

FROM CONTENT TO COURSEWARE: THROUGH A LOOKING GLASS

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ABSTRACT

We consider the foundation of the courseware development environment to be a resource library. A large-scale, robust resource database with object-oriented subject classification and task-oriented access layers can well address the needs of the main dimensions of courseware design. As a resource library it is to help in the selection and the design of representations, presentations and interactions. In addition to the created and curated object collections, a template library of presentations and interactions is an integral part of the proposed resource library. The courseware development process we followed consisted of the design and implementation of one building block in an imaginary, computer-based, interactive medical teaching system for patient education, a lecture on breast diseases. One result of the analysis of this process is a set of functional specifications for the first iteration of a local resource library. The resource repository (resource library) offers different functionalities during the different stages of courseware development.

INTRODUCTION

Interactive, computer-based lectures are being developed in increasing numbers. The time and effort required to create courseware depends to a large extent on the development environment. The foundation, the information-base of the courseware, is its content. To define the infrastructure or the foundation of the development environment, we first analyzed content creation from a systems point of view. The work on a proposed framework for a 'toolkit system' for CAD [1] inspired us in our analysis of a courseware development process. The process example for our analysis is the development of *InforMed/Patient: Teaching File on Breast Diseases*, a lecture on breast disease.

The creation of content starts with the identification of the concepts and/or concept systems, and their logical network structure. The selection or design of **representations** for those concepts identifies or creates the resource objects that are to be used. The design of the **presentation** specifies the screen or document layout, and the access pathway network, that is, the logical structure of the courseware. Presentation design criteria include the definition of the interactions, and the navigational possibilities between resource objects and between objects and courseware user.

Concept representation design is a process similar to the conceptual, form-generative part of industrial design. To decide in what way to represent the concept system "breast self-examination" is a problem-solving activity. The solution space contains the pieces of descriptive text, image, video, audio, animation or any combination. A solution for the presentation of "breast self-examination" can be thought of as a set of directional labeled graphs where the nodes are representation and navigation elements. The design steps for the creation of concept objects (the representation problem) and the combinations of them (the presentation problem) are very similar in their required tools. It is the material the tools are used on which is different in the two cases.

We go through the abstraction of the design process (assessment-selection, ideation, selection, implementation, evaluation) in order to identify the tools and specify methods. The goal of this phase of our process analysis is to identify the support system needed and to determine what are its required features. To decide whether to create or reuse a representation, we carry out extensive research in order to know what is already created by browsing in the network of resource object depositories (information systems) for courseware object data management. In the ideation phase we sketch, model, and visualize representations and presentations. An integrated, cooperative toolkit environment and appropriate template object data management system should guide the designer through this phase. In the selection, implementation and evaluation steps the object data information system is updated with objects added, or modified as objects are reserved or selected.

RESOURCE OBJECT REPOSITORY

The support system identified in every step of the courseware design and development is an information system for the management of information on object resources. This information is to help with the administration and management of acquired, developed courseware and courseware resource objects. Calling it also a resource library highlights the fact that some of its required features are those of a digital library's. When we use the term resource repository for it, it is to emphasize functional similarities to information warehouses or repositories used in reverse engineering.

The object data are data on resource objects, the representation of their logical network information (topics and their conceptual relationships) and the 'representation of their access pathway' network (to use the terminology of [2]). The

aim of the project is to identify the main functional features in the object data (or resource objects) management independently of particular data models used by specific database systems [3]. The multimedia object data in our development environment are the documents, images, video segments, animations, hypermedia link-object [4], and their associated information.

The information management needs of multimedia requires databases which are built on data types different from the traditional ones (Fig. 1); the multimedia information server system needs a video and a document database in addition to the traditional database.

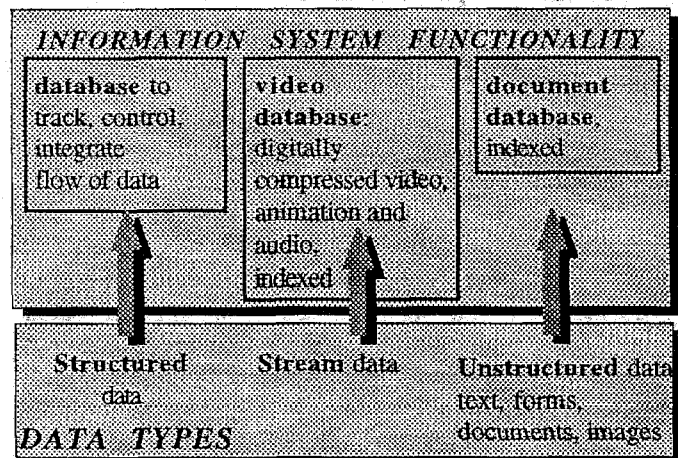


Fig. 1 Managing multimedia resource objects

The resource library is both an author's and a reader's tool. One set of functional requirements on the task-oriented access layers is for browsing methods to retrieve and visualize query results. Another is for the classification, categorization and indexing methods of object data: a group of resource objects (just as a pile of books) becomes a collection only when they are organized, classified and catalogued [5]. A possible approach to the generation of automatic classification is to use a concept space based on co-occurrence matrices. In molecular biology this has proven to be quite effective [6]. A growing and constantly evaluated template library of tests and visual layouts to ease development and strongly suggest guidelines is an integral part of this resource library. We expect such depositories to be created, networked and maintained in different departments, and/or at different universities. The universal structure (and user-interface to the information systems) for coordinated, cooperative courseware development might then be created and maintained via networked object data warehouses or repositories.

DISCUSSION

Some of the greatest challenges of courseware development are content acquisition and content object development, material classification, easy and organized viewing of the courseware structure including the

visualization of hyperlinks, and the change or update of constituent material that is reflected across all or some selected courseware.

As we developed our example courseware using WWW and HTML technology, we realized that we were challenged, or rather limited, in our effort in many ways. We needed to experiment with object selection, object use, with navigation strategy and with the housekeeping strategies of the material. Our attention had to be divided as we entered or left toolsets (drawing/painting to text editor to object listing). That is a problem of tool integration in the development environment.

We intentionally selected an authoring method (HTML) which freed us from considerations of interface and network design issues. It let us explore how to organize the set of accumulated potential content objects, and what information on content and courseware would help us in introducing order to a web of objects and information. One main feature of that order should be the ability to reconstruct (or have access to) the organizational guiding principles. Whence the need to use information systems technology. The prototype object library is to be a subject(project)-oriented information system, and might differ greatly from existing departmental libraries in the metainformation about collections and content. We therefore consider the prototype to be also a model for a data warehouse whereby information extraction is the bridge between the departmental libraries and the data warehouse.

Courseware development is a complex analysis and decision-making process. The resource repository serves to model, map, integrate, condense, and transform object data information; to create a unified view of consistent data for courseware development; to have a historical perspective; and to store at both summary (the developed courseware) and detail (the constituent objects) levels.

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