises and other modules, highlighting the difficulties, mixed with prompt icons, algorithm dynamic presentation, text animation, sounds explaining complex content and other multimedia material [3].

In the software functional requirements, the courseware should be a small file, zoomed without deformation and can be directly played on the user's computers and browsers, to meet the different users' needs of the courseware size, storage, playback and other conditions. The interface should be simple and generous with the uniform style, and buttons and other commonly used function keys should maintain their positions before and after. Accompanied the smooth and clear animation with the standard and lifelike sounds explanation, this CAI courseware provides users with a friendly operating environment, thereby improving classroom and self-learning efficiency [4].

## III. SUMMARY DESIGN

On the basis of requirement analysis, this section summarizes the operating system CAI courseware, which aims to determine the curriculum content structure framework and function modules of the courseware. The operating system CAI courseware

This work was supported by National Natural Science Foundation of China (Grant No. 61102163), Natural Science Foundation of Fujian Province (Grant No. 2012J01271), the fourth batch of Information Demonstration Course Construction Project of Shaanxi Normal University, "Teaching Model Innovation and Practice Research" Special Foundation of Shaanxi Normal University (Grant No. JSJX2016Y018) and All English Teaching Demonstration Course Construction Project of Shaanxi Normal University in 2017.

\*Corresponding Author: Zengguo Sun, duffer2000@163.com.

curriculum content structure is shown in Fig. 1, which includes six chapters, followed by operating system overview, process management, processor scheduling and deadlock, memory management, device management and file management. The functional modules design structure is shown in Fig. 2, which are mainly dynamic algorithm presentation (including banker algorithm, such a complex algorithm for dynamic demonstration, where the users can choose their own parameters to verify), sounds explaining (having a mandarin speech for each chapter's abstruse and complex knowledge points and algorithms), small animation to play (do some small animations to help students understand the text, improving students' learning enthusiasm) and other functions.

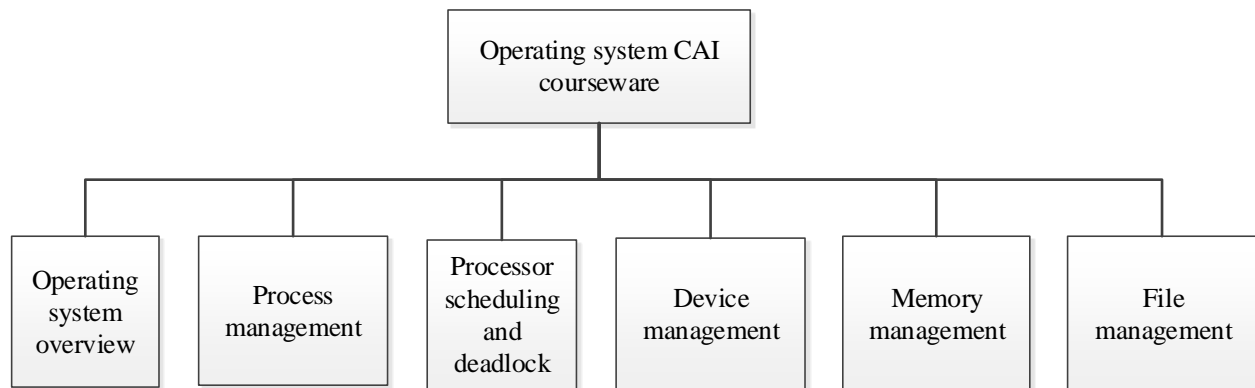


Fig. 1. Operating system CAI courseware curriculum structure

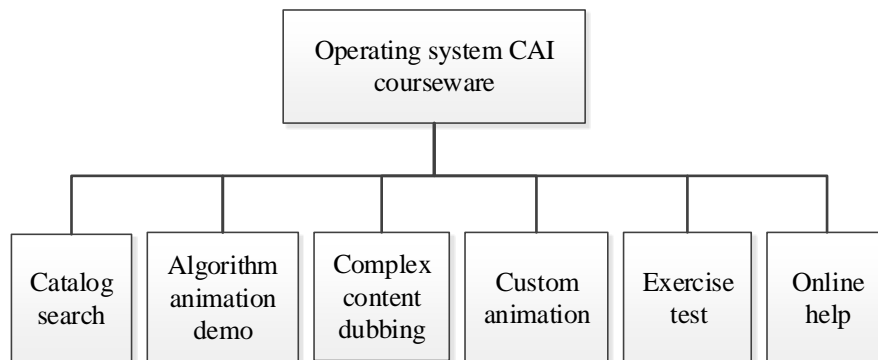


Fig. 2. Operating system CAI courseware chapter functional structure

#### IV. DETAILED DESIGN

This section is the detailed design of the operating system CAI courseware. The purpose is to determine the specific implementation process of each functional module. First of all, we find out how to use the entire courseware, as shown in Fig. 3. After entering the main interface, press the right button on the bottom of the screen to enter the directory interface, you can randomly select the section you want to learn, jump into, learn or demonstrate. There are left and right flip page buttons below each page. Clicking the exit button at the top of the screen can return to the directory interface, then you can select the chapter again.

In the algorithm dynamic demonstration module, we select the more classic and important algorithms in the course of the design, and put the same type of algorithms together to demonstrate comparison, then analyze the advantages and disadvantages of different algorithms. According to the specific situation of different algorithms, the feasibility of the algorithm is verified by using fixed parameters and variable parameters. In this section, the first adaptation algorithm (find the first size to meet the requirements of free space) in dynamic partition allocation algorithm is taken as an example, to show the details of the design process [2], as shown in Fig. 4.

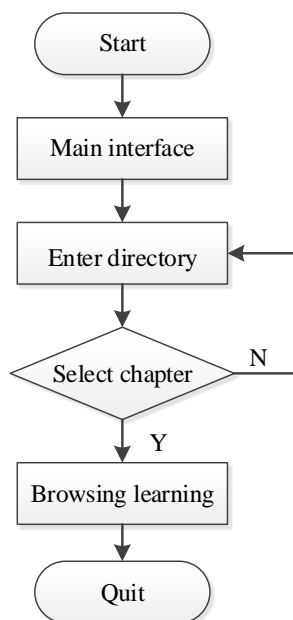


Fig. 3. Operating system CAI courseware use sequence

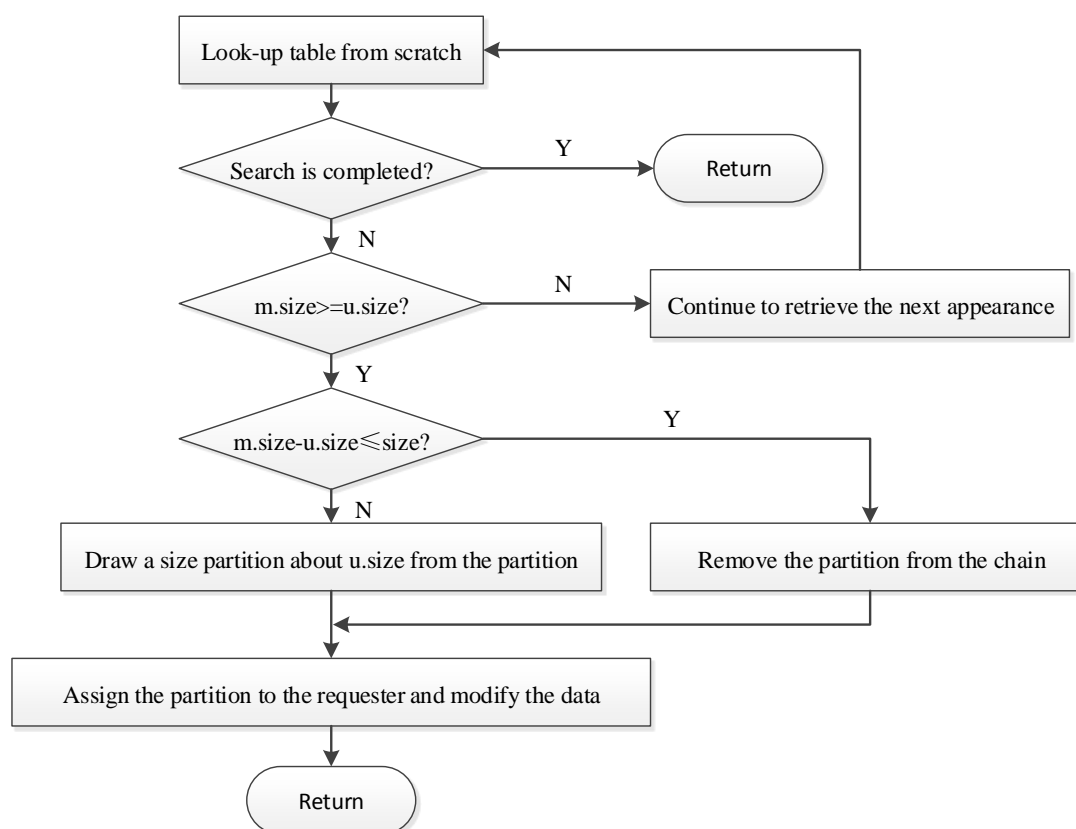


Fig. 4. First adaptive algorithm demo flow chart

## V. SCRIPT DESIGN

According to the results of the detailed design, we can script the design of the operating system CAI courseware. Here, we use the Adobe Professional CS6 Flash development tool for script design, because its operation is relatively simple and pretty powerful, its design is more freedom, and its animation is more beautiful. Adobe Professional Flash CS6 is one kind of animation creation software with a collection of painting, production, design, editing, synthesis and high-quality output. It includes three basic functions of drawing and editing graphics, tween animation and mask, which can help us quickly achieve the visual design about

button graphics and algorithmic animation, reducing a lot of code input. Using it to develop courseware has the advantages of simple code, small volume, strong interaction, easy to play and easy to promote.

This section takes the time slice rotation algorithm as an example, specifically showing you how to use the Flash script design algorithm for dynamic presentations: First of all, we should create a number of graphic components, such as the rectangle and round in Fig. 5, then enter the text backup. Next, create a movie clip symbol and create the algorithm animation by using the graphic elements created above on the time axis of the component [5]. Finally, put the movie clip symbol in the appropriate location in the scene, as shown in Fig. 6. It should be noted that there appear some Chinese characters in Fig. 5 and Fig. 6 because this CAI courseware is developed for Chinese students, with a total of 33 frames, has been designed with the visual method, so having only the codes generated automatically by the system:

```
stop();
on (release) {
    nextFrame();
}
```

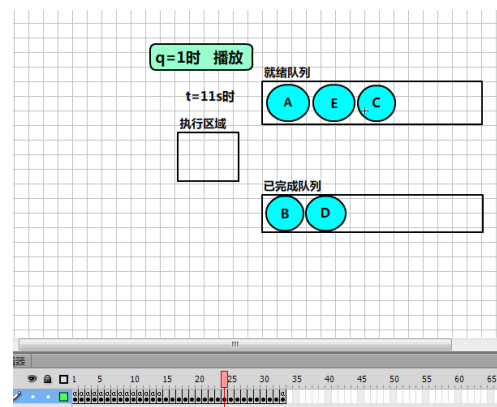


Fig. 5. Movie clip component production

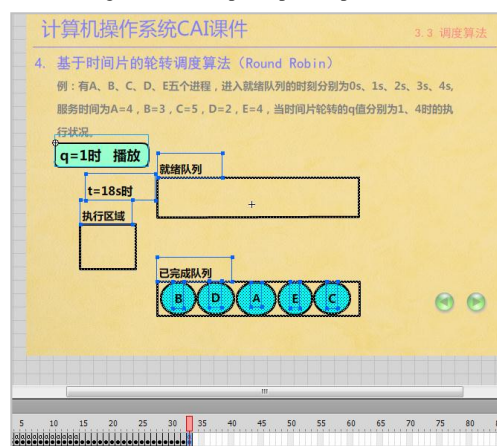


Fig. 6. Place the animation element into the scene

## VI. KEY ISSUES TO SOLVE

### A. Image Processing

This part mainly includes the image of the cut, paste and merge, image flip and rotation, image color effects adjustment, image art processing and so on. Photoshop can be used to achieve the effect.

### B. Voice to Explain

Firstly, according to the computer's sound card, we collect voice from the microphone to generate WAV file; Secondly, use the sound editing software (such as Audition) to edit and synthesize the sound source material, and ultimately generate the required MP3 format sound file; Thirdly, insert a new layer in the Flash animation as the sound layer, and insert the key frame in the

corresponding places of the sound layer with the character or the animation as the starting frame of the audio playback, then insert the MP3 format sound file. When voice playback is required to stop, the key frame is inserted on the corresponding frame, and the same sound file as the start frame is selected for the operation of the frame and the stop operation is performed [6].

## VII. INTERFACE IMPLEMENTATION AND INSTRUCTIONS FOR USE

Three versions of the courseware are developed by flash: .exe (played directly on the computer where you installed the Adobe Flash Player plugin), .swf (played with any player), and .html (played on any browser), which can meet the need of the courseware size, playback, storage and other conditions for various users. It should be noted that the Chinese characters appear in the following interfaces because this courseware is designed for Chinese students.

### A. Full-Screen Display

The default courseware playback display ratio: Normal 4: 3. The user can also adjust the screen size according to their own needs (See Fig. 7).



Fig. 7. Full-screen display

### B. Button Description

Click the left and right buttons in the right corner of the page to turn pages; click the button at the top right of the screen to exit the courseware (See Fig. 8).



Fig. 8. Button description

### C. Hierarchical Structure

This courseware uses graphics to summarize some basic knowledge as much as possible, and enable learners to master knowledge in the shortest possible time. For example, in the first chapter, outlines of operating system, the hierarchical structure of the computer system bottom-up are as follows: the bare metal, operating system, system software, application software and support software, as shown in Fig. 9. We can immediately capture the operating system that should be in the second layer.

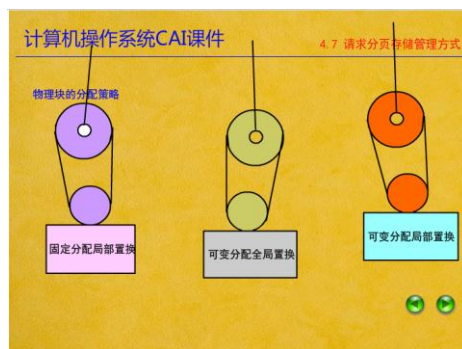




Fig. 9. The hierarchical structure of the computer system

#### D. Animation

Using the graphics rendering function of Flash itself can produce some simple animation with flip, stretch, erase, skew and other effects. You can also use the magic wand of the lasso tool to select the same color area in the image and create a mask that splits the image into many single elements for editing, setting the properties of the graphic (such as smoothing and quality distortion compression), which makes the boring curriculum content vivid and flexible. As shown in Fig. 10(a), we can use the tween to make the pulley in the figure swing to attract students' interest. As shown in Fig. 10(b), we draw some favorite graphics, fade them into the animation settings, then we can create a shine so that the screen can move up.



(a) Pulley animation



(b) Flashing animation

Fig. 10. Animation examples

#### E. Animation Demo of Algorithms

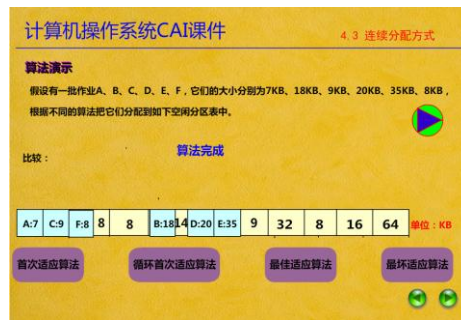
For all algorithms in this course, we try to present them with animation and interactive features as much as possible. This is the essence of this courseware. If these algorithms rely solely on the description of the text in the classroom, students cannot understand and master them well in a short time. With the help of the Flash animation demo, students can clearly understand each step of the operation. They can also set their own parameters to verify the reliability of the algorithm. In the fourth chapter, the first adaptation algorithm in dynamic partition allocation algorithm is taken as an example shown in Fig. 11. Firstly, select the specific method of the first adaptation algorithm, as shown in the Fig. 11(a); Secondly, allocate space for job A, as shown in the Fig. 11(b); Lastly, when the allocation is completed, the status of memory is shown in Fig. 11(c) [5,6].



(a) Select the specific method



(b) Allocate space for job A



(c) Status of allocation completion

Fig. 11. Animation demo of the first adaptation algorithm

## F. Chapter Exercise

At the end of each chapter, there is the job practice and the corresponding answers, which is convenient for users to master the content and application ability. Fig. 12 shows the exercise of disk scheduling algorithm in chapter 5.

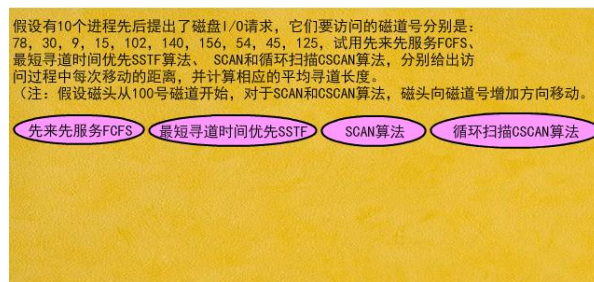


Fig. 12. Exercises of disk scheduling algorithm

## VIII. CONCLUSIONS

Operating system CAI courseware, which is developed by Flash professional animation-making software to break the traditional mode of courseware, is a set of graphics, icons, animations, voice and other multimedia material. It is based on the operating system material, designed including all the core content of the course such as operating system overview, process management, processor scheduling and deadlock, memory management, device management and file management. The courseware interface is simple and concise, the contents of each chapter are at a glance, the algorithm demo is accurate, and the human-computer interaction is efficient and friendly. It has been put into use in the classroom, and the response is very good. Three versions have been generated for the courseware, i.e., .exe (played directly on the computer where you installed the Adobe Flash Player plugin), .swf (played with any player) and .html (played on any browser), to meet the different users' need of the courseware size, playback, storage and other conditions. So this courseware can be regarded as an effective tool for teachers to teach and for students to learn independently. In order to apply this courseware well in teaching, humanization design of buttons and teacher-student communication module should be considered in the further work.

## REFERENCES

- [1] J. Feng, L. Wu, and R. Liu, Development of CAI Multimedia Courseware. Beijing: Posts and Telecommunications Press, 2008.
- [2] X. Tang, H. Liang, F. Zhe, and Z. Tang, Computer Operating System, Fourth Edition. Xi'an: Xidian University Press, 2014.
- [3] D. Li, Q. He, E. Gao, and Y. Chen, "The designing and developing Of CAI of the computer operating system course," Journal of Changchun Institute of Optics and Fine Mechanics, Vol. 22, No.3, pp. 56-59, Sept. 1999.
- [4] X. Yang, "Interactive CAI research and implementation of principles of database systems," Journal of EEE, Vol. 38, No. 1, pp.148-150, Feb. 2016.
- [5] G. Hu, Flash Classic Classroom. Beijing: Tsinghua University Press, 2013.
- [6] J. Lei and S. Gong, Flash Animation-Making. Changsha: Hunan University Press, 2010.