A Design of Subject Model for Web-based Education System

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Abstract

With the rapid growth of the Internet users and its applications there has been considerable interest in Web-based education systems that facilitates distance education. In this paper, we propose a Subject Model for Web-based Education system. The designed model uses a tree with multiple links. Each link weight has been derived from the conceptual relations, among the concepts of the subject. The designed modular tree with multiple conceptual links was very useful in guiding diverse students through the courseware.

1 Introduction

The Internet is the largest, most powerful computer network in the world. As more and more colleges, universities, schools, companies, and private: citizens connect to the Internet either through affiliations with regional not-for-profit networks or by subscribing to information services provided by for-profit companies, more possibilities are opened for distance educators to overcome time and distance to reach students. With access to the Internet, distance educators and their students can use: Electronic mail (e-mail), Bulletin boards, World-Wide Web (WWW). When using the Internet for educational purposes, there is no difference between local and distance education. The classroom becomes a virtual classroom and the location becomes transparent structure. Intelligent Tutoring Systems have opened the way for the emergence of Web-based Adaptive Educational Systems (AES). The classification of AES based on [1] their goal, is due to: Curriculum Sequencing (or instructional planning), Intelligent analysis of student solutions , Interactive problem solving support, Example-based problem solving, Adaptive presentation [2] technology, Adaptive collaboration support . Adaptive navigation support technology is to support the student navigation and orientation in hyperspace by changing the appearance of visible links. In particular, the system can adaptively sort, [3] annotate, or partly hide the links in the current page to make easier the choice of the next link to proceed.

Adaptive Web-based Education Systerns usually enable content and navigation adaptation, by altering the link structure and the node contents of the hypertext that contains the educational material. Hypertext is a promising means for constructivist learning, but its use poses problems that require curriculum sequencing, adaptive presentation and adaptive navigation AES. Such hypertext-based systems allow moderation of user-control versus user guidance in navigation and provide for better user orientation. Furthermore, ill-structured domains pose several important problems that are hard to solve for systems that provide problem-solving support and analysis of student solutions. Domain modeling should be based on flexible knowledge structures and incorporate concept dependencies. However, the issue of effectively establishing non-taxonomical concept relationships is hard to resolve. Detailed information on the user is required. In the following section we present, a Web-based system architecture. Section 3, explains a proposed Subject domain model. Simulations are presented in Section 4. Finally in Section 5, we present the conclusions.

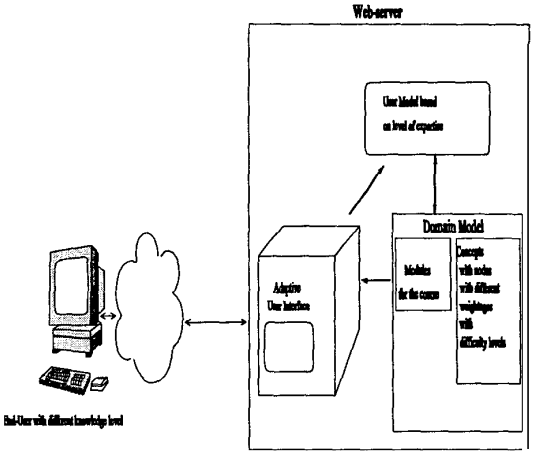

Figure 1. Web-Education Architecture

2 Web-Education Architecture

The components of web-based architecture are shown in Figure 1.

The components are:

- Adaptive User Interface.
- User Model.
- Subject domain Model.

Adaptive User Interface: The user logs on to access the course material through the web server, which launches adaptive interface. Adaptive Interface then accesses the database containing the user model and domain models, selects the appropriate information for this user according to his/her user model and returns the information to the user via web server.

User Model: The user model **[4]** deals with knowledge about each module. User knowledge level is analyzed and User model determines the module and the concept available to each user. If the knowledge of the user is superior to the weightage of the module and concept, then user is presented with appropriate module and concept relavent to user's knowledge level.

Subject domain Model: Structure of the subject domain depends on weighted links which are organized as set of Modules associated with relevant concepts. Student should have at least minimal expertise to access certain modules. We explain our approach to adaptive web-based courseware by means of an example courseware on "Communication Protocol", so that a student can easily find the most relevant information depending on his/her needs.

2.1 Some of the existing Web-based education systems.

Web-based AES inherits from two earlier kinds of AES: intelligent tutoring systems . (ITS) and adaptive hypermedia systems. Traditionally, problems of developing AES were investigated in the area of intelligent tutoring systems [5]. ITS use the knowledge about the domain, the student, and about teaching strategies to support flexible individualized learning and tutoring. Adaptivity was one of the goal features of any ITS. Existing adaptive Web-based systems can be divided into three groups: adaptive information systems which serves personalized information online like AVANTI [6], adaptive filtering systems which helps user to find relevant "drops" in the ocean of available information like ifWeb [7] and adaptive educational systems. AES is the biggest group: more than half of the existing adaptive Web-based systems are AES. Number of existing Web-based AES such as ELM-ART, CALAT, WITS or Belvedere were developed on the basis of earlier standalone ITS.

3 Proposed subject domain model

In this section we discuss the design of the subject domain model for web-based education system. The design is based on the module prioritization scheme. The given subject or topic may be divided into a set of Modules. The modules are interlinked based on the subject material placements in each of the modules. Each module is further divided into a set of associated concepts.

3.1. A Method of subject classification

The placement of subject material in the database is an essential, so that a student can easily find the most relevant information depending on his/her needs relevant to his knowledge level. Psychological models often mention three sources of knowledge competent teachers use. First, the teacher is an expert in the subject matter (e.g., he/she knows about the concepts of the domain and their interrelation, is able to criticise solutions of problems, answer questions, give examples, and far more). Second, teachers know how to teach something (e.g., they use strategies to teach a concept, they know when to use a certain teaching material or presentational method). Third, teachers build a model of the students' knowledge. This allows teachers to adapt their teaching methods to different students or groups of learners. Basically, the knowledge base is built on a conceptual network with different types of units which are lessons, sections, subsections, and concepts. Several types of information are associated with each concept. Besides, each unit has prerequisites (units that the student should be familiar with before working on the unit), and consequences (possible outcomes and effects on other units). The tests and prerequisites are weighted according to their importance for a unit. Integrating interactive tests in a WWW learning environment is one more valid way of getting information about the learner's knowledge. The diagnostic component stores the knowledge about several types of tests. Each test in the test base can be connected to multiple concepts, rated on difficulty and on relevance for a concept. Depending on the difficulty and the relevance of a test, a student's solution has different impacts on the learner model. The learner model stores the preferred settings of a learner and the domain units a learner worked on. Teach texts: With every concept a teach text with three levels of detail is defined. The first level contains only basic information about a concept. The second level explains some concepts used in the first stage in more detail and the third stage gives detailed information and advanced hints. Structure tests to represent an appropriate degree of difficulty, in terms of degree of comprehension:

- Basic knowledge (facts, definitions, identify concepts and/or ideas studied- 70%.
- Application of concepts and lor ideas in situations nearly identical to examples worked on in class or in homework - 20%.

- New applications or uses of concepts and/or ideas, or their use in situations previously unseen (tests for thoroughness of understanding 10%.

3.2 Weights of subject modules.

Generally given topic or course may be divided into set of Modules. Let S be the course which is divided into m modules, **S** = (M_1 , M_2, M_3....M_m). These modules has been interlinked, based on the subject material placements in each of the module. The modules are arranged in the order of degree of difficulty. $D_D(M_1) < D_D(M_2)$.....$< D_D(M_m)$, where D_D is degree of difficulty of the module. The degree of difficulty of a module can be given as weight, $W_i = x*i$, $i \in 1....m-1$. Where value **x** depends on the level of difficulty of the modules, that may vary from 10 for high school level, 20 for graduate level, 50 for post graduation level and so on. The interlinked weight increases **as** the modules gets more advanced. All the subject modules have been placed in ascending order are interlinked. For example, let subject **S** has **4** modules, S= {M_1 , M_2, M_3, M_4} and the: subject domain model is build at the post-graduate level, then the weights of modules, M_1 , M_2, M_3, M_4 are W_1=50, W_2 =100, W_3=150 and W_4=200 respectively.

3.3 *Module-concept relation*

Each of the modules of *S* are further classified into the set of concepts where the concepts and its related description along with example has been furnished. For example, Let M_i be divided into K_i number of concepts, then M_i = $C_{i1}, C_{i2}, ...C_{iKi}$. The interrelated association among the concepts are based on priority in which they will be displaced or transfered to the users for their access. The concepts of a module have been interlinked based on the degree of difficulty of the subject material in the concept. The degree of difficulty of a concept is calculated ***as*** follows:

$C_{wij}=B_{ij}+A_{ij}+N_{ij}$

Where B_{ij}=basic knowledge content coefficient of concept j of the module i. A_{ij}=Application coefficient of concept j of the module i. N_{ij} =New applications coefficient of concept j of the module i.

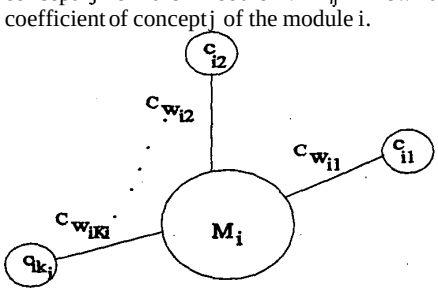

Figure 2. A Subject Module M_i with its associated concepts.

Module and its concepts relation linked with help of conceptual weights are depicted in figure **2.**

3.4 ***An*** *example*

In this section, we illustrate theoretical subject domain module for placing subject material Web-based Education as discussed in previous sections. A subject **S** is divided into modules and each module is further classified into set of concepts .

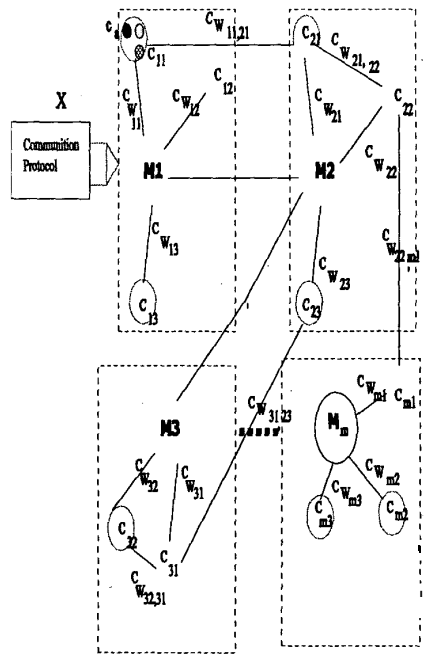

Figure 3. Hypothetical course model.

Intermodule relation and inter-conceptual relation as been set up based on the order in which material to be presented to the users. We have chosen multi-link conceptual graphs for the placement of entire subject material S. Figure 3. illustrates a conceptual graph for the hypothetical course S. When the user visits the Module M_i having weightage W_i, that is relevant to his knowledge level, and tries to access Concept, C_i, appropriate node designed for his knowledge level using adaptive navigation technique [8] is presented to him. This navigation is not in the preview of this paper.

4 Simulation

We have considered the subject material of communication protocols to construct the domain model. Figure 4. describes the modules of the course and Figure

5. clearly indicates Conceptual tree [9] meant for diverse users based on their knowledge levels .

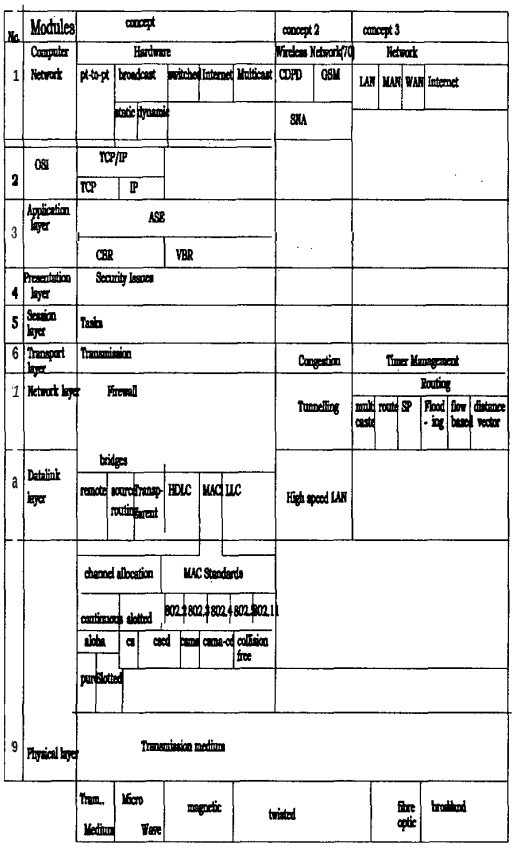

Figure 4. Modules and concepts of the subject: Communication Protocol.

Subject domain model for Communication Protocol course has been prepared based on degree of difficulty of the modules and concepts [10][11] based on degree of difficulty of the modules and concepts. The Simulation program was developed by using Java for computing the weights of the modules as well as concepts. The subject contents of modules and concepts with interlink information has been optimally placed in the multilink conceptual graphs as shown in Figure 5. The entire course material occupies around 100 Kilobytes storage space. The goal is to achieve better performance that **is** suitable for diverse users.

5 Conclusion

A prototype design of Subject model for Web-based Subject Material has been presented. Design structure allows the diverse users to offer relevant navigational possibilities. The designed modular tree with multiple conceptual links were very useful in guiding diverse students through the courseware.

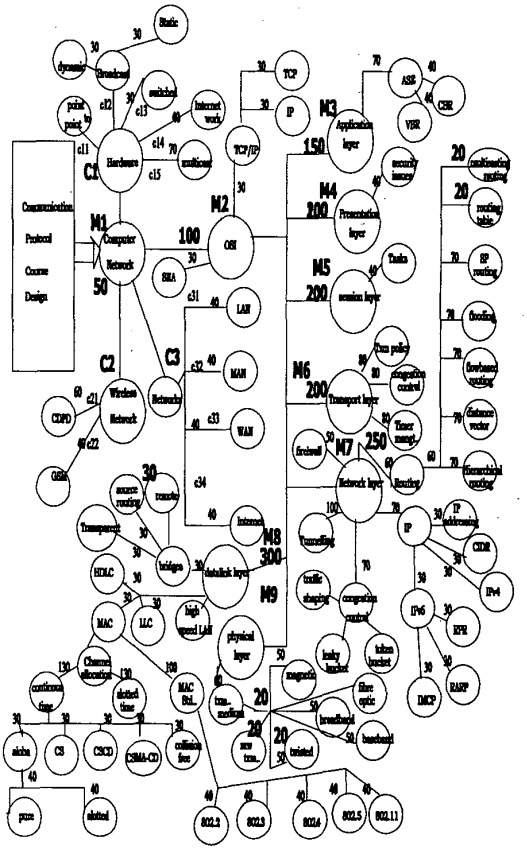

Figure 5. Communication course design model.

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