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A DYNAMIC COURSEWARE GENERATION FOR WEB-BASED INTELLIGENT TUTORING SYSTEM: AN OVERVIEW

Dr. Prasanna M. Hasabnis

Assistant Professor, Department of Computer Science& Engineering, Mauli Group of Institution's College of Engineering & Technology, Shegaon, (M.S.), India

ABSTRACT

With the initiation of Internet and porting of intelligent tutoring systems on the web, a variety of web-based intelligent e-learning systems have developed. However, these web-based intelligent e-learning systems have been used according to the needs of a specific domain or domain independent. Web-based intelligent e-learning systems are increasingly popular due to their appeal over traditional paper-based textbooks. Web courseware is easily accessible and offers greater flexibility through the internet, that is, students can control their own pace of study and do not depend on a teacher's presence and rigid classroom schedules. Unlike printed textbooks, Web-based e-learning systems can integrate rich multi-media and interactive elements, such as audio, video and animation to make a point. Web-based intelligent e-learning systems can add hyperlinks to allow students to click on a link on one Web page and immediately be transferred to another page or to other relevant sites.A course generator provides personalized learning experiences by accumulating structured sequences of learning objects that help learners to accomplish their learning goals. They can be stored in a multitude of repositories and are selected by the course generator based on a set of pedagogical methods that take into consideration the learners' goals. It generates an individual course according to the learner's goals and previous knowledge of the learner and dynamically adapts the course contents according to the learner's success in acquiring knowledge.

Keywords: *Intelligent Tutoring System, Web-based Intelligent Tutoring Systems, Dynamic courseware generation.*

I. INTRODUCTION

Intelligent Tutoring Systems are built on a fairly well well-known architecture, which relies on four interconnected modules:

1. Student Module
2. Pedagogical Module
3. Domain Knowledge
4. Interface Module.

This Paper is organized as follows: Section 2 defines intelligent tutoring system along with their components in brief. Section 3 briefly describes web-based intelligent e-learning systems. Section 4 discusses the dynamic courseware generation along with the current research work carried out all over the world. Section 5 concludes with the conclusion.

II. INTELLIGENT TUTORING SYSTEM

Intelligent Tutoring System-ITS (also called Knowledge-based Tutors) is computer-based educational system that agree for emulation of human tutor. Intelligent Tutoring System used artificial intelligence techniques that can determine what to teach, how to teach and learn certain teaching relevant information about student being taught. This requires the representation of a domain knowledge (called the Domain Knowledge) instructor's or teacher's knowledge (called Pedagogy Module) and the student learning state (called the Student Model. Through the

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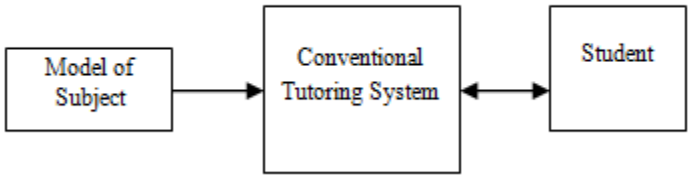
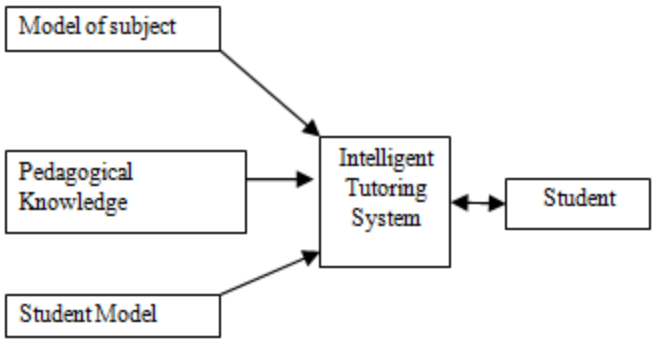
interaction of these models, an ITS is able to make judgments about the learners understanding level as well as progress. Instructions can then be personalized by the Pedagogy Module according to the student's requirements, automatically, without the involvement of a human instructor.

ITS is more intelligent than other conventional tutoring systems such as Computer Aided Instructions (CAI) and Computer Aided Learning (CAL) that are lacking "the flexibility and learner-centered orientation of ITS". ITS add "a dynamic and adaptive dimension to self-paced instruction"(In addition to the model of the subject domain found in conventional system, an ITS also includes pedagogical knowledge and a model of the student's knowledge level and understanding.) Figure 1 shows the difference between a conventional and an Intelligent Tutoring System



Conventional Tutoring System



Intelligent Tutoring System

Figure 1: The Conventional and Intelligent Tutoring System

The goal of ITS is to provide a learning experience for each student that approaches the standard of learning -that he -or she would receive in one-to-one tutoring from an expert teacher equipped with all necessary training aids. To achieve its goal, ITS monitors each student interactions, and builds a Student 'Model for each individual. This model comprises the student performance on training and remediation exercises; knowledge of all the information and remediation received; knowledge mastered, failed, unknown and misunderstood by the student as well as the student learning style. As an expert teacher, who works on-to-one with a particular student would, ITS develops a effective teaching style customized to each student.

The benefits of the ITS, there are some resistance in organizations and educational institutes in implementing them because of high costs and training requirements. The cooperation between teachers and program designers is required so that the ITS could be used in the classroom and there would be an improvement on today's instruction tools.

III. WEB-BASED INTELLIGENT TUTORING SYSTEM

The Internet is now becoming more and more popular and vital and is being integrated into all kinds of education and training. A large number of learners with all age groups and background are using computer networks for their different interests and motivations. Internet has generally been effective in keeping up with these motivations and interests by providing useful information and a greater sense of satisfaction through new ways of cognition. In the current educational background the available resources to the conventional education sectors are constrained. But the day by day the demand on educational opportunities is increasing. This makes alternative approaches such as web-based education even more attractive for academic institutions[Yang et al., 2002].

[Leigh, 1996] observed that the Internet can provide an instantaneous distribution of information to a wider audience and education at a distance can meet the economic needs of both the institution and the learner often proving a very effective substitute to traditional instruction or training. However, the students may not prefer to learn at a distance due to lack of lack interaction and attraction by the conventional distance learning methods. In this scenario, the Internet may even prove more advantageous than the conventional distance learning methods.

With the development of WWW technology, web-based ITSs are becoming mainstream arena of research and development. The web-based ITSs are such kind of systems those are installed in one place and can be used by thousands of learners all over the world in any place [Brusilovsky et al., 1996]. Although many web-based educational systems appeared recently, most of them emerged from their predecessor legacy standalone systems. Therefore, they not only restrict themselves in functionality, but also fail to take benefit of distributed nature of Internet. These systems are usually devoted to a restricted knowledge base and have closed architecture with less possibility of modifications once released.

Web-based course material have advantages over conventional textbooks and lecture notes, they have a number of common deficiencies [Buraga, 2001]:

a) Access to course materials is relatively slow.
b) Courseware does not adapt automatically to individual students.
c) Interactivity must be programmed using Java or other programming languages.
d) Features of Web processing caching and client side information hiding interface with collection of student performance data.

Development of Web-based ITSs has started in Mid-1990s. First-wave of Web-based ITS like ELM-ART [Brusilovsky et al., 1996] and PAT Online [Ritter, 1997], to name but a few, were followed by a number of other learning backgrounds that used Web technology as a resource of delivering instruction. Most of the recent Web-based ITSs addresses other important issues i.e. integration with standalone, external, domain-service Web systems [Melis et al., 2001], using standards and practices from international standardization bodies in designing Web-based learning environments [Retails & Avgeriou, 2002], and architectural design of systems for Webbased teaching and learning [Alpert et al., 1999], [Mitrovic & Hausler, 2000]. [Rebai & de la Passardiere, 2002]try to capture educational metadata for Web-based learning environments.

The components of the Web-based Intelligent Tutoring System is described below [Okazaki et al., 1997] -

a) Domain Model: It contains the knowledge of the subject that is being taught to the learners.
b) Student Model: It is answerable for dynamically representing the knowledge and skills of the student and for inferring the learner's knowledge and misconceptions from his behavior. The student model also records a history of the student's weaknesses and progress. It is constructed based on direct observations of the student's use of the system.
c) Expert Model: It is responsible for consulting to the student model for the model of a particular student so that it can generate the course contents dynamically according to the understanding and knowledge level of the learner. Those course contents are appropriate for that particular student.
d) Tutor Model: It is responsible for making several pedagogical decisions, based on the individual according to the student's competency level.

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e) User Interface: It acts as a bridge between the learner and the system. The learner communicates with the system by using the web browser at the client side.

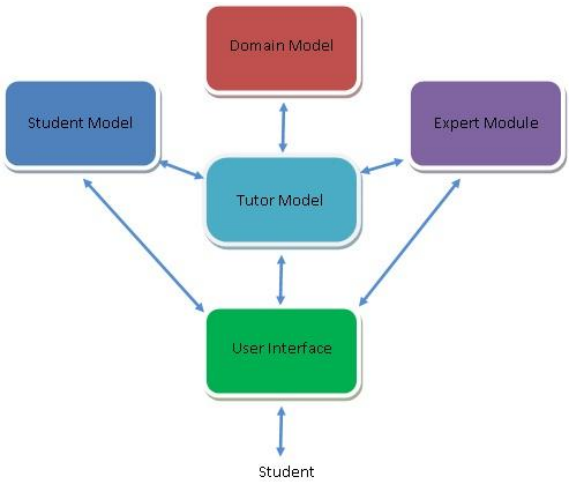

Figure 2: Components of Web-based Intelligent E-learning System

IV. DYNAMIC COUSEWARE GENERATION

Automatic Courseware Authoring is recognized as the most promising and interesting research arena in the field of Intelligent Web-based Education. It is the process of automatically selecting and sequencing of the learning object. Learning object selection and sequencing are based on a set of teaching rules according to the learning preferences and understanding level of the learner as well as cognitive style in most of the intelligent learning systems that incorporates course sequencing techniques. In spite of the fact that most of these rules aredomain independent. There are no well-defined and commonly accepted rules on how the learning objects should be selected and how they should be sequenced to make "instructional sense" [Karampiperis & Sampson, 2006].

In Automatic course sequencing, the key idea is to generate a courseware according to the understanding level of the learner and suited to the needs and preferences of the learners. Two main approaches have been identified for automatic course sequencing [Brusilovsky & Vassileva, 2003]: Adaptive Courseware Generation and Dynamic Courseware Generation.

In Adaptive Courseware Generation the goal is to generate a personalized course taking into account specific learning goals, as well as, the initial level of the student's knowledge. The whole course is adaptively generated before presenting it to the learner, instead of generating a course incrementally, as in a traditional sequencing context.

In Dynamic Courseware Generation on the other hand, the system sees the student progress during his interaction with the course and dynamically adapts the course according to the specific needs and requirements of the student. If the student's performance does not meet the expectations and desired performance, the course is dynamically re-planned. The advantage of this approach is that it gives and applies as much adaptivity to an individual student as possible.

Current research of the representative systems that generates the course dynamically are described below.

PAIGOS [Ullrich & Melis, 2009],GAPEDU [Seridi-Bouchelaghem et al., 2005], eLearner [Thyagharajan & Nayak, 2007], Maker [Jiuxin et al., 2007], ACE [Specht & Oppermann,1998] and WINDS [Specht et al., 2001], OntAWare [Holohan et al., 2005], DCG [Vassileva, 1995, 1997], ELM-ART [Weber & Specht, 1999], InterBook [Brusilovsky

et al., 1998], TANGOW [Carro et al., 1999] and PERSEUS [PERSEUS, 2003], KA2 [Murray, 1996], and EonITS [Staab, 2000],APeLS[Conlan et al., 2002, 2003].

A main issue in the development of an educational system, capable to support pedagogical decisions, is the domain knowledge to include multiple curricular viewpoints on the same knowledge [Wenger, 1987]. To this end, a three-layer curriculum representation has been suggested with each layer providing a different type of pedagogical information [Lesgold et al., 1987]. This distributed approach to subject matter representation emphasizes the notion of lesson rather than that of model as a reservoir of domain knowledge and forms the basis of three-layer architecture [Wenger, 1987]. The proposed model is designed in such a manner that adaptivity of lesson to the learner's knowledge level is simplified and it is based on domain independent metrics

Information about the subject, unit and topic comes from the tutor module. The learner's performance in a particular lesson is inferred from the test results. A major design decision is to decide the frequency of tests. The principle of total quality management applied to tutoring suggests that the quality test should be at the lesson level as it is the smallest learning object presented to the tutee. It should be however noted that the lesson object is aggregated from the assets and as such lesson is an abstract entity. If the performance is found to be 'excellent' in a lesson, the tutor module increments its lesson pointer or the topic pointer to the next lesson or topic and provides information to the course generator to aggregate another lesson. Thus the tests are kept at the lesson level with adaptivity at the content level. The physical layer of the subject domain is already organized according to the ontology of the subject.

Internally the course generator is composed of the following modules [Hasabnis & Ali, 2009]

i. Interface module: interacts with the tutor module and the student model to get the input.
ii. Search module: that searches the required assets for aggregation.
iii. Aggregation module: that retrieves the physical assets and aggregates them.
iv. Transformation module: that applies XSL transformation to the lesson.
v. Presentation module: that transfers the lesson object to the browser at the learner's site.

VI. CONCLUSION

This paper discusses the Intelligent Tutoring System, Web-based Intelligent Tutoring System and benefits of Web-based Intelligent Tutoring System over conventional teaching learning process. The proposed model of dynamic courseware generation generates the courseware according to the knowledge and understanding level of each learner. This proposed model will have some salient features

a) An adaptive rule based approach providesthe advantage of rule flexibility.
b) The proposed model is domain independent.
c) The instructional designer has full control on the content organization independent of the rulebase

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