International Journal of Grid Distribution Computing
Vol. 8, No.5, (2015), pp.273-278
http://dx.doi.org/10.14257/ijgdc.2015.8.5.27

An Ontology Based E-Learning System

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Abstract

Based upon several new technologies that have been developed such as semantic web, SPARQL language and ontology engineering, this paper proposes platform architecture for e-learning. It is an e-learning management system with metadata. This system consists of ontology for the e-learning process, such as teaching methods, learning styles, learning activities and course syllabus. It helps students, administrative staff and teachers to set up and maintain the course data and go through the learning content. This system architecture will be capable of gaining user adaptability, performance scalability and concept reusability. It has ability to act in an intelligent manner by evaluating the academics initially and then provide personalized suggestions to the academics indicating their weaknesses and strengths.

Keywords*: E-Learning; Semantic Web; Ontology; Web Ontology Language (OWL)*

1. Introduction

Education is improved with the emergence of computer related information technology. E-Leaning came into existence after the development of computer network [1]. E-Learning refers to term online learning which allows user to access materials and contents from anywhere and at any time. E-learning has been proven useful in education for e.g. in universities and in companies where lifetime learning is must. Contents of e-learning range from soft skills to technical skills, like social behavior. Classroom teaching can never be completely replaced by e-learning [2]. There are several forms of teaching e-learning courses, such as CBT (Computer-Based Training) or BLC(Blended Learning Classes), where e-learning is for Blended persons. Mobile and wireless computing Gave Rise to a new term called m-learning. New techniques enhance education and provide better education service. Although new techniques provide us with good services [3] for e.g., Content Reusability, Function Scalability, Performance Scalability and Device Independence etc. But it will result in too much work i.e. to update and modify the old system.

In order to overcome these drawbacks, we need a system which is easy to update and modify. Ontology based system is one of the good system [4]. This paper proposes a flexible education system based on ontology technology and semantic web.

The rest of paper is as follows: Section 2 introduces the technologies used in this paper: Section 3 describes E-Learning Requirements: Section 4 presents the system architecture: Section 5 represents the data flow diagram: Section 6 contains the Conclusion: Finally, References are given in Section 7.

ISSN: 2005-4262 IJGDC

2. Technologies Used

2.1. Ontology

Ontology is a prescribed naming and definition of the properties, types and interrelationships between entities that exist for a particular domain [5]. There are several languages available for developing ontology like Common Algebraic Specification Language (CASL), Common Logic, Developing Ontology-Grounded Methods and Applications (DOGMA), Rule Interchange Format (RIF), Web Ontology Language (OWL). In this paper we used Web Ontology language (OWL).

2.1.1. Web Ontology Language

The OWL (Web Ontology Language) was designed for those applications which need to process the content of information and not to just presenting information to the users [6, 7]. Web Ontology Language is mainly divided into 3 types:-

- OWL-Lite: OWL-Lite is the easiest version of the OWL family. It is easy to write and learn but it has one main disadvantage that is it restricts the expressiveness very much.
- OWL-DL: OWL DL is for those users who want the maximum expressiveness while performing complete computations. It also supports reasoning. It imposes certain restrictions. For instance a class can be a subclass of many classes but a class cannot be an instance of other class.
- OWL-FULL: OWL Full has full primitives of the OWL Language. Because of its large functionalities, it's become difficult to use.

We used OWL-DL language to develop ontology for our system.

2.2. Semantic Web

Semantic Web is an extension of web standards by the W3C (World Wide Web). The Semantic Web designed to have decentralized data and services linked and defined in such a way that they can be used by the machines not only for display purposes, but also for integration, automation and reuse of services and data across the various applications [8, 9]. Here we listed some of semantic web functions as follows:

- Automatic Web Service (AWS) Invocation: This function allows the automatic execution of identified web services.
- AWS Monitoring: This function helps clients and other users to know the status of web service that they are using.
- AWS Composition: This function automatically interoperates the web services to perform tasks. With the help of this function, new activities can be composed automatically.

3. E-Learning Requirements, Design and Structure

Figure 1 represents the basic components of the system and relationships between them.

3.1. Details of Lessons

In this component, the structure of each chapter will be elaborated more accurately. This part will meet and cover objectives of all courses. Proper syntax, presentation and wording of the content will be considered [10, 11].

3.2. Learning and Teaching Design

In this phase, along with the attractive presentation of material which leads to innovative process of learning there has to be a good interaction with the students as well. Various requirements of the users will be fulfilled. Regular tests and assessments will be designed with the help of which users evaluate themselves. There is also a feedback session which the user can give at every stage in learning process.

3.3. Interface Design

A good interface must be designed for the users to promote attention among them. Important things are shown in bold or italic. It should be clear how to use icons and buttons. No dead links will be presented in the system i.e. all links should be work properly. Graphical representation, text snippets and pictures are presented.

3.4. Metadata for E-Learning System

The main components of the system are system login, learning evaluation, course syllabus, communication between learners and teachers, the teaching approach, help system, facilities for students and teachers, promotion of news and information etc. All this metadata information stored in the ontology form [12, 13], some of functions are describes as follows:

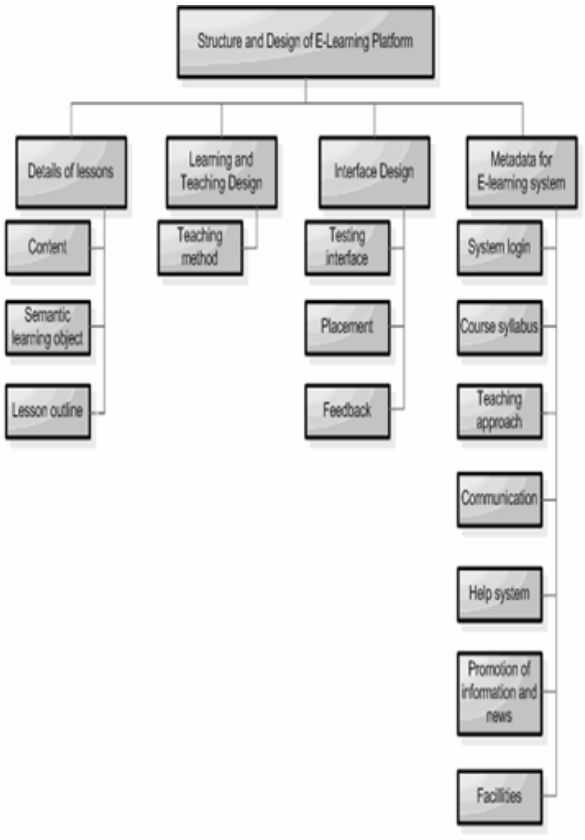

Figure 1. Structure and Design of E-Learning System

- System Login: If a user or teacher wants to log into the system, then they must have a username and password. If they are new to system, then they have to register themselves. There are 3 levels of login: student, teacher and administrator. Only the administrator can change anything in the system.

- Teaching Approach: It outlines the case studies, lectures, examples, homework, tests and quizzes. The teacher states the objectives of every lesson and their contents. Teacher must upload the presentation slides, PDF and word files so that students can download it from the internet. Assignment will be handed over to students only when they pass the quiz or test. Submission of assignments will be done online. On uploading the assignment by the students, assignment parameters are checked i.e. submission date and time.
- Course Syllabus: This part contains the objectives and contents of the course. It also contains the constraints on the assessment (grades vs. scores). Details of every lecture must be given for e.g., room number, name, websites, teaching subjects and phone number. Contact timings should be given for online communication. Related websites must be suggested for learning.
- Learning Evaluation: This can be tests, quizzes, assignment and so on. Based on the marks obtained by the students, they are given grades.
- Communication: Communication is an important activity during e-learning. It is the way through which students can interact with teachers or vice versa. This can be done by the use of web boards. Web boards are for discussion. There are other forms of communication like chat rooms, email etc.
- Help System: This system will design to provide help to users, students or teachers. Frequently asked questions are provided here. New questions can be asked through email.
- Promotion of news and information: The important part of the e-learning system is to advice the students for studying. Important dates such as assignment submission and exam dates are given on the website. Scholarships for students and researchers are shown on the website.
- Facilities: This part includes the system for the submission of the assignments and their results.

4. System Architecture

The System Architecture of e-learning system consists of 4 important components [14, 15]:

- Learning Environment
- Repository
- Semantic Web
- Administrator

Each of these components is explained as below:

- Learning Environment: It consists of all the events that exist in the system. The students who want to join the e-learning system have to firstly go through registration process i.e. they have to register themselves with the required details and information. By this they gain entry into system and can see the details of courses that system contains. The course details contain all the necessary details and list of courses available. From the list, student selects the desired course. On the website, tutorials are mentioned from where students can get the notes from reputed colleges and from different faculty members and external links. The external links are the way through which students can also learn from the internet. The external links also contain PDF's, videos etc.
- Semantic web: It is the main part of our system where the search takes place. It contains many parts such as XML files, list of servers and metadata. Metadata consists of data about data that is presented in the system.
- Repository: It is the database of the entire system. All OWL files are stored in this. It contains the details of entire system. Any information required by teacher or student is fetched from the repository. It also contains student database

which contains all the details about the students. Any student's entire details is in this repository.

- Administrator: Administrator is the person who controls the entire functionality of the system. The administrator appoints people to perform the functions like evaluator, advisor, instructor etc. they will perform their specified functions like evaluating the students and giving advice to the students or teachers and instructing the students with the functionality provided by the system.

Figure 2 represents the main components of the system and architecture of our E-Learning system.

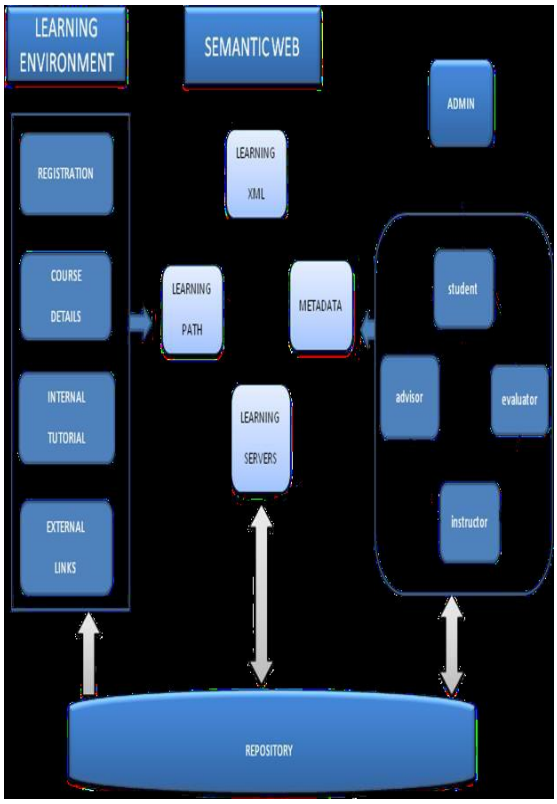

Figure 2. System Architecture of Ontology Based E-Learning System

5. Data Flow Diagram

Any user who wants to search a topic can input for a keyword through the interface. The user interface uses an ontology search engine to search ontology files from database for the mentioned keyword. The search engine performs a string search on class names using the specified keyword and retrieves the required ontology files. The user interface has one more important function i.e. users can type synonyms for the given keywords. The main reason behind this is that the keyword may not exactly match the terms that are in ontologies.

The class extractor then processes the required ontologies and extracts the class names. This process continues until the required class in obtained.

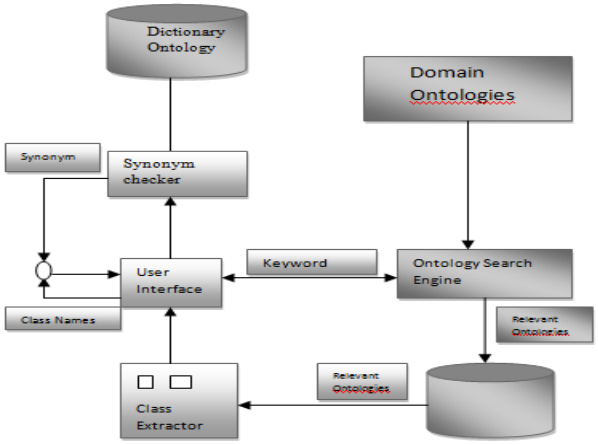

Figure 3. Data Flow Diagram

6. Conclusion

This proposed system contains most of the E-Learning features. It provides users with a very good interface that makes the system easy to access irrespective of user's computer knowledge. Learning or gaining knowledge is one of the key aspects for a student. This system allows students to learn concepts in an efficient and easy way in which each concept is well organized based on their classifications. It is capable of handling 1000 requests at a same time and in future it become easy to increase the throughput of system for better performance. Furthermore, if we want to insert more functions in it, we can insert them easily. In future we will try further to extend this framework to enhance its functionalities

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