Developing Web-based Courses on Computing Using a Hypermedia Model

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Since its creation, the World Wide Web opened up the possibilities of global training, which can be accessed by any user, any time, and in any location. This circumstance has determined the development of a lot of courses teaching multiple subjects and using the web as a delivery medium. Web-based courses have been classified (Steed 1999) into three general categories: text and graphics courses, interactive courses and interactive multimedia courses. Most of the current courses fall into the first category and they are close to the traditional book-based courses. Second category shows the importance of interactivity as a way for engaging the user's mind and stimulating the learning. The introduction of multimedia elements in the third category adds richer resources for enhancing the effectiveness of the user learning.

The development of web-based courses in areas such as Computing and other technical subjects shares previous features. Most of them have been developed as a support or a complement for the traditional book-based courses. They are oriented towards university degree students and in this context, it is not frequent the use of specification and design methodologies so the resultant application is hard to keep updated or being reused. However, the topics taught in these courses are associated to complex technologies that combine a lot of concepts that can be viewed from different points and accessed through multiple paths. Hypertext models are good candidates to represent these units of information and their links, but they are unable to describe contents of multimedia information and their temporal and synchronisation relationships.

Furthermore, computing courses have experimental and technical features that make interesting the deployment of interactive and multimedia resources as components of the course. More advanced courses introduce this type of resources such as simulations, access to remote laboratories, graphic animations, virtual reality scenarios, ... Such resources enhance the description of a topic but introduce more complex relationships as well. In this context, hypermedia models provide a powerful way to represent this kind of resources and also to model sophisticated navigational capabilities.

There are several hypermedia models but most of them are limited to specific authoring or programming tools. Other models cannot be used to define some features of hypermedia applications such as the heritage of common characteristics between elements of the model or the creation of dynamic links. The current paper proposes the use of Labyrinth hypermedia model (Diaz et al. 1997) for specifying web-based courses on Computing.

An abstract model like Labyrinth is a powerful tool for designing hypermedia applications such as a web course. It provides an unambiguous description of the static components of a multimedia course as well as the definition of the dynamic interactions between these components. The Labyrinth model represents a hypermedia application by means of a Basic Hyperdocument. In addition, each user or group of users can have a Personalized Hyperdocument in which users can adapt or modify the components of the Basic Hyperdocument to their own requirements (e.g. student's knowledge in order to get an individualized learning). The Basic Hyperdocument is composed by the following elements: Users, Nodes, Contents, Anchors, Links, Attributes and Events.

A contribution of the paper is the management of active contents such as simulators and other program based resources, within the Labyrinth model. This includes the management of events to obtain relevant information related to the use of these resources.

In the context of Computing, an example of hyperdocument has been generated to show its application to the topic described above. It is part of a distance learning project at the School of Computing in the Universidad Politécnica de Valencia. Fig. 1 shows the distribution of elements in the hyperdocument example having a root node ("Introduction Node") which presents the basic concepts of the Memory Management. The first part of the node includes a special type of content (contextual), called "Introduction guide" that acts as the plot of the remainder of contents. The next content is a definition of the memory concept from an operating system point of view. It has attached a graphic animation content that shows a graphic and interactive view of an example of memory area.

Fig. 1.- Example of hyperdocument.

The paper also presents a design strategy to create web-based courses from a hypermedia specification. To date web application development has been focused on the tools and little attention has been paid to the development process itself. In (Fraternali 1999) there is an overview of tools for web development, mainly oriented to data-intensive applications. Other approaches such as the presented in (Conallen 1999) intend to model a web application using a formal notation (e.g. UML). For web applications, there is an object oriented model called DOM (Document Object Model), which is becoming a web standard [http://www.w3.org/DOM/].

The option chosen here is the use of the DOM as the basis to implement Web-courses. Its main purpose is to define "a platform - and language neutral interface - that allows programs and scripts to dynamically access and update the content, structure and style of documents". DOM can use HTML to represent most objects of a Labyrinth course specification. However, the HTML format imposes the presentation aspects when the course document is browsed. In order to separate the course contents from the visual presentation of these contents, a language such as XML (Extensive Markup Language) can be used. XML allows the author to define his own tags and his own document structure. This aspect is fundamental in the course design because in this context, there are multiple sources of information each one with its own structure and characteristics. Some of these sources can have a predefined syntax.

In this work, one of the main contributions is to show how to translate the Labyrinth entities to a model like DOM based on entities such as Document, Nodes, Elements or Attributes.

The main problem to apply these design and implementation strategies is the lack of tools to support them. Future works plan to develop this kind of tools.

0.1 References

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