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ABSTRACT

E-learning systems are of no help to the users if there are no powerful search engines and browsing tools to assist them. Most of the current web-based learning systems are closed systems where the courses and the learning material are fixed. The only thing that is dynamic is that the organization of the learning content is adapted to allow individualized learning environment. The learners of web-based e-learning systems belong to different categories based on their skills, background, preferences and learning styles. This paper focuses on personalized semantic search and recommending learning content that are appropriate to the learning environment. The semantic and personalized search of the learning content is based on comparison of the learner profile. The learner profile depends on re individual learning style of the user and learning objects' metadata. This concept needs to be represented both in the learner profile as well as learning object description as certain data structures. Personalized recommendation of learning objects uses an approach to determine a more suitable relationship between learning objects and learning profiles. Thus, it may advise a learner with most suitable learning objects. Semantic learning objects search is based on the query expansion of the user query and by using the semantic similarity to retrieve semantic matched learning objects.

Keywords: Semantic Web; Domain Ontology; Learner Profile; Adaptive Learning; Semantic Search, Recommendation.

1. INTRODUCTION :

Learning environment allows learners to access electronic course contents through the network and study them in virtual classrooms. It brings many benefits in comparison with conventional learning paradigm, e.g. Learning can be taken at any time and at any place. However, with the rapid increase of learning content on the Web, it will be time-consuming for learners to find contents they really want to and need to study. The challenge in an information-rich world is not only to make information available to people at any time, at any place, and in any form, but to offer the right thing to the right person in the right way [1].

In the context of e-learning, [2] adaptive systems are more specialized and focus on the adaptation of learning content and the presentation of this content. An adaptive system focuses on how the profile data is learned by the learner and pays attention to learning activities, cognitive structures and the context of the learning material [3].

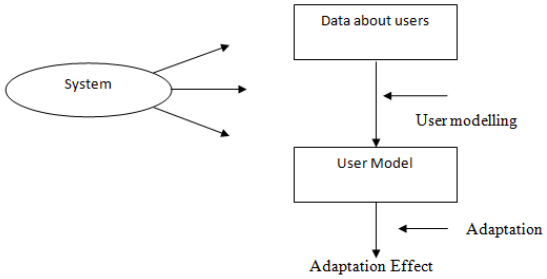

Fig. 1 : Structure of an adaptive system [4].

The figure 1 depicts the structure of an adaptive system [4]. Here, the system intervenes at three stages during the process of adaptation. It controls the process of collecting data about the user, the process of building up the user model and during the adaptation process.

The theory proposed in the paper is to create an advanced e-learning system which needs to have the following pre-requisites [5]:

a. Personalization : This requirement suggests that the learning process needs to take into account the user's preferences and personal needs. This implies either that the user has to explicitly specify these preferences or that the system has the ability to infer them through a monitoring process. The latter is far more convenient for the end-user and constitutes a highly desirable feature.
b. Adaptively: The user's preferences change over time and the system must be able to track them and properly adjust to them. It implies that the whole history of the user's learning behaviour must be taken into consideration, and not just the user's recent actions.
c. Extensibility: An e-learning system has to be extensible in terms of the learning material it provides. It must be easy for the system to incorporate new courses and learning resources.
d. Interoperability: An e-learning system must be able to both access content from and provide content to digital libraries and other e-learning systems. In this way, the provision of enriched and updated content is feasible.

The semantic web [6] is a space understandable and navigable by both human and software agents. It adds structured meaning and organization to the navigational data of the current web, based on formalized ontologies and controlled vocabularies with semantic links to each other. From the E-Learning perspective, it aids learners in locating, accessing, querying, processing, and assessing learning resources across a distributed heterogeneous network; it also aids instructors in creating, locating, using, reusing, sharing and exchanging learning objects (data and components). The semantic web-based educational systems need to interoperate, collaborate and exchange content or re-use functionality.

Ontology [7] comprises a set of knowledge terms, including the vocabulary, the semantic interconnections, and some simple rules of inference and logic for some particular topic. Ontologies applied to the Web are creating the Semantic Web. Ontology facilitate knowledge sharing and reuse, i.e. common understanding of various contents that reach across people and applications. Using ontology in learning environments aims to provide mechanisms to enhance the process of searching and finding learning resources and have the capability to organize and display information that make it easier for learners to draw connections, for instance, by visualizing relationships among concepts and ideas.

This paper aims to perform the personalized semantic search and recommendation of learning contents on the learning Web-based environments. Semantic and personalized search of learning content is based on a comparison of the learner profile and the learning content description. This approach needs to present both the learner profile and the learning object description as certain data structures. Personalized recommendation of learning objects is based on ontological approach to guide what learning contents a learner should study, i.e. what learning objects a course should have according to learner preference and intention.

2. PROPOSED MODEL :

Personalized service has emerged as a new method of intelligent information service to satisfy the increasing informational demands of the users in different systems. User model plays an important role in providing personalized service by representing the user's identity information and interests. There are many user models which have been adopted in various systems to acquire interests of users. In the e-Learning scenario, the learner model is exploited to represent the interests and background knowledge of individual learners [8]. The key technology of providing personalized learning services is to represent and acquire user's interests that are used in user modelling. User modelling is used to search and recommend content relevant to user interests.

In the proposed model, personalized search of learning objects in e-learning is based on a comparison of the learner profile and the learning object description[9,10]. This

approach needs to present both the learner profile and the learning object description as certain data structures, it requires the development of ontological models of the learner and learning object [11,12].

There are two aspects in the proposed approach. The first aspect is a personalized search of learning objects that is generally described and the second aspect aims for personalized recommendation suitable learning objects [13]. The key idea of the Semantic Web is to have data defined and linked in such a way that its meaning is explicitly interpretable by software processes rather than just being implicitly interpretable by humans[14,15]. The Semantic Web can represent knowledge, including defining ontologies as metadata of resources. Ontologies are used to describe the semantics of information exchange.

The metadata that is used here provides structured information that describes, locates and explains information resources making it easier for resources to be retrieved. It is important to remember that data and metadata are different. Data is values, individual parts of information, whereas metadata describes the relationship between the parts and other data. Together data and metadata make information portable, because the relationships among the data values remain separate from their storage. Metadata is a key concept in developing the Semantic Web, to allow computers to share information automatically, data and metadata must be grouped together.

The present research will describe details of building the learner and learning object ontological models to perform personalizes search in learning objects and recommendation suitable learning objects to learners. In order to implement the proposed personalized search of learning objects according to the created ontological models of the learner and learning object, some IMS Learner Information Package Specification corresponding to some IEEE LOM [30] standard have been chosen, and the criteria to estimate conformity of LOM to the learner personal profile with the coefficients of importance. Our proposed system architecture is shown in figure 2.

The objectives of the proposed system are:

1. Presenting a technical solution to an approach and methodology for personalized search of learning objects according to criteria that determine the learner's interests.
2. Proposing an approach to adjust a learner's interests. Because different attributes have different importance to different learners, the system adjusts the weights in comparison to the learner's interests and goals.
3. Proposing personalized learning objects search in E-learning, which is intended to allow a learner (user) to create a learner profile describing his/her personal interests[16].
4. Ranking available learning objects by comparing values of corresponding attributes in the learner profile and learning object metadata (LOM).
5. Using specific ontology to infer what learning objects are needed for a course established for a specific learner requiring a specific subject and how to look for them on the Internet.
6. Recommending suitable learning objects according to a user's preference and intention.
7. Referring to the experiences of similar users and adopting neighbor-interest to look for the learning objects that the user should be interested.
8. Providing adaptive, personalized recommendation for each learner.

A. Reusable Learning Objects (RLO) Creating - The reusable learning objects is a reusable chunk of content with the following two fundamental properties[17]: first is instructional sound content with the focused learning objectives. Second property is the facility that allows the learner to practice, learn, and receive assessment. Also, they define the sharable learning objects as RLO with the additional interoperability property that is the metadata or keywords that describe the object's attributes and mechanisms for communicating with any e-learning system. The aim of this methodology is to select and extract as much of the existing raw content into RLO. The methodology is an iterative five step process to select appropriate content for the RLO with

opportunities to refine and re-structure as the extraction is taking place. A learning object must be modular, discoverable and interoperable, in order to be reused.

B. Learner Profile Acquiring using learning style - There are five popular and useful features when is viewing the learner as an individual, these are: the learner 's knowledge, interests, goals, background, and individual traits[18]. Learning styles are typically defined as the way people prefer to learn. The learner actions that can be used to identify learner cognitive traits in learning systems by learner behaviors that can enable to acquire the learning style[19,20].

C. Learning Content Recommendation and Matching - Personalized recommendation is a widely used application of Web personalized services which alleviate the burden of information overload by collecting information which meets the user's needs. An essential of Web recommendation is how to build user profile, which involves the information and preference of user and has a great impact on the performance of Web personalized recommendation. The Adaptive Systems and Recommender Systems[21] are focused in exploring a certain hypermedia structure in order to help user finding the best way for their interests, while the Recommender Systems are focused on a network of Web resources, bind by existing or virtual relations, aiming to provide users with individual views on Web data. By matching the learning objects metadata, that is stored in learning objects repository, with the learner profile in the system, the system can recommend the learning objects based on the learning styles.

D. The Domain Ontology - The main reason for ontology is to enable communication between computer systems in a way that is independent of the individual system technologies, information architectures and application domain [22]. Ontology includes rich relationships between terms and each specific knowledge domain and organization will structure its own ontology which will be organized into mapped ontology. The domain of our learning content and the ontology we have developed within proposed system is that of computer science. The ontology covers topics like artificial intelligence, communications; computational theory, computer graphics, data structures, database, programming, etc. It is used mainly to index the relevant learning objects and to facilitate semantic search and re-usability of learning objects.

E. Semantic LO Search – The keyword-based search has problems related to the quality of the search results. It often happens that relevant pages are not indexed by a traditional search; in this case important information can be reached only if its specific internet address is known. Moreover, searches based on keywords are very closely related to the spelling of the word and not to its meaning. One current problem of information search issues is that it is not really possible to automatically extract meaning from the relevant results of a query.

3. CONCLUSION :

The adaptive learning system provides support to the learner according to the individual characteristic. It can provide a learner view adapt to learner personalization characteristic, which not only includes personalized resources, but also includes the personalized learning process and strategy. So we should establish a learner model for each learner, containing the information such as state-of-art of learner, the goal and interest and so on. The system reduces the information spaces for learner browsing according to the learner model in the application, and presents the most interesting information to the learner.

This paper has presented a theoretical solution to an approach and methodology for personalized search and recommendation of learning objects according to the learner's profile. Adaptive recommendation model is to retrieve and recommend for a learner suitable learning objects. The paper has defined a methodology for linking learning object meta data and learning profiles for automatic content recommendation. The semantic search of the learning objects is based query expansion and using semantic similarity between the learning objects and the query

keywords.

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