Adaptive Content for Personalized E-learning using Web Service and Semantic Web

Jamuna Rani S
Department of Computer Science,
Pondicherry University,
Puducherry-605014, India
jamuna.cse@gmail.com

Marie Stanislas Ashok, Palanivel K
Computer Centre,
Pondicherry University,
Puducherry-605014, India
{head.cce, kpalani.cce@pondiuni.edu.in}

Abstract - **E-learning refers to learning that is delivered or enabled via electronic technology. Learning is a cognitive activity that differs from student to student. Personalization is the process of tailoring pages to individual user's characteristics or preferences.E-learning system provides a set of personalization functionalities such as personalizing learning plans, learning materials, test and necessary instant messages etc., to online learners. The problem in the existing system is the lack of personalization due to weak-semantic learning resources. The possibilities of personalized searching for information will be improved, with the advance of the semantic web and available web services. This paper present an approach to e-learning personalization based on ontology and information exchange is maintained by web services based on Service-oriented architecture. Therefore the learning process is enhanced by providing personalized learning content to the learners in an effective and dynamic intelligent way.**

Keywords- E-learning, semantic web, ontology, SOA, web service.

I. INTRODUCTION

E-Learning is the teaching and learning activities that carry on through Internet. E-learning is defined as "the effective learning process created by combining digitally delivered content with support and services" [7]. E-learning is classified as *synchronous* or *asynchronous*. Both terms refer to "the extent to which a course is bound by place and/or time," Synchronous simply means that two or more events occur at the same time, while asynchronous means that two or more events don't occur at the same time.

The problem in the existing system is the lack of personalization due to weak-semantic learning resources. This is due to lack of semantic parts in web services technologies and also increasing number of web services are making it too difficult for finding suitable web services according to the user's request. The old-fashioned methods recommend information resources, based on user models which are based on the behavior of the user instead of the actual knowledge of the user. Due to such e-learning system, it has found that the learners become increasingly dissatisfied with courses. The information web is a one kind of complex network. Due to this, the web requires an intelligent system, which can be implemented using Semantic Web.

Service-Oriented Architectures (SOA)[11] for E-learning describe an architectural concept which defines the expression of processes and logic in E-learning system as individual services which in turn publish or expose facets of their functionality in a standardized way allowing other services to access and use their functionality in a flexible manner.

The semantic web is called the third generation intelligent network, is a kind of network which can make computer discover semantic data's meaning according to the label defined by semantics and logic reasoning rules, and make intelligent judgment according to semantics. The most advantage of semantic Web is that it can make the computer have the ability of intelligent valuation of the data stored in network cyberspace. So, the computer can serve as an "*intelligent agent*", that means the compute can "comprehend" the meaning of information just like human's brain [12].

The services and semantic worlds come together in two ways. The first is that services provide a semantically rich description of their functionality in order for applications to reason about them in the same way as they reason about data on the semantic web. The second (which is complementary to the first) is that the applications that use the data from the semantic web could actually be services themselves. This paper applies the technologies of the Semantic Web most especially knowledge-representation standards and knowledge-processing techniques.

The purpose of the proposed system is to add semantics to the Web to facilitate the information finding, extracting, representing, interpreting and maintaining records according to the individual needs of the user.

Section 2 presents the survey of the architecture of various e-learning systems. *Section 3* gives the proposed methodology for personalized E- learning system and finally *section 4* concludes the work and future enhancement.

II. RELATED WORK

There are number of research regarding architectures of E-learning system. Most of the papers have described the

architectures of web service-based system but have not illustrated the problem of personalization based on semantics.

Kai Wang et.al [6] proposed Web services-based framework that provide intelligence and adaptiveness to each individual learner for E-learning portal systems. This framework includes two parts: portal framework and Web services framework. Portal framework is comprised of presentation component, portal engine component and portlet container. Web services framework includes a service provider, a service broker, and a service requester.

Olga C. Santos, Jesus G. Boticario [10] designed a recommendations model and a multi-agent architecture. They designed an Accessible and Adaptive module (A2M), which is supported by a set of agents that cope with a twofold objective to provide the required inclusive and dynamic support.

MihaelaDinsoreanu and Ioan Salomie [8] analyzed the distance learning domain and investigated the possibility to implement some E-learning services using mobile agent technologies. They presented a model of the Student Assessment Service (SAS) and an agent -based framework developed to be used for implementing specific applications. A specific Student Assessment application that relies on the framework was developed.

Angad Grewal et.al [1] presented a web service based e-learning lifecycle and its services. This Lifecycle defines all the functionality needed for the interactions between the service provider and the service requester. Here the focus was given mainly in the transformation of digital assets into a learning object in an interoperable way by means of web service to enhance the learning process.

Moon Ting Su et.al [9] developed an e-learning system that uses web service technologies. The objective of the proposed system was to provide interoperability between components written and running on different hardware. The architecture is based on the JISC e-Learning framework (ELF).Here a set of e-Learning web Services is constructed by choosing the required services.

K.K.Thyagharajan and Ratnamanjari [5] addresses the problems of automatically selecting and integrating appropriate learning materials for a learner using web services based on the learners initial knowledge, goals, preferences etc. The approach is based on fulfilling learning objectives based on a dynamic supply of services.

Athanasios D. Styliadis et.al [2] proposed a personalized E-learning system which is based on GIS case for distance learning. GIS E-learning initiatives that incorporate by default a number of sequencing spatial techniques (i.e. spatial objects selection and sequencing), will well benefit from a well defined personalized E-learning implementation with embedded spatial functionality.

Victor Pankratius et.al [13] presented a distributed Service-Oriented Architecture (SOA) for e-learning systems based on Web services, and described the extensions to support software agents. They also proposed the use of intelligent software agents for the distributed retrieval of educational content.

Desislava Paneva [3] presented approaches and methods for adaptive learning implementation, which were used in some contemporary web-interfaced Learning Management Systems (LMSs) to provide the contents in the personalized way. One big limitation of the web-based interaction is the smaller communication bandwidth than traditional face-to-face interaction. Giovanni Acampora et.al [4] presents a novel multi-island memetic approach for managing a collection of models and processes for adapting an E-Learning system to the learner expectations.

Vincenza Carchiolo and Alessandro Longheu et.al [14] proposed architecture organized into four layers: a database layer to store, share and reuse courses and teaching materials, an adaptation layer which allow personalized courses generation, a presentation layer that arrange personalized courses into learning paths, and an interface layer to develop several learning interfaces. The architecture is mainly focused on personalization capabilities by presenting details of how courses are actually tailored and attended by students.

III. PROPOSED METHODOLOGY

The main objective of the paper is to adapt the content for Personalized E-learning. It includes semantics and web service technology that can be employed to achieve personalization in E-learning system and as a consequence to improve E–learning effectiveness dramatically. The system structure is described as Fig 1. It includes *Presentation layer*, *Adaptation layer* and *Database layer*

The main idea of the system is to identify the user requirements, student's preferences and characteristics, such as his knowledge expressed as a set of keywords belonging to a common ontology and adapt the course to each single student. The Learner model will be created based on the information provided by the user. Based on the Learner model the system conducts objective type test for each topic of the subject. Using reasoning mechanism the system will decide what to adapt to the learners. Then, it provides, to the adaptation service, the decisions and modifications are performed and integrate the materials according to the needs of the user.

A. Database layer

The database layer includes profile database, ontology library, resource library, and some label documents. Profile database generally includes user ID, authority information. The administrator can manage and maintain it.

The resources library stores various teaching materials which a certain course needs, including teaching contents in class, exercises behind class, etc. To provide various learning contents, the resources are stored in various ways, such as html page, video, and word document, etc.

The ontology library gathers various resources description information, in which, the ontology resource have various description methods, such as RDF file etc, and it has grammar semantic functions. The ontology library files are mainly built for share and reuse of knowledge. While building, it should be implemented under the expert's help, and the contents should cover the contents of a certain field as much as possible

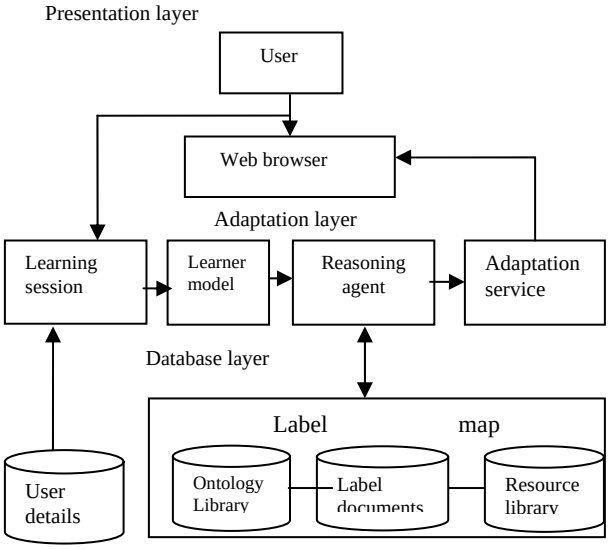

Fig 1- Architecture of personalized E-learning based on SOA and semantic Web.

B. Adaptation layer

In the Adaptation layer the Content is adapted according to the learning characteristics and knowledge specified by the learner. The student model makes reference to course concepts, which are then used for making decisions about what contents should be shown to the student. These concepts are organized in an ontology which represents the domain knowledge. Basically the ontology is a formalization of the domain concepts, in which concepts are represented by classes. There can be relations between classes and class attributes.

Related to the course modules and the student model the objective test will be conducted which can then be traced during learning sessions to determine the student's knowledge about the associated concepts. Then learner model will be created. Based upon that the Reasoning agent finds one or more items that match the user's preferences. For each description about the user the reasoning gent matches the related terms in the ontology library and rated items is created. Thus the Reasoning agent computes the learning progress of a student and to known which concepts are well understood and learned by learners. Depending upon the knowledge scored by the learner, the system searches in the XML structure stored in the database and integrate the course content according to the individual needs.

C. Presentation Layer

Presentation layer provides the entry point to access the E-Learning web services. It also generates adaptive interface to the particular learner.

Web services: Web services provide a solution to a major problem in the computer world i.e. interoperability. Interoperability is provided by allowing different applications from different sources to communicate with each other without time-consuming customized coding. Since all communications are in XML, the services are not tied to any specific operating system or programming language. And also the use of an ontology to map the student knowledge to course concepts, the system better access her/his progress to adapt contents and navigation structure to a particular student.

IV. Conclusion

Learning is an active process of constructing knowledge. It is individual in nature. Personalized support for learners becomes more important, when e-Learning takes place in open and dynamic learning environment. This paper presents an approach to E-Learning personalization based on an ontology and SOA. The use of SOA and Semantic Web technologies facilitate the information finding, extracting, representing, interpreting and maintaining in an effective and dynamic intelligent way.

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