

Applying Weighted Learning Object to Build Adaptive Course in E-learning

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Abstract: This research focuses on learning path selection – a part of work in my doctoral research whose goal is to develop an adaptive hypermedia. To generate adaptive learning path for each learner, we base on learner's profile in which learner's model is evaluated as well as stored. We have supplemented some attributes of learning object as well as a set of weight for each attributes of learning objects which is basic for selecting learning path process. In this paper, we promote a method to select learning object in order to create learning path for each learner and summary our experiment results.

Keywords: weighted learning objects, learner modeling, and adaptive hypermedia.

Introduction

Adaptive course content is an important phase in many processes to build adaptive hypermedia system. Based on evaluated results of learner's features such as goals, knowledge, background, hyperspace experience, and preferences, adaptive learning path will be created for each learner. There are many methods as well as techniques to build adaptive hypermedia system [1] such as, but a little research is focusing on learning object selection. Some latest research's, for example, an algorithm for shortest learning path selection only based on time to finish the course was promoted [5]. Also based on this algorithm, adaptive learning objects sequencing have been addressed [4]. In addition, focuses on rating as well as selecting learning object has obtained results [2, 3].

In this paper, we address the problem of selecting learning path which is based on all learners' features (stored in learner's profile). The main part of the paper describes framework of my adaptive hypermedia system as well as how to select learning path. In this paper we also describe work in progress and methodology. The final part discusses our results, some unsolved problems and proposed future work.

1. Framework

1.1 Background

There are five features used by existing adaptive courses: user goals, knowledge, background, hyperspace experience, and preferences. User goal or user task is a feature related with the context of user work in adaptive course systems rather than with the user as an individual. It is a problem – solving or learning goal in educational systems. User knowledge is variable for particular user. This adaptive system which is relied on user knowledge has to recognize the changes in the knowledge state and update the user model accordingly. User background is all the information related to the user previous experience which is outside the subject of the adaptive course system. This includes the user profession, experience of work in related areas, user point of view and perspective. User experiences in the given hyperspace are how familiar with the hyperspace structure the user is and how easily user can navigate in it.

1.2 Adaptation methods

Hiding some information about a particular concept which is not relevant to the user knowledge level is the goal of most popular content adaptation method. Besides basic method, two other methods, prerequisite explanations and comparative explanations, change the presented information about a concept according to the learner knowledge level of the related concepts. The first method is based on prerequisite links between concepts. In this system, before presenting an explanation of a concept, the system inserts explanations of all its prerequisite concepts which are not sufficiently known of the learner. The second method is based on similar links between concepts. If a concept that is similar to the concept being presented is known, the user gets a comparative explanation. In addition, the explanation variant method is used to store several variants for some parts of page content and the learner gets the variant corresponding to his model.

In our approach, we combine some methods mentioned above into adaptive course. We use basic method to hide some learning objects which do not correspond with learner. We use prerequisite explanations as well as comparative explanation to supplement adaptive content in the courses. We use explanation variants to choose matched learning objects for each learner.

1.3 Adaptation techniques

There are some techniques for adaptation, some popular of that are adaptive presentation and adaptive navigation support. The former technique uses adaptive multimedia and adaptive text presentation. The later uses direct guidance, adaptive sorting of links, adaptive hiding of links, adaptive annotation of links, and map adaptation. In our approach, we use adaptive navigation supports, special links on local maps and links on global hyperspace maps. Maps usually represent a hyperspace or a local area of hyperspace graphically as a network of nodes connected by arrows. Using maps, the learner can directly navigate to all nodes visible on the map just by clicking on a representation of the desired node. We describe course content as maps or graph, nodes of the map are learning objects that learner can learn.

1.4 Learner Modeling

In this adaptive course system, to adaptive content that is suitable for each learner, must be based on learner model. This is collecting data as well as information about the learner when he or she participating the course. In our research, we mean all of information and data related with learner before as well as in process that learner participates the course. Learner model is frequently updated through the course. Learner model contains some attributes supplying information and data to processing adaptation. Those attributes can be extended to correspond with strategies as well as course targets.

1.5 Our Framework

Based on method and techniques of adaptive hypermedia as well as learner model concept, our designed model includes three modules: learner module, content module and view module. The first module manages learner modeling as well as profile of them. The second module generates suitable learning path for each learner based on learner's profile. The last module represents suitable course outline for each learner. In our model, learner's

profile is always updated so the course content as well as structure adaptive through the course [6].

To make a good adaptation through the course is not only in the first phase but also in the whole of the course. In our model, we mean that all information of learner is updated automatically in learner profile through the course, so the content of the course can change dynamically, the entire time learner participating in, according to learner demand, goal, background, and knowledge. To start the course, learner must login, when learner login successfully, he had an ID which is a number to identify him all time. To get information of each learner, we use questionnaires and tests.

Questionnaire is used to get some learner general information about the course that he intend to participate in. That information includes strategies, prefers, goals of learner such as browse content of the course top – down or bottom – up, browse some section of the course beginner, intermediate, advance, etc...

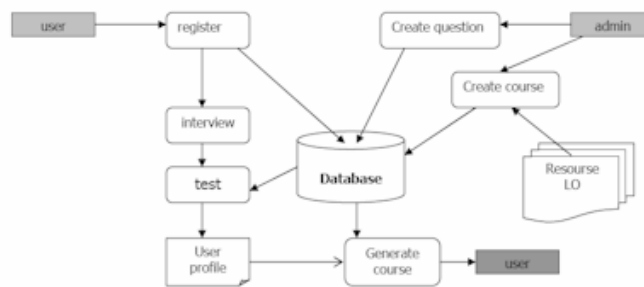


Figure 1. Adaptive course model

Test is designed to get learner data about course content , this data is based on our system generate dynamic content of the course all time to adaptive with each learner. Our test process is divided into some parts: pre – test, test after each sections that learner have browsed and post – test. The result of those tests is stored in learner profile, this is updated automatically. Each test includes some questions which is set of value for each answer. All value is evaluated to create a threshold that is stored in learner profile and is a foundation to generate adaptive course.

After the learner take the test, automatically the course is built with content and structure suitable for learner. However, the content and structure of the course is continuing for following sections based on result of the next test after each section. So course content and structure change dynamically all the time. The features of our model are the learner profile which continues to be updated automatically all the time learner participating so the course is also continuing to be automatically updated content as well as structure for each phase in the course. However, if learner wants to learn the course following his manner, learner can browse the content that he wants. It is flexible for learners to browse the course on their demand. In addition, our model is designed to support learners who can browse the course following knowledge – paced model. It means that if learners pass the test of a section, they can bypass content of that.

2. Work in Progress

Our model includes three main phase to generate adaptive course. The first phase is evaluating learner process, the second phase is selecting course content suitable for each

learner corresponding with learner modeling and the last is select view model of course for each learner.

In this phase, we focus on designing the content module. The main point is learning path generating process.

All content of the course includes many learning objects. Course structure is presented as a graph in Figure 2 with nodes corresponding with LO or set of LO. This LO set can be classified into two categories: Mandatory Learning Objects (MLOs) and Secondary Learning Objects (SLOs) [6].

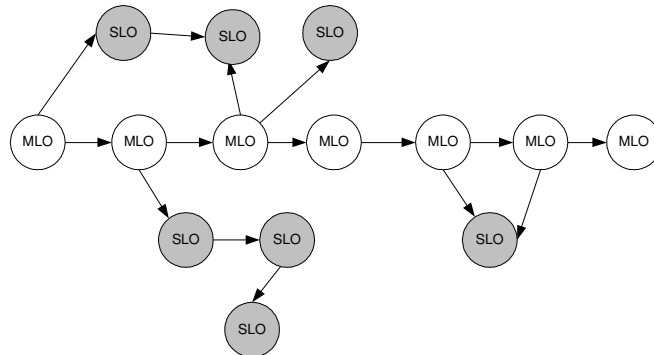


Figure 2. Course structure as graph

To do this, the course’s material such as text, images, video is stored in learning object database. We supplement some attributes for each LO, at this time we added seven attributes. With each attributes we assign a value of [0, 1] so each LO has set of value correspondingly.

We use a table to all LO with attributes and values of it shown in Table 1. The columns represent attributes, each rows represent an attribute value of each LOs in databases. With a new attributes, the table is added a column. It is the same manner, if it has a new LO in the database, the table is added a row. This represent is flexible so it can help course designer or administrator extend easily.

Table 1. Learning Object Attributes

STT	Learning Objects	Difficult	Total time	Request	Require	...
1	LO_1	0.5	0.4	0.3	1	
2	LO_2	0.2	0.3	0.2	0.7	
3	LO_3	0.3	0.2	0.5	0.2	
4	LO_4	0.2	0.1	0.4	0.3	
5	

To select learning path, we use a function to evaluate learning object based on value of its attribute. Based on function result – a threshold, the LO will be selected or not.

Let us consider a set of learning objects which is valued by a set of attributes $v = (v_1, v_2, \dots, v_n)$. To evaluate learning objects leads to the aggregation all of attribute into a unique criterion that we call suitability function: $S(v) = S(v_1, v_2, \dots, v_n)$. We define the suitability function as additive function of the form $S(v) = s_1(v_1) + s_2(v_2) + \dots + s_n(v_n)$ with:

$S_i(v_i)$: Marginal suitability of the i^{th} selection attributes value v_i
 $S(v)$: Global suitability of a learning object

This process also includes the evaluation. Some advantages of this design are considering many aspect of the learning object to evaluate so the selection is better than using separate LO attributes. In addition, using a little attribute of LO (around 20 attributes) satisfying real – time selection. The disadvantage, however, selected LO can not match with learner’s profile in some case because using all of LO attributes. We will improve the select function and can use open learner modeling so learners can adjust learning path themselves based on automatically generated learning path.

3. Our Experiments

We built a course to teach C++ programming techniques. The course is a web - based application so learner can participate in via Internet. In this system, we have built some modules. Administration module manages learner profiles, questions, and test results. Course generating module chooses LO that has value in the threshold from database. It will create a XML file. Course view module reads the XML file to view the course in the browser as tree structure including nodes and links to the content.

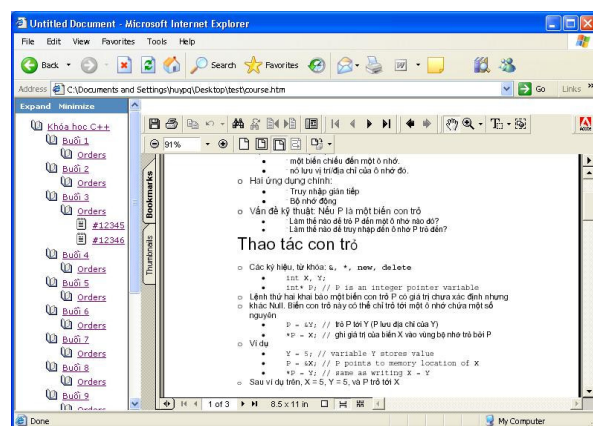


Figure 3. An adaptive C++ programming course

4. Methodological issues

In this area, alongside work previously completed, there is a plenty of literature available from consolidated domains such as Adaptive Hypermedia, Learner Modeling, Knowledge Management, and so on. The project will resource to diverse methodologies, considered suitable for its different features: action–research, case studies, probability statistics model and so on. A prototype system will be developed which will aim to generate a course for learners based on their modeling that used learner modeling theories. Probability statistics model will be used for assigning value for LO. Using Bayesian Belief Networks to decide LO will be selected or not. The test result of system will be interpreted, and recommendation set will be developed.

5. Conclusion

This research focused on learning path selection work which based on weight learning object and learner's modeling. To select object, we use a function to evaluate learning object. The learning path for each learner base on result of function as well as learner's modeling stored in learner's profile. With supplementing some attributes for learning objects, the learning path is suitable enough for learner participating in. Our project is still at an early stage, we are now improving the select function in order to choose LO which will meet all learner requirements. By the time, this conference takes place we believe there will be some new results to share with the audience.

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