Adaptivity in Web-based Educational System

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Abstract

The paper discusses an implementation of adaptivity and intelligent technology in the TILE project, which is researching, evaluating and developing an integrated system for education at a distance, with powerful adaptivity for the management, authoring, delivery and monitoring of such material.

Keywords

Adaptivity, Web-based educational system, Student model, TILE

1 Introduction

It is well known that one of the characteristics a WWW based educational system should have is *adaptivity,* i.e. the ability to be aware of user's behavior so that it can take into account the level of knowledge and provide the user with the right kind of documents (Barra *et al.*, 1999). We are applying adaptivity and intelligent technology in the TILE project at Massey University. The TILE project is researching, evaluating and developing an integrated system for education at a distance.

2 Adaptation in Web-based Educational Systems

Although a number of attempts have been made to implement the concept of 'adaptation' in learning systems (e.g. Crampes, 1999; Oppermann & Specht, 1999), there have been no significant attempts to provide adaptation in web-based education.

If web-based systems do not exploit their full potential, in particular, the facilitation of dynamic interaction, they are no more than a repository of information, replacing the disk space on stand-alone computers or hardcopies in traditional distance learning scenarios. The dynamism in the system requires consideration of following criteria (Kinshuk et al., 1999):

a. adaptation with respect to current domain competence level of the learner;
b. suitability with respect to domain content; and
c. adaptation with respect to the context in which the information is being presented.

The fulfilment of these criteria requires the development of a student model, which captures the interactions of students with the system to extract information about their competence level for various domain concepts and tasks represented in the system.

3 Adaptivity in TILE environment

The technology integrated learning environments (TILE) project at Massey University is researching, evaluating and developing an integrated system for education at a distance.

In web-based systems, the interactions between client and server normally take place using Hypertext Transfer Protocol (HTTP). HTTP is a stateless protocol, which makes it difficult to track the students progress and hence to analyze the mental processes of the student (Kinshuk & Patel, 1997). However, using a judicious mixture of SQL and HTML protocols, we can be more precise about browsing behaviour. Since part of the student model resides on the server and part on the user's machine, off-line adaptation with intermittent update of server side student model as and when possible has also become a possibility.

The TILE system models individuals and classes of users (extracted by a cumulative analysis of the individual student models) to maintain *individual student model* and *group student model*.

3.1 Individual student model

Individual student model allows adaptive behavior of the system by providing information about the learner. The student model contains granular information about student's competence level for various domain concepts and tasks represented in the system. The student model is based on overlay model. It is simple in construction but is quite detailed to facilitate rapid updates and better context sensitive guidance. It contains four main components:

➢ Global preferences of the learner (behavioral component): the global preferences are applied to the whole system.

- Specific content presentation related preferences of the learner (behavioral component): it is applied to specific contents.
- Domain competence related information about the learner (domain based component)
- Student's working history with annotated system feedback (only in problem solving scenarios, for the problems which have sequential processes)

Individual student model is always updated by:

i. learning criteria fulfillment: ready for problem solving (assumed model)
ii. problem solving: full grasp of domain content (definite model)
iii. stereotypes in domain content: (assumed model)
iv. changes in weight factor in particular learning units due to student's progress in other learning units within the system: (assumed model)

The individual student model is used by the system primarily:

i) to provide adaptive navigation guidance - based on prioritized successors and learner model
ii) to select coarser/finer granularity of domain content
iii) to provide context based excursions to other learning units
iv) in making analogies with previously learnt material
v) in making direct references to previous learnt material
vi) to provide dynamic messaging and feedback, for example:
   a) navigation related system messages
   b) content related system messages
   c) dynamic progression recommendations based on learner's domain competence and current context

3.2 Group student model

The system summarizes students' common behavior and preferences to create and maintain the group student model. Student using the system are categorizes into different groups by matching their behavior and domain competence with that reflected by a certain group student model. The structure of the groups is multi-dimensional; one student can belong to one or more such groups (say in a *serialistic learning style* group and in an *active learning* group). The mutuality of the group student model and the individual student model highly improves the effectiveness and accuracy of TILE system's adaptivity. It also offers more reasonable default setup and help for newcomer individual students.

The group student model contains attributes such as (based on the data collected over a certain number of students):

- Common mistakes/errors made by certain number of students in problem solving
- Certain common behavior of a number of students

- Common preferences of a number of students during study and interaction with the system

The update of group student model takes place at every startup of the program.

4 Conclusion

We believe that the future of education, not only within continuing education, will more and more be reliant on web-based, on-line educational material. The TILE project has a major thrust at providing an integrated system for the management, authoring, delivery and monitoring of such material. It is based on a sound research foundation and is being developed in a manner that provides simple-to-use interfaces in order to reach out to the educators in developing archives of indexed material that may be accessed adaptively by the students in the same way as they would interact with a tutor or mentor.

Reference

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