



A Peep into Adaptive and Intelligent Web based Education Systems

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ABSTRACT

Teaching/learning paradigm has undergone a vast change in recent times. With the advent of Internet technology the modality has jumped by leaps and bounds. Usage of web has made learning/teaching independent of time and location. Courseware hosted at one place can be accessed globally on demand. An intelligent interactive courseware incorporating simulation, animation and audio combined with educational technology makes it a lucrative option enhancing the efficiency of learning. However, a courseware catering to a single level of intelligence and/or proficiency makes a dull proposition. With this in view adaptive course content makes it not only desirable but also essential. The present work gives a brief review of the work on adaptive systems with available technologies for development of such systems. It is proposed to extend adaptivity to web based I^3 -text books incorporating audio, animation and visual simulation.

Keywords: adaptivity, web based education systems, AI in education, ITS, I^3 - text books

1. Introduction

Web based educational systems have changed the paradigm of teaching/learning. They have made the teaching-learning independent of time and space. Materials/information stored and maintained at one place can be accessed globally at any time on demand.

This brings in more generality to the content. However, in practice this will not suit all levels of users. All learners will not be at the same level of proficiency or intelligence. The web content should be capable of satisfying different users according to their capabilities/abilities. A static content of general nature of a web page makes a very boring reading. Intelligence of users varies from one individual to the other. Even in the same individual, the level of learning/understanding varies. Also, a learner moves up step by step in the ladder of learning levels. This makes an adaptive content not only desirable but also essential. When intelligence is added to adaptivity, the content of the web page becomes highly lucrative posing a very challenging development goal.

Traditionally web based educational systems were developed by converting hard copies of contents to electronic copies. The exigent task is to design the courseware for the web. Much research has gone into the development of content presentation and delivery of courses so that learning becomes more effective (Sirohi, 2007, 1999, 1998). Integrating the powers of WWW with educational technologies has proved to be a great asset to online education. Integrating intelligence, interactivity and simulation in the web based

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courseware makes it not only attractive but also essential for effective learning process.

Computer use in education started with the implementation of textbook as model for developing learning support tools (Schwarz, Brusilovsky, & Weber, 1996). With the advancement of technology, the concept, started as electronic copy of the hardcopy of the text book, underwent many modifications. Additions like audio, video, animation etc. were also introduced. Birth of Internet introduced global access along with hypertext technology. The passive text books were made more vibrant and functionally effective by integrating with Intelligent Tutorial System (ITS) technology. Many systems combining the features of electronic textbooks and ITS are available (Anderson, Corbett, Koedinger, & Pelletier, 1995; McKendree, Radlinski, & Atwood, 1992; Brusilovsky, 1993; Weber & Möllenberg, 1995). This type of textbook called I³ – textbooks, integrated+interactive+intelligent textbooks, are enhanced with visual simulation and working models providing for hands-on experience, animation along with audio to give boost to comprehension (Sirohi, 2007).

However, these course wares, with all their enhancements are of type ‘one-for-all’. The content caters to one set level of intelligence or proficiency. Adaptation of the content to the individual learner’s needs makes the system very attractive. It is argued that the goals of the learners is achieved more successfully when the presentation and delivery of the learning content addresses the individual differences of the learner. This introduces personalization in content delivery and presentation. The differences in the learners are determined by their previous knowledge on the subject, their learning style, general attitude, cultural and linguistic background. This enhances the functionality of the system. In such systems the models of the goals, preferences and knowledge of the individual user are built and they are used for adaptation to the needs of the user. The present work reviews the work on adaptive systems with the available technologies for the development of such systems. It is proposed to extend adaptive nature to the web based I³-text books along with audio, animation and visual simulation.

2. The System

E-learning scenario today is dominated by Learning Management Systems like Blackboard (Blackboard, 2002). These systems support several activities performed by instructors and learners during e-learning process. While the learners use the system for learning, communicating and collaboration teachers use it to develop web-based course notes and quizzes, communicate with learners, and evaluate and monitor learner’s evolution. However, all the LMS-based courses offer the same educational material for all learners irrespective of their individual differences in skill and knowledge levels, goals and interests of the learners. This approach is changed by Adaptive web based educational systems (AWBES). These systems are found to perform better than LMS (Brusilovsky, 2004). Adaptive quizzes, Intelligent solution analyzers, adaptive class monitoring systems and adaptive collaborative systems perform their respective functions more efficiently.

The web based educational system incorporates adaptivity and intelligence by building a model of individual learner’s goals, preferences and knowledge. The system is then adapted to the learner’s needs by using this model throughout the interactivity with the learner. Intelligence is brought to play in the system by imitating human teacher through tutoring functionality. This includes functions like coaching, help in problem solving etc. There are some systems which are intelligent (Mitrovic 2003), and some adaptive (Mitsuhara, Ochi, Kanenishi, & Yano, 2002). Some systems incorporate both and are adaptive and intelligent. The first intelligent and adaptive web based educational systems were developed in 1995-1996 (Peter Brusilovsky and Christoph Peylo, 2003). These were followed by many interesting ones.

3. The Technologies

Adaptive and intelligent technologies are different ways to add adaptive or intelligent functionalities to

education systems. Brusilovsky(1999) groups the adaptive and intelligent technologies for web-based educational systems (AIWBES) into three groups as per their origin. Most of the technologies are derived from Intelligent Tutoring Systems (ITS) and adaptive Hypermedia systems. These methods are found to exist before Internet era and termed classic technologies. These technologies are five in number. Adaptive presentation and Adaptive navigation support owe their origin to Adaptive Hypermedia; curriculum sequencing, Intelligent Solution Analysis and problem Solving support come from Intelligent Tutoring Systems. These together make the five classic technologies. Internet entry introduced some technologies. These are web inspired methods. Adaptive Information Filtering, Intelligent Class Monitoring and Intelligent Collaboration Support are the web inspired technologies (Brusilovsky and Peylo, 2003). Thus the five groups of modern AIWBES technologies are ---adaptive Hypermedia, Adaptive Information filtering, Intelligent Monitoring, Intelligent Collaborative Learning and Intelligent Tutoring. By following different techniques and methods these functionalities are added to educational systems.

Adaptive hypermedia and hypertext systems, coming from adaptive hypermedia systems support present adaptive presentation and adaptive navigation as two major technologies. In adaptive presentation content presented in each page is adapted to the learner's goals, knowledge and other information stored in the learner's model. Each page presented is generated for each learner as per the learner's model stored. Example of adaptive presentation system is ActiveMath (Melis, et al., 2001). ELM-ART(Weber, et al., 2001) and MetaLinks(Murray, 2003) are the two other examples wherein the technology is demonstrated in a specialized format.

Adaptive navigation support helps the learner in hyperspace orientation and navigation by changing the appearance of visible links. Helps the learner find 'optimal path' thorough learning material. Learner can select the next material to be learned. In the WWW context this is forms a usual and efficient support. This is the most popular technology. It is one of the earliest AIWBES technologies to be explored. Examples of this technology are ActiveMath (Melis, et al., 2001), ELM-ART (Weber, et al., 2001), Hyperbook(Henze, et al., 2001) and MLtutor(Smith, et al., 2003).

Adoptive information filtering(AIF), from the field of information retrieval, helps the learner find the relevant information from vast pool of information. The technology is applied to adapt the web search results by using filtering and ordering. Most relevant documents in the pool are recommended using link generation. Content based filtering and collaborative filtering are the two versions of AIF available. The emphasis in the two versions, as the name suggests, is on content matching and matching of learners interested in the same document. Machine learning techniques are used widely here. This, a very popular technology in information retrieval, is being adopted to education lately. Examples of this system are MLTutor (Smith, et al., 2003) and WebCOBALT (Mitsuhara, et al., 2002).

Intelligent class monitoring technology is derived from web based education technology. Absence of feedback from learners makes it difficult for remote teachers to tailor their instructions suited to the learners' needs. This technology helps the remote teacher to keep track of the reactions of the learner by using artificial Intelligence. For the first time fuzzy technology was used in HyperClassroom (Oda, et al., 1998) to achieve the tracking. This technology aims at instructor support and uses mainly data mining and machine learning.

Intelligent collaborative learning technology originates from the combination of computer supported collaborative learning (CSCL) and ITS. AI (artificial intelligence) techniques are increasingly used to support collaborative learning. The work on intelligent collaborative learning was done before internet era. Advent of internet has brought increased demand on this technology. The strength of simple collaboration support tools is enhanced by intelligent technologies.

Adaptive group formation and peer help, adaptive collaboration support and virtual students are identified as three distinct technologies within the intelligent collaborative learning group. COLER (Constantino Gonzalez, et al., 2003) provides the example of adaptive collaboration support.

Adaptive group formation and peer help technology forms a matching group for different kinds of collaborative tasks by using the knowledge about collaborative peers. Work in the area was done by forming a group for collaborative problem solving, finding the most competent peer to answer a question.

Adaptive collaboration support provides interactive support for collaboration process. This is similar to problem solving support. Using collaboration patterns collaboration support systems can coach or advise collaborating peers. Examples of this type of work are COLER (Constantino Ganzalvez, et al., 2003) and EPSILON (Soller et al., 2003).

Virtual students technology introduces virtual peers into learning environment. These peers can be a learning companion, a tutee, or even a trouble maker. Here the role of collaboration with a teacher or advisor is eliminated.

Intelligent tutoring technology comprises mainly of curriculum sequencing, intelligent solution analysis and problem solving support. Origin of this technology is ITS. Curriculum sequencing technology helps the learner to find optimal path through learning material. Curriculum sequencing guides the learner through the hyperspace of available information. This makes it an important technology and is one of the first to be implemented. Sequencing is implemented in several forms. It can be a recommended link or a suggested learning path. Examples of systems applying this technology are ELM-ART (Weber, et al., 2001), KBS-Hyperbook (Henze, et al., 2001) and KBS-Hyperbook (Henze, et al., 2001).

4. The Follow-up

Computer assisted Instruction has undergone vast transformation. Introduction of artificial intelligence and entry of Internet contribute significantly for this. The goal of computer usage in education has changed to comprehensive support from knowledge transfer. AIWBES gains importance in this context. These systems provide rich learning materials with global accessibility, interactivity, intelligence, adaptability with web enabled features like animation, visual simulation, audio etc. All these features are incorporated in course ware development in I³-text book form (Sirohi, 2007). However, this system is a general one in one-for-all format. It is proposed to bring in adaptability to this format so that the system can cater to the individual capability and also different levels of proficiency in each individual.

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