Development of Semantic E-Learning Web using Protégé

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Abstract

This paper holds a research about the Semantic Web and E-learning along with a proposed model for a Semantically Active E-Learning system. This system makes use of some E-Learning agents, semantic web services, ontologies and properties of ontology. Protégé is used to implement this E-Learning system.

Keywords: Semantic Web, E-Learning, Semantic Web Services, E-Learning Agents, Ontology, Properties of Ontology.

1. Introduction

The semantic web is a coactive operation led by the international standards body, the World Wide Web Consortium (W3C) [4] [5]. It is a concept of having data on the web which can be defined, integrated and programmed together for distinct applications [1]. In semantic web the information is given unambiguous meaning so as to make smart machine agents proficient in apprehending the content [1].This make possible for the human agents and machine agents to communicate with each other. This new idea foe web can be very productive in the world of education, technology and social development. E-Learning is an imminent and equally resourceful improvement of new times. It has made the edification structure more interactive and engaging as compared to the traditional education system. To make E-Learning more efficient Semantic Web can prove to be a good dais to implement it.

2. Semantic Web Architecture

The term Semantic Web was coined by Tim Berners-Lee, the founder of World Wide Web and the director of the World Wide Web Consortium (W3C), in the year 2001. The very first structural design for semantic web was given by Lee only [2]. It consisted of five layers as shown in fig. 1.

- The XML Layer
- RDF+RDFS Layer
- Ontology Layer
- Logic Layer

*Typeset names in 10 pt Times Roman, uppercase. Use the footnote to indicate the present or permanent address of the author.

- Proof Layer

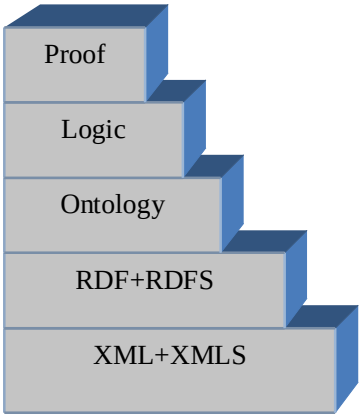

Fig. 1. Architecture of Semantic Web

XML (Extensible Markup Language) defines a set of rules for encoding documents in a practice that is human readable as well as machine readable and is designed only to carry data and not for displaying it. In XML the user gets the privilege to define its own tags because XML does not make use of predefined tags. Generally the user defines a tag with a name which gives idea about the content enclosed within those tags. For example:

<semantic_web>
<layers> 1. Xml<lf>
2. Rdf <lf>
3. Ontology <lf>
4. Logic <lf>
5. Proof <lf> </layers>

Here <semantic_web> is the root element and <layers> is a tag defined to declare all the layers of semantic web. But having semantic tags only cannot provide semantics to the whole document. Therefore XML lacks a semantic model. It only has a surface model for the foundation of semantic web [2]. RDF (Resource Description Framework) is the language exercised for unfolding information and resources on the web. It is written in XML. The XML used by RDF is called RDF/XML [3]. The need of RDF is because the information stored in RDF files only can be searched and looked for by the web spiders. Therefore RDF can be used by the semantic web to describe resources. Ontology refers to knowledge of any pernickety domain. This consists of a set of facts and with the help of ontologies we can relate among various facts and domains. OWL (Web Ontology Language) is the language used to write ontologies. We will study more about Ontologies in the following sections.

3. The Proposed Model

We have proposed a model (fig 2) in order to make an attempt to develop an E-Learning system making use of semantic web. We have made use of some E-Learning agents as well so as to distribute the work among these agents to make well organized flow of data. The basic idea is to make the content customizable as per user's need and prior knowledge. Following are the agents used in the proposed system:

3.1. Instruction Agent

This agent helps the instructor to alter the learning material as per learner's learning style and his/her prior knowledge. Instructor agent can also help the instructor in picking up the teaching style most preferred by the learners.

3.2. Lesson Planning Agent

This agent is also meant for instructors to decide the scheduling of learning content as to which content should be taught after which. This step will be useful for learners because proper scheduling of learning content will make the learners comprehend the course better.

3.3. Learner Centered Agent

Learner Centered Agent can help the learners in providing their response. This agent can keep a trail of learner's performance and can converse to Personalization Agent concerning learner's choice and learning style.

3.4. Personalization Agent

The whole concept of customization revolves around Personalization Agent. The Personalization Agent analyses the technique preferred by learner by communicating with Learner Centered Agent.

3.5. Collaboration Agent

The work of Collaboration agent is to act as interface between the instructor and the learner. The Collaboration Agent can get queries of the learners & can pass them to the instructors. The instructors can broadcast announcements through this agent. This agent

can also initiate chat between two users working on the same problem [6].

3.6. Resource Location Agent

The work of Resource Location Agent is to locate resources on the web semantically. This agent can make use of Semantic Web Services [7]. According to Mr. of semantics into the web services [7]. This procedure also makes use of Ontologies. As described earlier Ontologies make the services more declarative and understandable by the machine agents. The elements involved in the architecture of semantic web services (fig. 3) are: Service Requestor, Service Provider and the Service Registry [7].

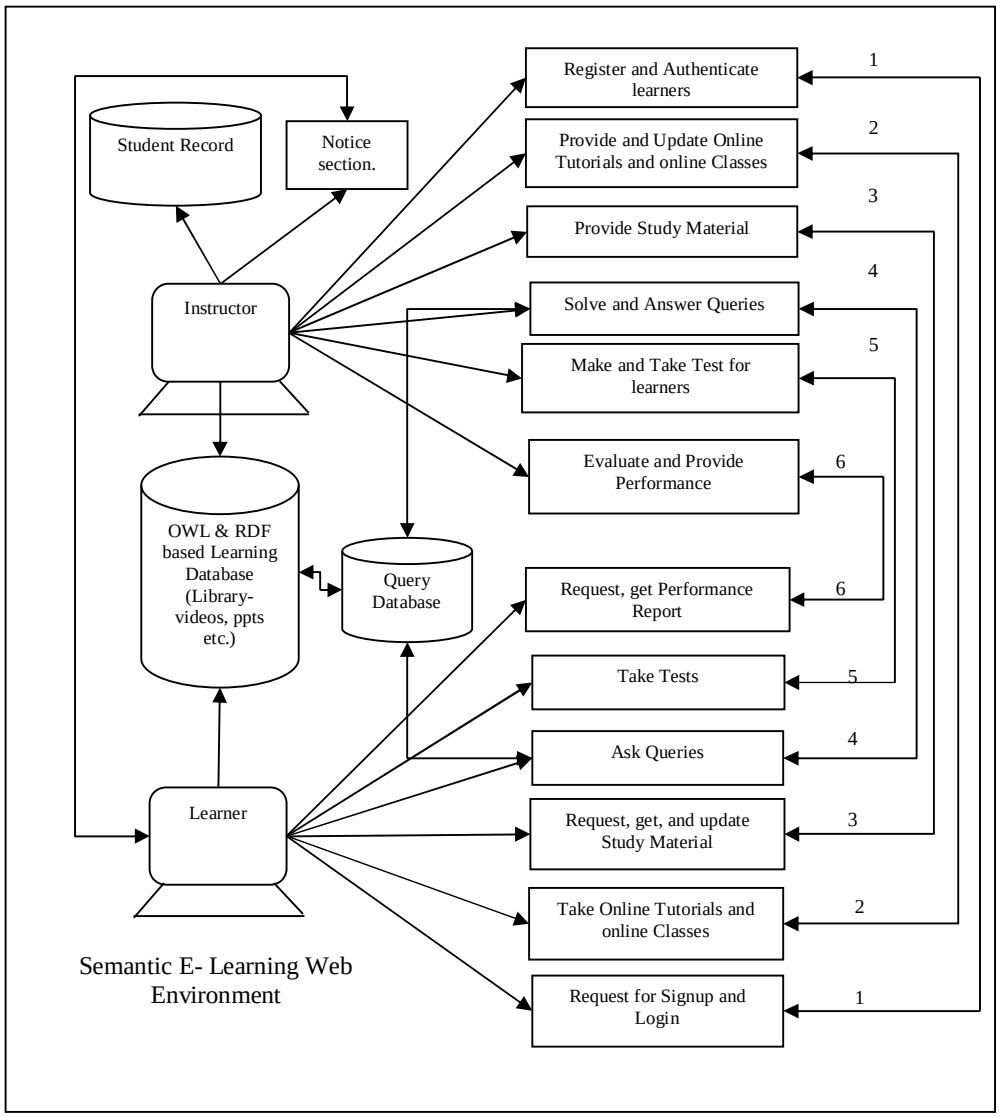

Fig. 2. Semantically Active E-Learning System

Malik S. et al., Semantic Web Service is the deployment

In this architecture for Semantic Web Services all the three elements i.e. Service Requestor, Service Provider and the service Registry make use of Ontologies for their work. The service requestor requests for the services and uses ontologies for service description. The service provider is one who provides semantic services.
It also uses ontology for service description. The services requestor and the service provider have to be registered in the Service Registry. The requestor requests query to the provider via Service registry. The registry then asks the query to the service provider on behalf of the requestor. The provider then publishes the solution for that query on the registry, and the service registry then provides the response to the service requestor. Thus, service registry acts as an interface between the service requestor and the service provider. That is how the learners and the instructors can locate resources on the web semantically.

4. Description of the Proposed Model

(1) The Instructor has the supremacy to authenticate the users i.e., the learners. This gives them the power to add or remove students from the group. On the Learner side any registered student can login to the group or a new user can sign up for the same.

(2) The Instructor can make tests or quizzes for the learners. This tests and quizzes are received by the student on the learner's side.

(3) Based on the tests taken by the learner, the instructor can evaluate learner's performance, the record of which will be provided to the learner. This record can be sent to Learner Cantered Agent so that the track of improvement in performance of learner can be kept.

(4) The instructor can provide learning material to the database. Here Personalization Agent is used to provide the learning material as per learner's prior knowledge and his/her performance. Personalization agent communicates with Learner Centred Agent to do so.

(5) The learner can ask queries to the instructor through the Collaboration Agent. Collaboration Agent forwards those queries to the instructor and can make available the answer to the learner. These queries are stored in the database along with their answers for future use.

(6) An instructor can also maintain a database for student record.

(7) An instructor can make announcements in the notice section regarding placement, timetable, or absentees.

(8) There is a learning database which is available to both the instructor and the learner. This database can be a library containing videos, PowerPoint slides, e -books etc. Instructor and Learner both can upload data in this database.

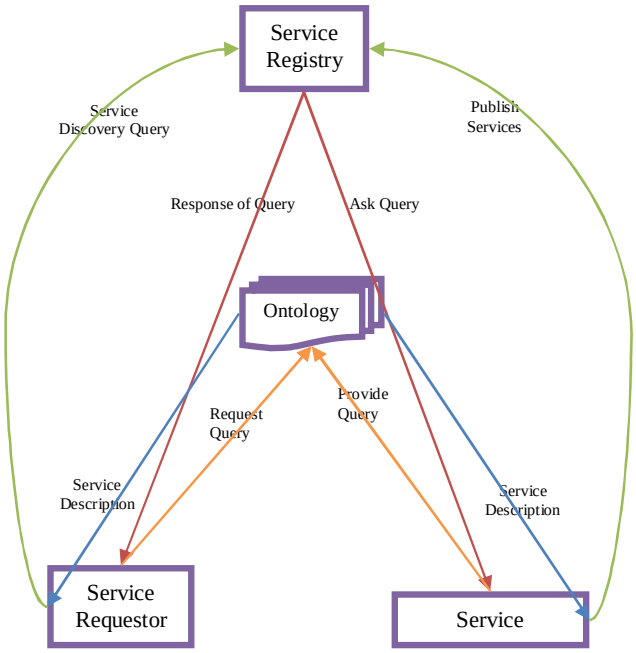

Fig. 3. Semantic Web Services using Ontologies

5. Ontology and Its Properties

Ontologies are the basic structural blocks for applications based on semantic web. Reusability and integration of concepts from different domains are the foremost and significant functioning of Ontology Layer in Semantic Web architecture. The Ontology gives a precise description of the shared conceptualization of a certain domain. The ontology confines the set of all feasible mappings between symbols and their meaning [8].

5.1. Properties of Ontology:

(1) Functional Property:
According to this property the objects falling under this category can have only one unique value or no value at all.

Let X and Y are two groups such that:
(x1, x2, x3.....xn) □X, and
(y1, y2, y3.....yn) □Y, then
If (x1, y1) holds true then (x1, y2)is not possible i.e. for an instance x1 there cannot be two different values y1 and y2.

For example: A student can be registered with only one student id.

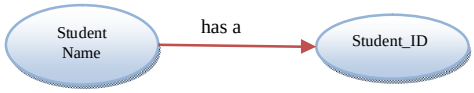

Fig. 4. Functional Property

(2) Inverse Property:
This property states that if there is a relation between instances of an element from domain to range then there must be a relation of that instance from range to domain also.

Let S be a group such that:
If (x, y) □S1
Then, (y, x) □S2

For example: If a student is related to his grades by 'has' relationship then the grades will be related to the student by 'of' relationship.

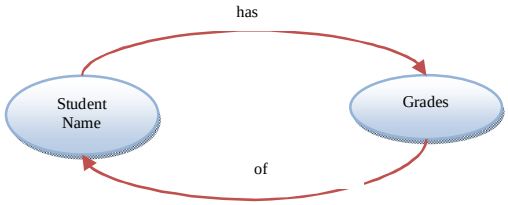

Fig. 5. Inverse Property

(3) Transitive Property:
Transitive Property states that if an element 'x' is related to 'y' via some property and y is related to another element 'z' via same property, then, 'x' will also be related to 'z' via the same property.

Let x, y, z ∈P
If (x, y) ∈ P, and (y,z) ∈ P, then
(x,z) ∈ P

For Example: If every student has some student id, and every student id is rewarded with some grades, then indirectly those grades have a relation with the student name as well.

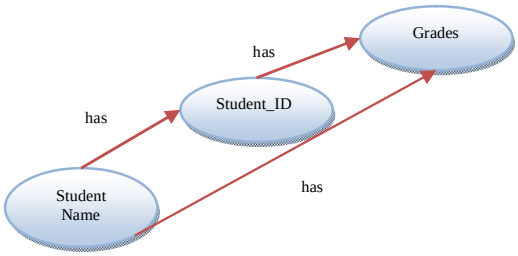

Fig. 6. Transitive Property

(4) Symmetric Property:
This property states that if (x, y) are an instance of P then (y, x) is also an instance of P.

i.e., if (x, y) ∈ P
Then, (y, x) □ P

For example: If a student is connected to his id by 'has a' relationship, then the student id is also connected to the student via the same relationship.

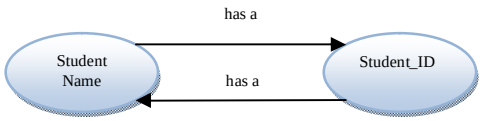

Fig. 7. Symmetric Property

We have also tried to implement the proposed model on Protégé, snapshot of which is shown in Figure 8.

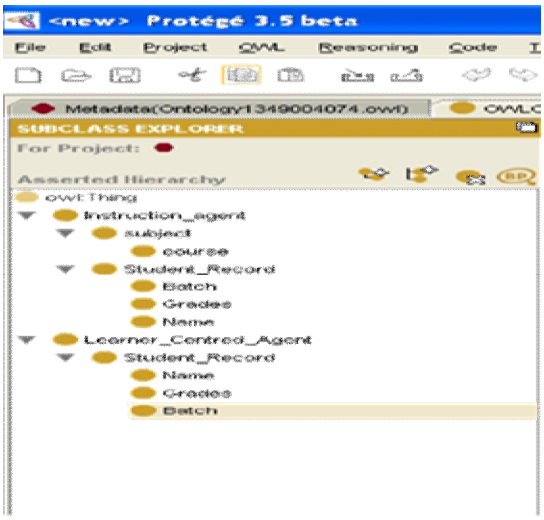

Fig. 8. Class Hierarchy of Instruction Agent and Learner Centered Agent developed in Protégé

Protégé is an open source ontology development tool developed in java. This tool was developed at Stanford University in collaboration with the University of Manchester. We have firstly tried to develop the Instructor Agent and the Learner Centered Agent along with the above mentioned properties of OWL through Protégé. Above shown is class hierarchy of Instruction Agent and Learner Centred Agent, Ontological tree structure of which is shown in Figure 9.

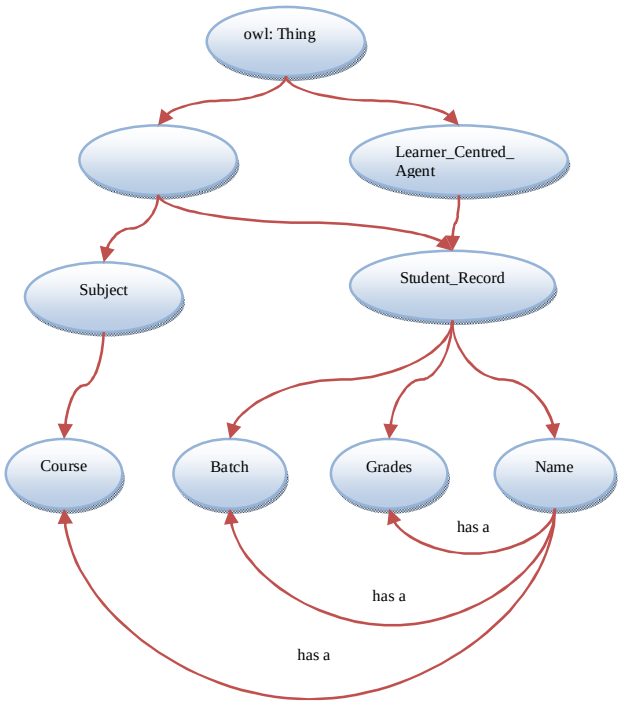

Fig. 9. Ontological Tree Structure

6. Conclusion & Future Work

In this paper we have made an attempt to propose a new model and provide an idea about the working of this model using some of the E-Learning agents. Ontologies play a very significant role in development of applications based on semantic web. In the near future we would like to work more on this model to make it a live implemented E-Learning System with enhanced security [9, 10, 11].

Acknowledgements

We would take the opportunity to thank our college Dronacharya College of Engineering for unavoidable support always and during the work on this paper.

This work was conducted using the Protégé resource, Protégé is supported by grant GM10331601 from the National Institute of General Medical Sciences of the United States National Institutes of Health.

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