A Net Courseware for "Image Processing"

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Abstract—**To help the teaching and learning of the undergraduate course named "Image Processing", and to take the advantage of the progress of network for improving the education efficiency, a new and particular corresponding net courseware has been developed. This courseware is developed to support the education, to provide a vivid complement for the textbook, while not to replace the textbook. This paper introduces some design considerations and principles related to pedagogical requirements, the framework and structure for the organization and arrangements of contents, as well as the characteristics of the web-pages and interfaces of the courseware. In addition, some typical web-pages of this net courseware are shown to illustrate the results of different efforts in the design and development. Parts of the courseware have been used by professors and students, and some good feedbacks have been obtained.**

Keywords-computer assisted instruction, net courseware, knowledge component, image processing.

I. INTRODUCTION

Computer Assisted Instruction (CAI), as a powerful technique, plays an important role in modern education. The progress of computer and communication technology as well as multimedia equipments and network infrastructures have greatly enhanced the quality of teaching and learning in recent years [1].

One of the most important tasks to make educational learning effective is the designing of courseware. From the pedagogical point of view, the use of courseware can greatly thrust the interest of learner and stimulate their subjective motivation, which would have significant influence both on the course conducting performance and educational effects.

Different media, such as image/picture, animation, audio, and video have been employed in various coursewares to give students some vivid and dynamic representations to stimulate their deep thinking and to push student's motivation in active participation.

With the wide utilization of networks, net coursewares become popular. They organize the education materials with the help of well organized web-pages [2]. Learners can use network technology to access remotely the contents in courseware. Net courseware becomes an important educational resource. In this paper, a net courseware has been used for 3 years are presented.

"Image Processing" is an important course in image engineering [3]. As a basic course for the discipline, it is conducted for the third year undergraduate students in our university. To help the teaching and learning, the development of a corresponding net courseware has been taken. Three key factors in developing such a courseware are the content selection, the courseware structure, as well as the interface and web-page layout.

The construction of web courses should take into consideration, besides the general pedagogical demands, the particularity of course and learning style, satisfy the condition of operating with the help of Internet, and profit from the advantage of a network environment.

The rest part of this paper is organized as follows. Section 2 introduces the selection criteria in choosing the relative contents. Section 3 gives the framework for organizing the contents and media in the courseware. Section 4 provides a number of typical web-pages in courseware to show the layout and form of interface and contents. Finally, Section 5 summarizes the good points of the courseware.

II. CONTENT SELECTION

The content of courseware is the core of the courseware. Some criteria should be respected. The current trend in the development of discipline under question should be reflected in selecting the sources of information. The courseware should cover the subject matter of the course. In one side, it should correspond to the substance in the textbook. On the other side, it should be complementary to the contents of textbook.

The selection of contents for this courseware has been made in accordance with the goal and function of this course. As this course is given in campus for full time students with a textbook specially written for it, the courseware is designed as an assistant to help the students for extended self learning and reviewing. The following considerations and actions have been made:

- To help the process of course conduction, the material selected and the script designed should be correspond to the materials in the textbook. Taking this factor into consideration, the number of chapters in the courseware has been made to be equal to the number of chapters in the textbook. In addition, for each chapter, the correspondence between the

sections in the courseware and the sections in the textbook is also maintained.

- There is a significant difference between self-learning and the learning by following lecture. In addition, the first learning and the reviewing after learning are also quite different. Therefore, the courseware should provide some variations and supplements. From one side, the courseware can use its advantage in capacity to provide more examples and even more materials than printed textbook. From other side, based on the existing explanation in the textbook, the courseware can just list the compact definitions for a number of concepts to facilitate the sum up and remember.

- The modern theory for education and psychology emphases on the various learning styles to help acquiring knowledge. It is believed that combining different learning styles would greatly improve the efficiency of learning. Considering this factor, the courseware provides a number of demonstrations for illustrating the procedure and for displaying the process results. Such a dynamic manner provides a vivid impression.

III. COURSE STRUCTURE

The structure of courseware is related to the internal organization of contents. From one side, the structure should match the strategy of education, connect different course and learning parts, and make the study easy. From other side, the structure should fit the network environment and the characteristic of computers.

The contents of courseware are to be organized in modules. In particular, it is better to use knowledge component (KC) as a learning/studying unit, and to arrange contents around knowledge points.

The structure of course has provided a guide to learners. A dynamic and layered structure supporting association of related KCs is important. These KCs should be linked to support cross-reference, which is normally enabled by numerous inter-links between related text notes and demonstrations [4]. However, getting lost in hyperspace should be avoided [5].

The following measures have been made:

- A combination of dynamic tree-structure and graph-structure has been adopted in the courseware. The tree-structure can provide a layered outline for the courseware as well as a fast and logical access route for different branches. The graph-structure can provide a cross-grid relationship for the content, and make the browsing and navigation inside courseware easy and intuitive.

- A module implementation has been conducted for the concrete contents. The section has been taken as the logical module of courseware, which has been named "knowledge component". Each knowledge component corresponds to an independent learning unit, which consists of four groups of contents corresponding to specialized knowledge: the

Concepts (for principles and definitions), the Examples (for processing methods and explanations), the Demonstrations (for dynamic process and result displaying), and the Key-points (for summary and references). Each knowledge group has been made quite independent, to perform connected study.

- The web-page has been taken as the physical unit/module corresponding to the section of courseware. The contents in web-page are arranged according to the lecture/study order. On the web-page, not only some concrete contents are directly shown (for compactly representing the concepts and key-points), but also other related contents (examples and demonstrations) are connected by using the hyperlink functionality of web-pages.

The overall framework of the courseware is shown in Figure 1. It can be seen from Figure 1 that the learners have two choices once getting into the courseware. The first is to select the chapter from the Chapter List, and follow the pre-determined learning order. The second is to go to the classified KC lists. From the outline to knowledge component, a tree-structure provides an access mode like using the table of content in a book. While from the list to learning term, a graph-structure supplies a visit mode like using the index of a book.
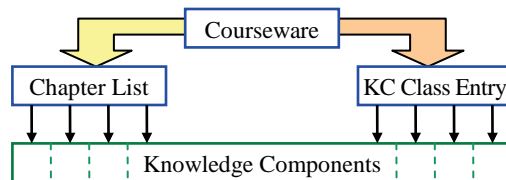

Figure 1. Framework of courseware.

Figure 2 shows the access paths from KC Class Entry to individual KC, via respective lists. All knowledge components are classified into four groups (modules): Concepts, Examples, Demonstrations, and Key-points. The titles of different groups of knowledge components are listed in four corresponding lists. From the concept list, learners can access the definitions of several hundreds of concepts. From the example list, learners can view more than hundred examples with pictures or drawings. From the demonstration list, learners can manipulate a number of dozens of dynamic illustrations. From the key-point list, learners can look over the summary of each section and related reference introductions for further study.
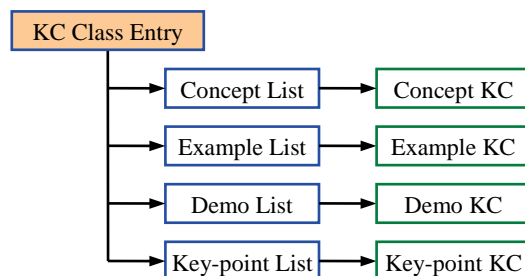

Figure 2. Access from KC class entry.

Figure 3 shows the organization of a chapter in courseware. Getting into a chapter, the summary of this chapter, with four title lists for concepts, examples, demonstrations and key-points in this chapter, is displayed. Beside, a list of sections in this chapter is also provided. A section is a study unit that is formed by a number of KCs arranged in learning order.
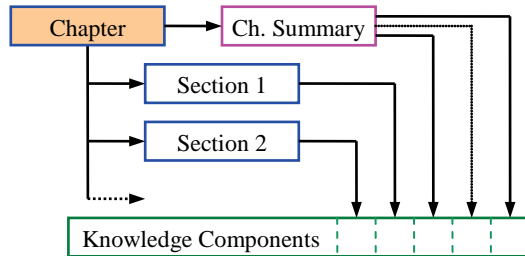

Figure 3.   Chapter organizations.

IV.   INTERFACE AND WEB-PAGES

The interface of net courseware provides a way for communication between the computer and users. The net courseware is composed of a number of linked web-pages, in which the interface for the learners to use the net courseware is resided. The web-pages convey the information to the learners and receive the control from the learners via interface.

Some careful considerations in the design of web-pages are as follows:
- The form and appearance of courseware should take the advantages of computer capacity, provide intuitive visual effect, encourage the participation of learners in the studying procedure, and make the abstract concept more concrete and more visible to help the understanding.
- A flexible and user-friendly interface is an important criterion to judge the usability of courseware. It should provide fast access to different parts of the courseware. To fulfill this requirement, the hyperlinks between the four lists and the study unit have been established as shown Figures 1, 2 and 3.
- Interactivity plays an important role in courseware. Many interactions among different forms, such as image, video, animation, dialog box, have been included. The styles for each knowledge component and the operating interface have been unified.
- In general, different interfaces in the web courseware should be concise (such as the interface layout), uniform (such as the window locations) and easily operable (such as the keys for interaction). Thus, users could be concentrated more on the course contents themselves than on the learning of how to use the interface.
- Dynamic demonstrations are added in courseware, which would be impossible in textbook. Many tools exist, such as Adobe Acrobat, Macromedia FLASH, Microsoft EXCEL, MATLAB, LabVIEW, and WebCT [6]. By considering various factors such as

the security, the data volume, the quality of products, and the effect of demonstration, the demonstrations have been developed with Macromedia FLASH and embedded in web-pages.

Some typical web-pages are given below for examples:
- Web-page for courseware entry (Figure 4)

This page has been divided into three regions: on the left is the table of contents which gives the titles of chapters and sections in order; on the top right are the hot-key for four class lists (Concepts, Examples, Demonstrations and Key-points); and on the low right is the content display region which provides an introduction to the courseware. The top part of Figure 1 is implemented in this page.
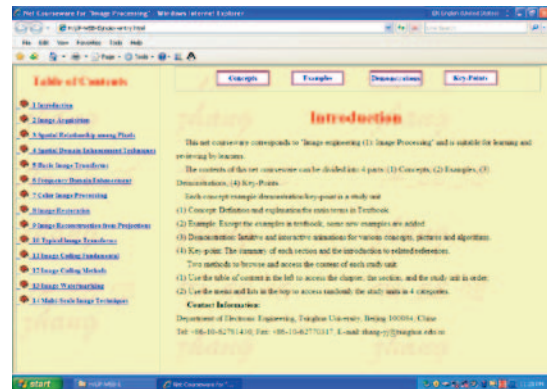

Figure 4.   Web-page for courseware entry.

- Web-page for KC class entry (Figure 5)

This page will pop out after clicking the concept list on the top of the web-page for courseware entry. Such a page displays the list for concept titles (here the list for concepts is an example, similar pages with other lists can also be obtained), and the definition of every concept is linked behind, as shown in Figure 2.
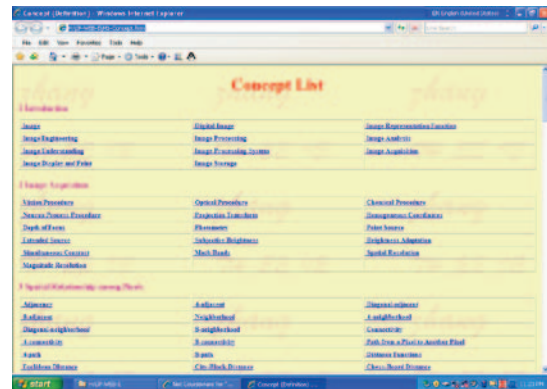

Figure 5.   Web-page for list entry.

- Web-page for chapter entry (Figure 6)

This page appears after clicking the chapter title on the left of the web-page for courseware entry. The region on the low right provides a summary of the chapter by giving the title lists of each knowledge component in four groups. From here, all knowledge components in this chapter can be randomly accessed as shown in Figure 3.
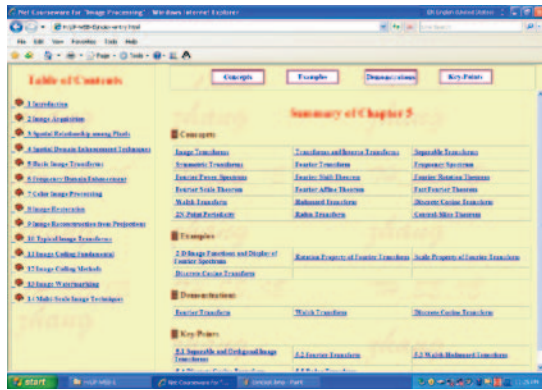
Figure 6.   Web-page for chapter entry.

- Web-page for section and content (Figure 7)

This page appears after clicking the section title, which will appear after clicking the book-logo at the left of chapter title (the closed book-logo changes to opened book-logo) on the left of the web-page for courseware entry. From the section list, a selection of a particular section will provide the contents of this study unit on the low right window (as shown in Figure 3), in which different knowledge components are arranged according to the learning order.
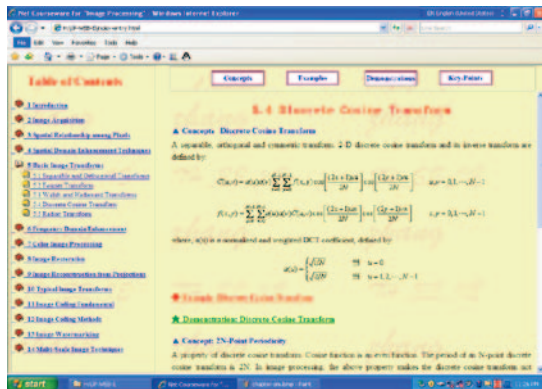

Figure 7.   Web-page for section and content.

Note in Figure 7, the contents of concepts and key-points are directly displayed, while the contents of examples and demonstration will be shown in new popup windows.

- Web-page for examples (Figure 8)

This page will pop out after clicking the example title in the low right region of web-page for section and content. It can also be obtained if one clicks the same title from the example list on the top right of the web-page for courseware entry, or from the example list in chapter entry (see Figure 6). Examples are illustrated by a number of pictures showing the procedure and the result of particular techniques.

It is often said that "one picture is worth more than ten thousand words". Using pictures for teaching and learning image courses has great advantages [7], especially for showing pictures on the computer screen with courseware, as the quality of images is much better than that on the printed textbook, and the details caused by noise and the removing effect, for example, could be readily visible.
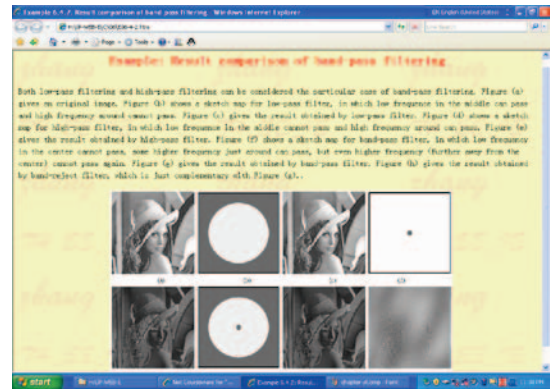

Figure 8.   Web-page for examples.

- Web-page for demonstrations (Figure 9)

This page will pop out after clicking the demonstration title in the low right region of web-page for section and content. It can also be obtained if one clicks the same title from the demonstration list on the top right of the web-page for courseware entry. Demonstrations are made by using Flash to achieve interactivity between learners and the courseware. Figure 9 shows a demonstration for color processing. Learners can use the function keys (forward, backward, circle/rewind) in the low right to control the process order and can also click on the web-pages to start the interaction with the demonstration.
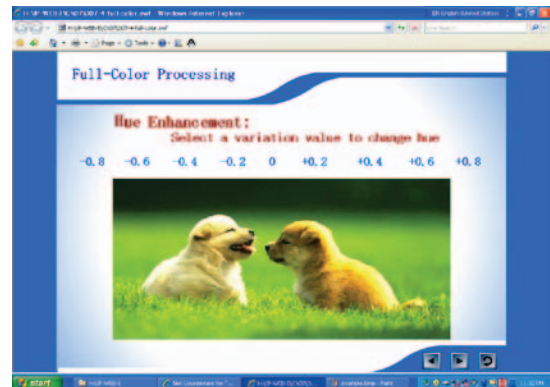

Figure 9.   Web-page for demonstrations.

Various demonstrations have been developed. Some of them display the dynamic drawing procedure; some of them provide the image operation gradually with sequential pictures, and some of them interactively and selectively perform actions according to learner's request. Learners could not only view the middle results but also get more impression on the course and flow. Those demonstrations can be used by teachers on the class lecture and by students after the lecture for self-learning.

V.   CONCLUDING RMARKS

A new net courseware for "Image Processing" has been designed and developed. The three important factors, the selection of content, the course structure, and the interface and web-pages, have been explained in this paper.

The design process was performed before the start of the course, and the development was made in similar pace with the conduction of the course. Therefore, the professor and students have already the chance to use it once and to provide some useful feedback for improvement.

Some feedbacks from students are: with this courseware, they feel that the course and the subject are more interesting, some abstract concepts become easily understanding, and the emphases are simple to catch in the reviewing.

Some feedbacks from teachers, related to students side, are: less students pose questions on the concepts and process of techniques after class, and more students accomplish their homework with more visual forms [7] (some of them are made by students with their own programming) now.

Some good points of this net courseware include:

- Comprehensive contents: Cover the whole textbook and provide complementary information.
- Combined structure: Both layered and cross-linked structures are employed.
- Uniform outer shell: All materials are embedded into web-page and can be viewed by a net browser
- Interactive demonstration: Push learner's learning interests and motivate learner's visualize thinking

The principle and techniques used in this courseware should be also suitable for use in other coursewares.

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