

Smart E-Learning Ontology Based Web System

Dina Darwish

Associate Professor and Head, Multimedia and Internet Department,
International Academy for Engineering and Media science,
Giza, Egypt

Abstract:- Quick changes in learning materials, variability of the learners' knowledge and the inability to determine the learner's advances in learning can make e-learning systems inefficient due to their inflexibility in dealing with these factors. In this paper, for managing such issues, a smart ontological approach is proposed, including the design and the implementation of the system; covering its components from ontology design to web development. The proposed Smart E-Learning Ontology based Web System (SELOWS) allows learners easily to determine their learning needs. This system stores all the activities of the learners and updates their profiles according to their behaviors in education and tests offered in the site. Besides, SELOWS proposes the activities that the learner must do based on the learner profile. This system enables giving feedback to learners about their progress and is characterized by the ease of integration of its components.

Keywords:- Smart e-learning system, Learner's profile, Ontology based data, Web development, System design and implementation.

I. INTRODUCTION

The Web-based technology enables information sharing and retrieving in online society, since web users increase every day with their increasing information retrieving habit. The trend of modernization has entered the online e-learning system that is implemented in higher education through the Internet. The traditional online e-learning which presents learning information only in the form of electronic data, is just a static information showing web-based system or using standalone personal computer applications gathered on CD or DVD. But the current era of information system can be one step ahead, meaning that information in text or in multimedia format can be displayed in an intelligent way, as per the knowledge level of online learner, just like human instructor.

E-Learning is grouped into four categories, from the very basic to the very advanced [1-3]. The categories are: firstly, knowledge databases; These databases represent the most fundamental method of e-learning. These databases are provided on software sites providing indexed explanations and guidance for software questions, beside step-by-step instructions for doing certain tasks. These are considered usually moderately

interactive, secondly, online support; which is represented in the form of forums, chat rooms, online bulletin boards, e-mail, or live

instant-messaging support. This is slightly more interactive than knowledge databases, thirdly, asynchronous training; It allows reaching instructors through online bulletin boards, online discussion groups and e-mail. Or, it can be self-contained with links to reference materials in place of a live instructor, fourthly, synchronous training; It is accomplished in real-time with a live instructor facilitating the training. Everyone can log in at a specified time and has the ability to communicate directly with the instructor and with each other.

It is considered a very challenging task for a web site provider to deliver the user-specific accurate information, on demand and as per requirement without any prior knowledge of that web user. After analyzing the current client-server-based web service architecture, it was discovered that all information available on the websites is heterogeneous, it means, data is delivered in different formats, like audio, video, text, multimedia etc.

The semantic web technology, is a new future generation of web technology, that was suggested by Mr. Tim Berners Lee, director of the world wide web consortium (W3C), to deliver the information in an intelligent way. The Semantic Web is considered a new world wide web architecture that provides not only Web content, but also associated formal semantics. Information is provided in a well-defined meaning that allows computers and people to work in cooperation using semantic web [4]. Also, Semantic Web defines explicitly the knowledge embedded in many web-based applications, merging information in an intelligent way, delivering semantic-based access to the Internet and extracting information from texts [5-7].

The Web is huge, but not smart enough to easily merge all of those numerous components of information from the Web, that a user really requires. This integration at a high, user-oriented level is needed in almost all uses of the Web. But, the Web was designed for human use, not for machine use, although everything on the Web is machine-readable, it is not machine-understandable [8]. The Semantic Web needs to treat information in a precise, machine-interpretable form, ready for software agents to execute, share and reimplement it, and to understand what the terms explaining the data mean. In this way, web-based

applications can interoperate both on the syntactic and semantic level.

To provide an effective semantic web technology, ontology is needed to be designed. Ontology defines some application-important part of the world in a machine-understandable format. Ontology is considered as a tool that determines additional meanings that are related to web pages and makes them available to be implemented by software agents and web applications [9,10]. The representation of the semantics of data, accompanied with domain theories (ontologies), allows a Web to present a qualitatively new level of service, for example, intelligent search engines, information brokers and information filters [11, 12].

It is believed that an educational frame of learning resources can be presented into an e-learning system, including ontology-based properties and hierarchical semantic associations.

This e-learning system will own the capabilities of delivering adaptable and intelligent learning to learners. The hierarchical contents structure is capable of showing the entire educational contents. For these goals, ontology is used in this paper. It can have an important role in allowing the representation, executing, sharing and reimplementing of knowledge between applications in modern web-based E-learning systems. The number of ontology-centered researches has grown dramatically, since popular ontological languages are dependent on Web technology standards, such as XML, RDF(S) and OWL(S), so as to share and reimplement it in any web-based knowledge system [13,14].

In this paper, a smart E-learning ontology based web system is designed and developed using suitable tools. This system is abbreviated as SELOWS. It is characterized that it acts as real teacher by educating through learning materials, evaluating the learner's performance, and updating the learner's profile automatically, at the same time, it is capable of proposing new learning materials based on the learner's profile.

The paper is organized as follows. Section 2 provides some related work done on semantic web and ontology description. Section 3, describes the developed main smart E-learning ontology based web system components. Section 4 gives description of the tools used in the smart E-learning ontology based web system. Section 5 presents the smart E-learning ontology based web system implementation. Conclusion and future work are given in section 6.

II. RELATED WORK

In this section, related work on semantic web and ontology description will be discussed briefly.

A. Semantic Web Architecture

The very early structural design for semantic web was presented by Lee [15]. It is composed of five layers as shown in Fig. 1. These five layers are: the XML layer, the RDF+RDFS layer, the ontology layer, the logic layer and the proof layer.

XML (Extensible Markup Language) determines a set of rules for encoding documents in a method that is human readable, as well as machine readable and is developed only to carry data and not for displaying it. In XML, the user has the privilege to determine its own tags, because XML does not use of predefined tags. Generally, the user determines a tag with a name which gives idea about the content enclosed within those tags. But, semantic tags only cannot provide semantics to the whole document. Then, XML lacks a semantic model. It only owns a surface model for the foundation of semantic web [16].

RDF (Resource Description Framework) is considered as the language utilized for extracting information and resources on the web. It is written in XML. The XML used by RDF is called RDF/XML [17]. The RDF is required because the information saved in RDF files can be searched and looked for by the web spiders. Then, RDF can be utilized by the semantic web to describe resources.

Ontology is referred to knowledge of any domain. Ontologies are considered as the basic structural blocks for applications based on semantic web. The most significant functions of Ontology Layer in Semantic Web architecture are reusability and integration of concepts from different domains. The Ontology provides an accurate description of the shared conceptualization of a certain domain, and, includes the set of all feasible mappings between symbols and their meaning. This is composed of a set of facts and one can relate among different facts and domains using ontologies. OWL (Web Ontology Language) is the language utilized to write ontologies.

The logic layer is used to enhance the ontology language further and to allow the writing of application-specific declarative knowledge. The proof layer involves the actual deductive process as well as the representation of proofs in Web languages and proof validation.

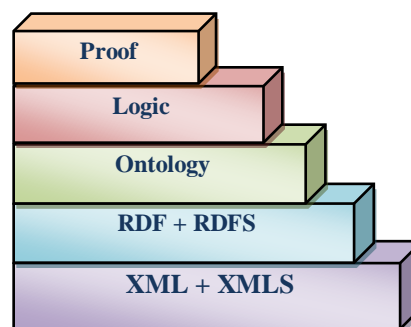


Fig. 1:- Architecture of Semantic Web

B. Benefits of using Semantic Web in E-learning

A lot of e-Learning applications are considered as monolithic and lacking in flexibility. The kind of intelligent computer support enabled by Semantic Web descriptions, such as software agents and self-describing systems, is not considered in the design. Then, the e-learning community is lacking in knowledge representation technology [18]. The key properties of the Semantic Web architecture (common-shared-meaning, machine-processable metadata), allowed by a set of suitable agents is regarded as powerful enough to meet the e-Learning requirements: fast, just-in-time and relevant learning [19].

Learning material is semantically annotated, and for a new learning demand it can be easily included in a new learning course. According to his/her preferences, user can find useful learning material very easily. For a new learning demand, it can be easily included in a new learning course. In Table I, a summary view of the possibility to use the Semantic Web for realizing the e-Learning requirements is shown [20].

Requirements	e-Learning	Semantic Web
Delivery	Pull	Knowledge items (learning materials) are organized on the web, and connected to commonly agreed ontologie(s). This allows construction of a user-specific course, by semantic searching for topics of interest.
Responsiveness	Reactionary	Software agents on the semantic web can utilize commonly agreed service language, which allows ordination between agents and proactive delivery of learning materials in the context of actual problems. The method is that each user possess his own personalized agent that communicates with other agents.
Access	Non-linear	User can explain situation at hand (goal of learning, previous knowledge..) and make semantic searching for the suitable learning material. The user profile is also accounted for. Access to knowledge can be extended by semantically

		defined navigation.
Symmetry	Symmetric	The semantic web (semantic intranet) provides the potential to become an integration platform for all business processes in an organization, including learning activities.
Modality	Continuous	Active delivery of information (based on personalized agents) delivers a dynamic learning environment.
Authority	Distributed	The semantic web can be as decentralized as possible. This allows an effective cooperative content management.
Personalization	Personalized	A user (using personalized agent) searches for learning material customized for her/his requirements. The onotology is considered as the link between user requirements and characteristics of the learning material.
Adaptivity	Dynamic	The semantic web allows the utilization of knowledge provided in different forms, by semantical annotation of content.

Table 1. Benefits Of Using Semantic Web As A Technology For E-Learning

III. SMART E-LEARNING ONTOLOGY BASED WEB SYSTEM

A. Conceptual Architecture for Semantic E-learning

In this section, the conceptual Semantic eLearning framework for the proposed SELOWS is described. It delivers high-level services to people searching for accurate online information. The basic six levels of this framework are the human level constituting of the learners, the access level that enable access of learners into the system, the interface level that delivers different facilities, the service level that manages the background processes, the middleware level (or interference server) that contain the search engine and the interference engine, and the knowledge base level composed of different repositories. Fig. 2 illustrates the conceptual architecture for semantic e-learning in SELOWS. From this conceptual architecture, the key

elements of a semantic eLearning platform are extracted and described below [30].

- *Interface layer*

It presents an integrated interface through which learners can access, upload or modify the data with particular authority. The learners can deal with different services.

- *Access layer*

It has the role of a security layer between the learners and the system. It delivers an interface and allows access into the system.

- *Annotations*

Annotation is considered as the activity of annotating text documents written in plain ASCII or HTML using a set of tags that represents the names of slots of the selected class in ontology. Semantic annotation of WEB resources needs the capability to transform syntactical information into semantic descriptors related to a conceptual domain model [21]. But, the selection of relevant annotations may be very expensive in terms of complexity since it requires understanding semantic relationships between concepts used to describe web resources; it needs the capability to deal with various levels in document descriptions, and it should generate semantically significant mapping of resources to concepts. The annotation may be manual or automatic. Several approaches were suggested for automatic semantic annotation, based on two main research fields: natural language processing and machine learning. Natural language processing (NLP) is depending on the detection of typical human constructs in textual information, and tries to connect known sentence composition rules to semantic rich descriptions.

- *Search Engine*

It provides an API with methods for querying the knowledge base.

- *Knowledge Base*

It is a repository where ontologies, metadata, inference rules, educational resources and course descriptions, learners' profiles, etc. are saved. The metadata can be placed within the document itself or in some external metadata repository [22]. In the Fig. 2, the metadata are saved externally in the knowledge base, because it is easier to scan a separate Meta description saved in a database, and it takes less space to save it. The second advantage is that the point of view can change depending on different users who reuse the same learning material. Meaning that, it is possible to have different descriptions of the learning material depending on the different contexts.

- *Ontology Based Knowledge*

In an eLearning environment, the situation can become that different learners have very different backgrounds and levels of knowledge accompanied by a combination of various learning

materials. Then, the retrieval of accurate information is difficult. So, some mechanisms for initiating a shared-understanding are required. Ontology is considered as a powerful mechanism for achieving this task. Also, an ontology contains the set of possible mapping between symbols and their full meanings [23].

- *Metadata*

Metadata is defined as data, about data that helps us to obtain better search results [22]. Each component of the eLearning system may be described using metadata. The metadata level is considered as the first level of a semantic WEB-based application [24]. This metadata may be connected to each software component of the eLearning system in order to save several important characteristics (such as, information regarding uptime, ownership, execution platform, etc.). So, each user can retain the information about his/her status. For example, the user job can be saved as teacher, student, regular user and so on. Also, the system can retain personal data (such as, user name, user e-mail address, etc.).

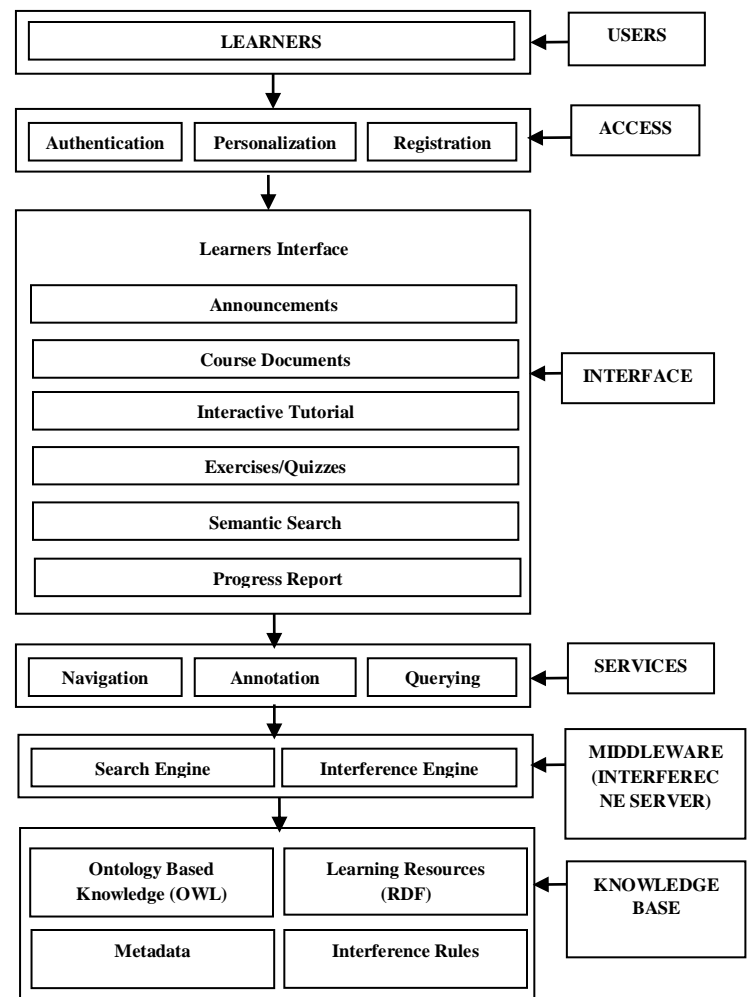


Fig. 2:- Conceptual Architecture for Semantic E-learning in SELOWS

B. System in action and User Actions in SELOWS

The SELOWS main component is the OWL & RDF based learning database containing learning materials library (such as, pdfs, videos, ppts, ...etc.), tests (exams or quizzes) and learners' profiles (signup, login, performance, etc.). The learner enters the SELOWS system to perform one of the following tasks:

- Request for signup and login
- Take online tutorials and online courses
- Request, and get study material
- Ask queries
- Take tests
- Request and get performance report

The OWL & RDF based learning database performs the following actions using database queries in response to learners' actions:

- Register and authenticate learners
- Provide online tutorials and classes
- Provide study material
- Answer queries
- Provide test for learners
- Evaluate and provide performance

The SELOWS system design is based on studying learners' actions and system's reactions [31]. Fig. 3 shows the active proposed E-learning system.

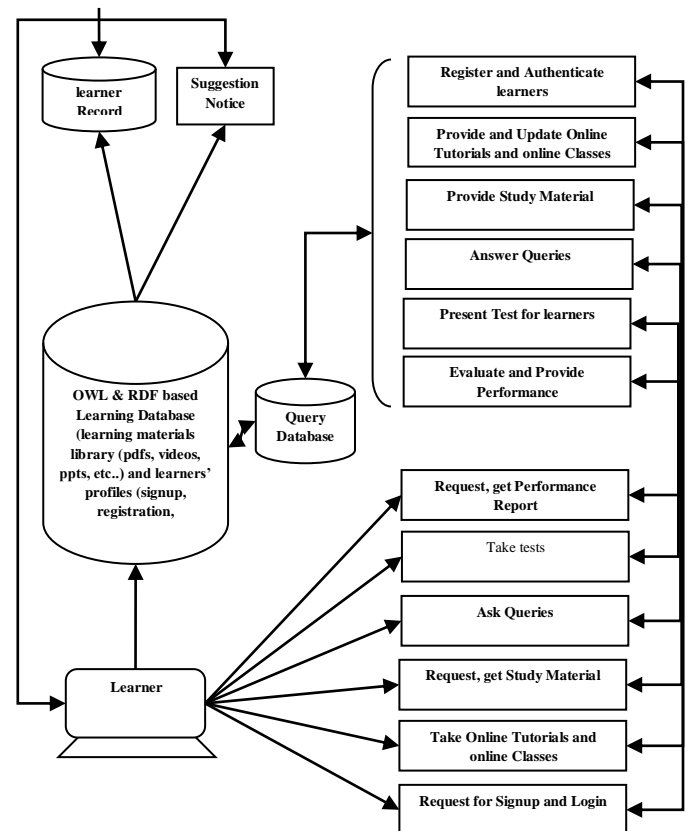


Fig. 3:- Active Proposed E-learning System

Considering the user's actions, in the system flow, the system is divided into two main blocks regarding learner's actions: user registration/login process, and user evaluation process. In the first main block of the system, the learner can be a new user or a registered user. If the learner is a new user, he must register first to create his profile in the learning database repository. If the learner is a registered user, he must log in to the learning database repository, then, every time the learner log into the system, his profile is updated to include the time of system entrance.

In the second main block of the system, the learner has to the choice to perform one of these actions: taking tests, taking learning materials, or requesting performance report. If the learner has decided to take tests, the SELOWS system suggests some exams/quizzes for the learner to make depending on his profile. The learner could follow the system proposal or choose by himself the test to take. After performing the test, the learner profile is updated in the learning database repository. If the learner has decided to take learning materials or courses, the SELOWS system suggests some learning materials or courses depending on his profile. The learner could follow the system proposal or choose by himself the learning material or course. After taking the learning material or course, the user profile is updated in the learning database repository. If the learner has

decided to request his performance report, then, the SELOWS system retrieves the learner’s performance report from the learning database repository to be displayed to the user. Fig. 4 illustrates SELOWS system flow overview and the learner’s actions.

- Individuals tab: enable creating and populating individuals.
- Metadata tab: enable ontology management and annotation.

Protégé can generate OWL/XML, RDF/XML or triplets RDF files for an ontology. Also, Protégé enables the usage of SPARQL queries, which is considered as the query language for RDF documents.

B. Apache Jena Framework

Apache Jena is considered as a free and open source Java framework [26] specialized for developing semantic web and Linked Data applications. The framework contains different APIs interacting together to execute RDF data. The interaction between the different APIs is illustrated in Fig. 5. RDF triples and graphs, and their different components, can be reached through Jena's RDF API. Typical abstractions here are Resource representing an RDF resource (whether named with a URI or anonymous), Literal for data values (numbers, strings, dates, etc), Statement representing an RDF triple and Model representing the whole graph. The RDF API own basic facilities for adding and removing triples to graphs and finding triples that meet particular patterns. So, a user can read in RDF from external sources, whether files or URL's, and serialize a graph in correctly-formatted text form. Both input and output support most of the commonly-used RDF syntaxes.

While the programming interface to Model is quite rich, internally, the RDF graph is saved in a much simpler abstraction named Graph. This enables Jena to utilize a variety of different storage strategies, as long as they suit the Graph interface. Also, Jena can save a graph as an in-memory store, in an SQL database, or as a persistent store using a custom disk-based tuple index. The graph interface is considered also a suitable extension point for connecting other stores to Jena, such as LDAP, by writing an adapter that enables the calls from the Graph API to work on that store.

A key feature of semantic web applications is that the semantic rules of RDF, RDFS and OWL can be utilized to infer information that is not explicitly mentioned in the graph.

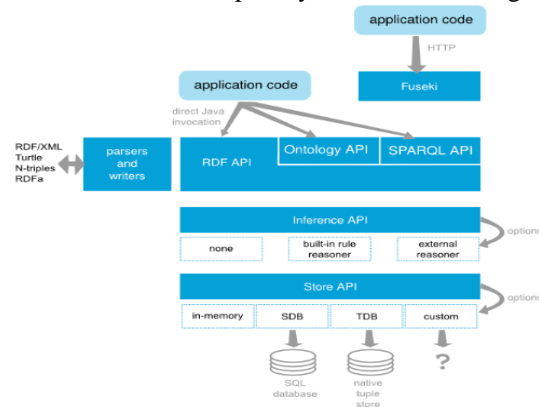


Fig. 5:- The interaction between the different APIs in Apache Jena Framework

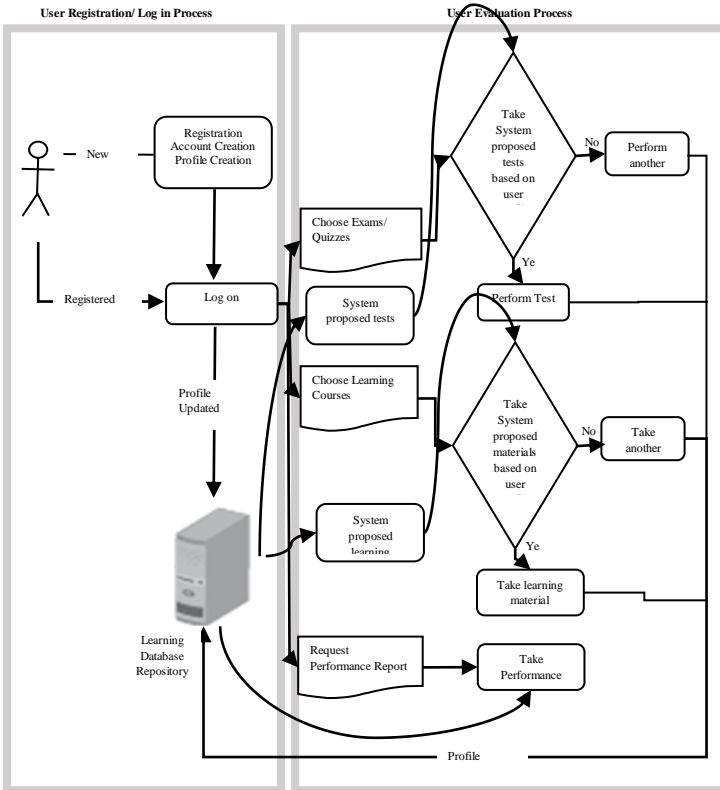


Fig. 4:- SELOWS system flow overview and learner actions

IV. SMART E-LEARNING ONTOLOGY BASED WEB SYSTEM TOOLS

In the following sections, the main tools and programs used in the SELOWS design are described.

A. Protégé

In this paper, version 4.3 of Protégé [25] is used, as one of the most updated, oriented OWL ontologies. As a big advantage of these versions 4.x., the friendliness towards the creation of the properties is considered and their limitations on the classes and instances. On the other hand, the concealment of SWRL and the replacement of the corresponding tab that the versions 3.x delivered with rules tab, restricts the possibilities for developing complex rules on classes or instances. The most popular tabs of Protégé 4.3 are:

- OWL classes tab: provides class hierarchy and definitions.
- Properties tab: provides property hierarchies and definitions.
- Forms tab: enable forms editing for instances and meta-classes.

C. Using Servlets inside Eclipse EE

Servlet Technology [27] is used to create web applications. Servlet technology uses Java language to create web applications. Web applications are helper applications that resides at web server and build dynamic web pages. A dynamic page could be anything like a page that randomly chooses picture to display or even a page that displays the current time.

D. Servlet Life Cycle

The following steps describe the servlet lifecycle [28]:

- Loading Servlet Class: A Servlet class is loaded when first request for the servlet is received by the Web Container.
- Servlet instance creation: After the Servlet class is loaded, Web Container creates the instance of

It. Servlet instance is created only once in the life cycle.
- Call to the init() method : init() method is called by the Web Container on servlet instance to initialize the servlet.
- Call to the service() method: The containers call the service() method each time the request for servlet is received. The service() method will then call the doGet() or doPost() methods based on the type of the HTTP request, as explained in previous lessons.
- Call to destroy() method: The Web Container call the destroy() method before removing servlet instance, giving it a chance for cleanup activity.

Fig. 6 shows the lifecycle for a servlet.

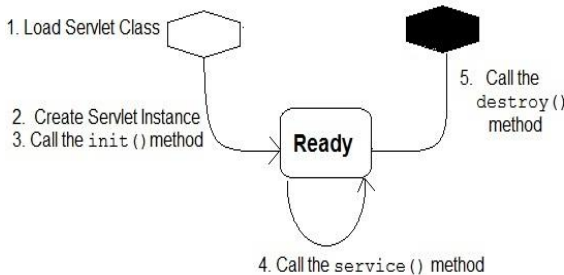


Fig. 6:- Lifecycle for a servlet

V. SMART E-LEARNING ONTOLOGY BASED WEB SYSTEM IMPLEMENTATION

A. Ontology Classes and Ontology Relationships in Protégé

The Smart E-learning ontology based web system (SELOWS) consists of several classes representing the learners’

profiles, the learning materials and the tests used to evaluate the learner’s level. In this section, the ontology of the SELOWS system is described including classes, properties and individuals, as well as relationships between these classes.

➤ Ontology for the SELOWS

The ontology allows the learning system to be able to represent any visible information during learning process. Also, ontology’s test grades, learners’ dynamic profiles should include frequently changing knowledge background, achievements, and preferences depending on the learner’s progress. In order to model information, an ontology based modeling is applied to SELOWS. Ontology for SELOWS is represented and accomplished using Protégé 4.3 described earlier. Fig. 7 shows ontology representing the SELOWS classes and subclasses developed by Protégé Ontograph.

➤ Ontology Classes

The ontology of the SELOWS consists of 10 main classes, which are:

- *User class*: contains learner’s individuals.
- *Personal_Data class*: contains learners’ profiles in subclasses, including their data, such as first name, last name, password, job, email, taken courses, achieved tests, number of times the learner’s accessed the website and time of access.
- *Resources_N class*: contains the main learning resources for networking.
- *Resources_n_data class*: contains information in subclasses about learning resources for networking, such as: resource id, resource name, resource type, and number of times a resource is uploaded.
- *Resource_E class*: contains the main resources for English language.
- *Resources_e_data class*: contains information in subclasses in about learning resources for English language, such as: resource id, resource name, resource type, and the number of times this resource is uploaded.
- *Activities_N class*: contains main tests (exams/quizzes) for networking organized to different levels and skills.
- *Activities_n_data class*: contains main information in subclasses about networking tests, such as, test id, test name, test description, test type (exam or quiz), test skills (to be evaluated), test learner’s duration, test learner’s mark.
- *Activities_E class*: contains main tests (exams/quizzes) for English language organized according to different levels and skills.
- *Activities_e_data class*: contains main information in subclasses about English language tests, such as: test id, test name, test description, test type (exam or quiz), test skills (to be evaluated), test learner’s duration, test learner’s mark.

Fig. 8 shows how the SELOWS ontology including classes and subclasses is displayed inside the Ontograph in Protégé 4.3.

➤ *Defining Properties*

The Protégé enables definition of object properties. Dealing with ontologies is different than dealing traditional databases. Hence, storing and retrieving ontologies is different than storing and retrieving data from traditional database tables. Using ontologies, each property has a domain (a class to which it is part), and a range (another class containing data it needs). For example, the property hasID, its domain is class User, but its range is class ID, which is a subclass of Personal_data, and so on. Fig. 9 shows this example represented in ontology. Also, Fig. 10 shows ontology properties and their classes (domains and ranges) represented in Protégé 4.3.

➤ *Adding Individuals*

To complete the ontology, the individuals for classes (User, Activities_N, Activities_E, Resources_N, Resources_E) must be added. Every individual pertaining to a class represents this class, including the class properties, for example, user1 (individual) ∈ User (class). So, user1 own all the properties including their domains and ranges of class User (hasID, hasF_name, hasL_name, hasEmail, hasPassword, hasJob, TakeResID, TakeActID, TakeActTime, TakeActMark), and so on. As mentioned before, each property has a domain class; its own class and a range class; the class containing the data it needs.

Fig. 11 illustrates how individuals and their classes are represented in SELOWS ontology inside Protégé 4.3. The relationships in SELOWS ontology between different classes, subclasses, properties and individuals are illustrated in Fig. 12 in details.

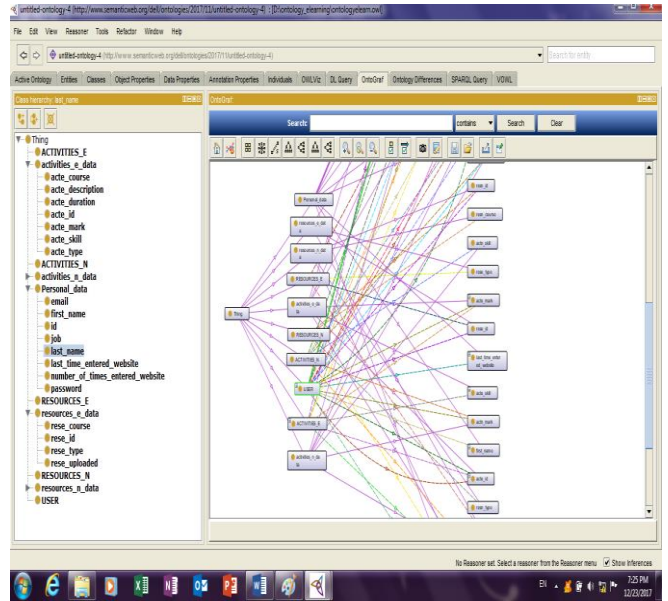


Fig. 8:- Ontograph inside Protégé 4.3 showing classes and their subclasses

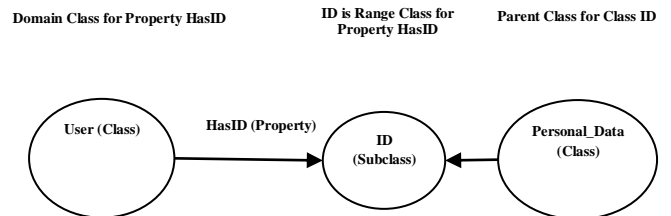


Fig. 9:- Relationship between properties and their domain and range classes in ontology

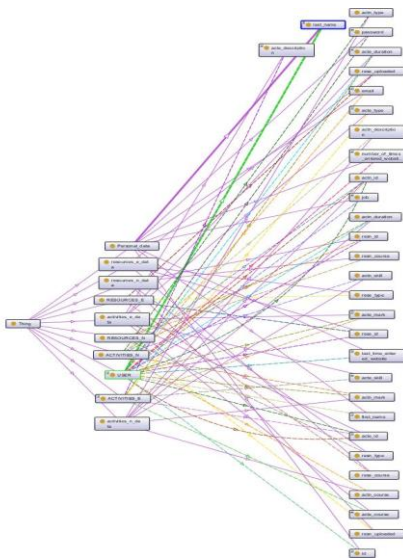


Fig. 7:- The SELOWS Ontograph showing classes and subclasses designed with Protégé 4.3

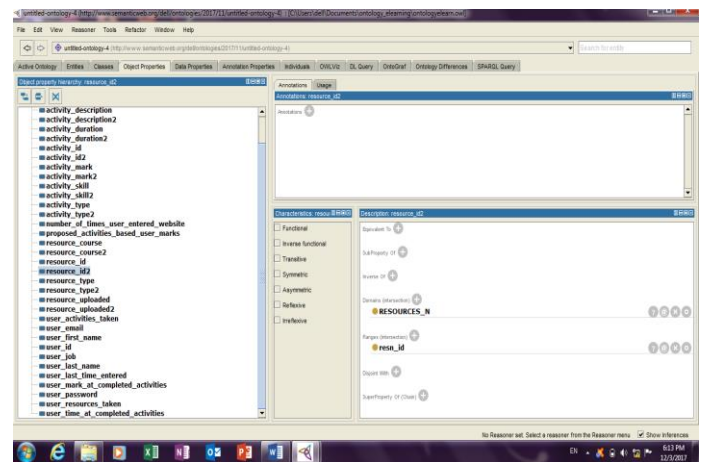


Fig. 10:- Ontology properties and their classes (domains, ranges) represented inside Protégé 4.3

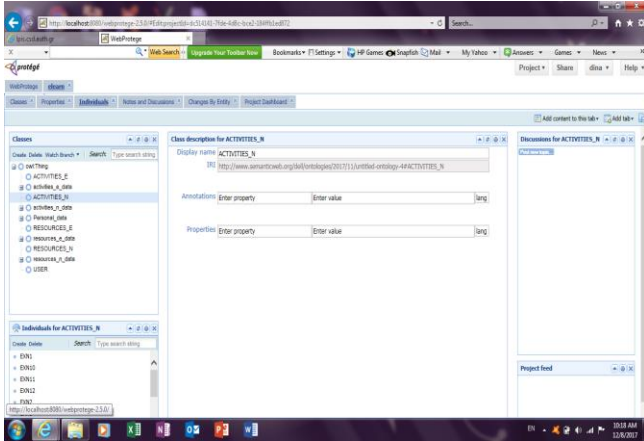


Fig. 11:- Ontology showing Individuals and their classes represented inside Protégé 4.3

B. Apache Jena implementation inside Eclipse EE

Jena is used inside Eclipse EE for SELOWS implementation to read and write from the ontology file containing learners' data, learning materials and tests' data. One of the advantages of Apache Jena, that it can be easily imported and integrated inside Eclipse EE without any problems. Fig. 13 illustrates Eclipse EE processing Jena commands that query a RDF file containing ontology resided on hard disk, to retrieve names of people from it, then, displaying them in a website consecutively. Fig. 14 shows people's names displayed in a website after retrieving them from the RDF file inside the Eclipse EE using Jena library.

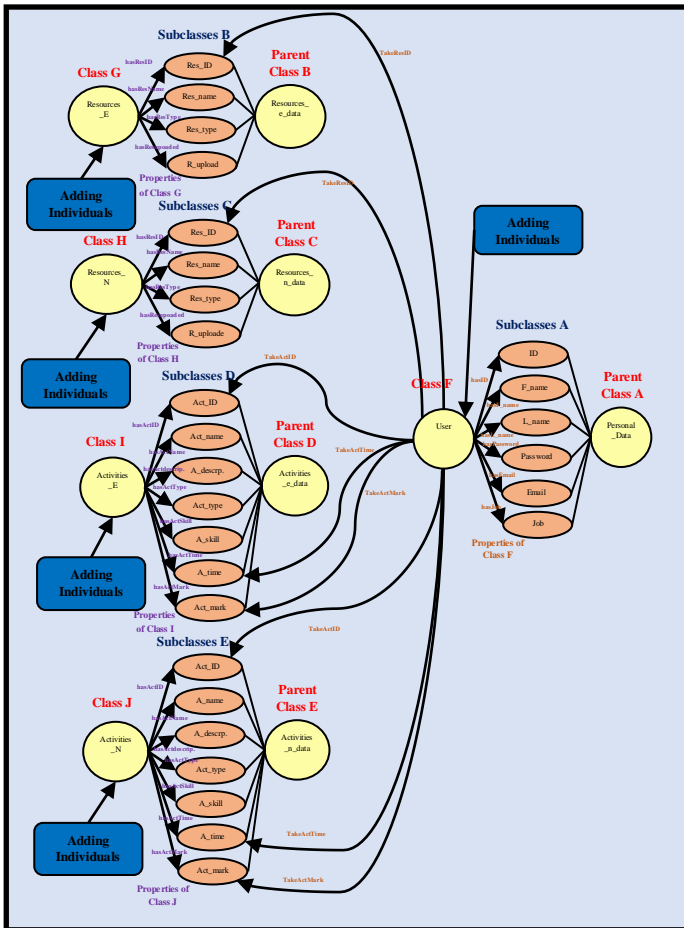


Fig. 12:- Relationships between different classes, subclasses, properties and individuals in SELOWS ontology

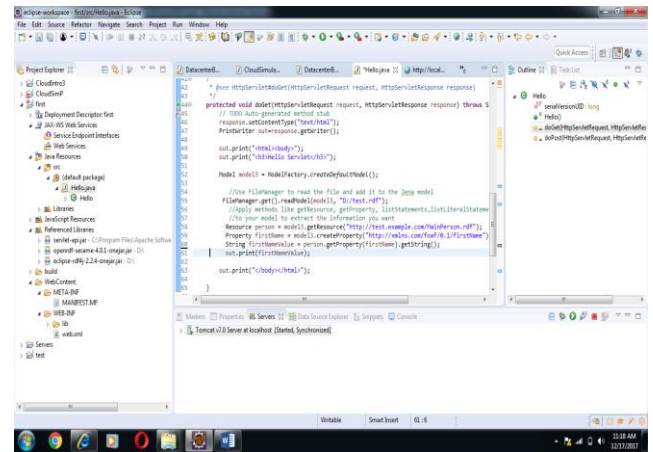


Fig. 13:- Jena commands executing inside Eclipse EE

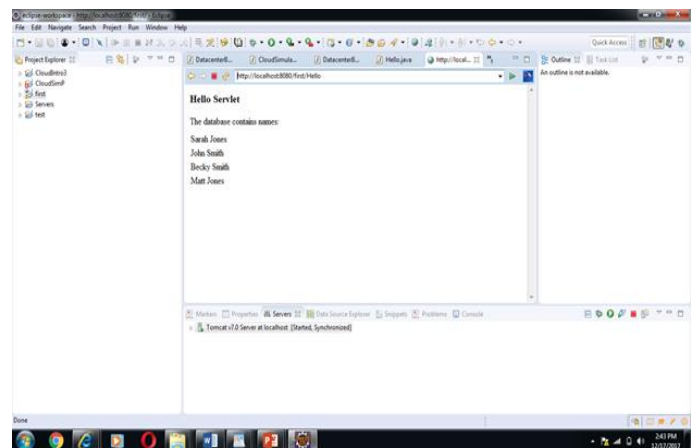


Fig. 14:- People's names displayed in a website inside Eclipse EE Servlet using Jena

C. Web interface development in Eclipse EE

The SELOWS website is achieved using Eclipse EE Servlet, using Jena framework and ontology file. After that, the registration form must be created, then the rest of the website must be developed. The main parts of the servlet containing form used for registration are: *index.html*, and *Register.java*. Fig. 15 shows the registration form of the smart E-learning Ontology based Website inside Eclipse EE.

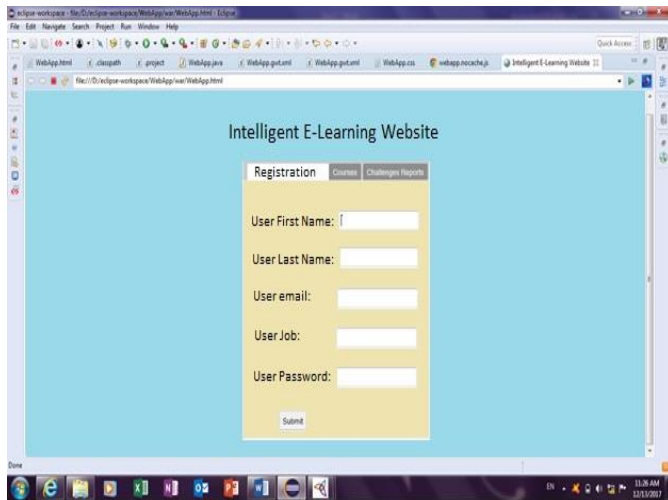


Fig. 15:- The registration form of the smart E-learning ontology based website

D. Users Profiles

The methodology utilized in this paper and its implementation provided a real-life form for the extraction of information of learners’ profiles, as well as educational content delivery to the learners’ levels, then, appropriate e-courses are proposed to them according to their profiling information. Depending on the IEEE fundamental e-learning model, the system delivers faster learning at reduced costs, increased access to learning information and clear accountability for all participants in the learning process, thus, presents an efficient approach to the learning process using simple to use web interface. The learner’s profile is automatically updated after completion of a test or loading of a learning material. Learners can then know and access the learning material suitable to their level depending on their profiles.

The test acts as a mediator towards information gathering; as the amount of answered questions increases, the score increases in the learner’s profile. The overall process provides a weighted mapping of the learner in the specified profile. In this method, learners are organized to static profiles that characterize their knowledge and learning levels, and determines their treatment by the system.

The website contains learning materials and tests for networking and English language. Additional courses can be added. The learning materials can be videos, notes, pdf books and presentations. The tests are organized to quizzes (short tests) or exams (long tests). The system uses the learners’ answers in order to count their knowledge level in networking and English language and to propose the learner a proper tutorial. Networking learning materials are organized into different levels beginning from the basics. Also, English language materials are organized into different levels of difficulty in order to evaluate the learner.

Learning evaluation is the most important factor to determine learning performance in E-Learning systems. The evaluation has two levels, *conceptual* and *objective*. The first one refers to the learner’s understanding out of the lesson *concept*. The last one denotes to the learner’s understanding of the lesson *topic*. The learner’s knowledge level is determined by *concept level* and *objective level*. The system updates the learner’s profile after questions answering. It can also save last academic status of learner and all his learning records. There exit five categories of learner’s knowledge level. Table II shows the five categories for learner’s knowledge level. Performed study in E-learning area found that E-learning improves learning performance [29].

Knowledge Level	Score
Excellent	85-100
Very good	75-84
Good	60-74
Average	50-59
Below Average	35-54

Table 2. Categories Of Knowledge Level

VI. CONCLUSION

A smart E-learning ontology based website system is presented in this paper. This SELOWS system acts as a real teacher, since it teaches, then, evaluates learners, and maintains their status. Also, the tools chosen for SELOWS development are characterized by ease of their integration without providing any compatibility problems. E-learning proved to be efficient and faster in learning than traditional learning.

REFERENCES

[1]. P. Barker, “Developing Teaching Webs: Advantages, Problems and Pitfalls”. Educational Multimedia, Hypermedia & Telecommunication (AACE) Conference, 2000.
 [2]. P. Drucker, “Need to Know – Integrating e-Learning with High Velocity Value Chains”. Delphi Group White Paper. Available at: <http://www.delphigroup.com>.

- [3]. How e-Learning works. Available at <http://communication.howstuffworks.com/elearning1.htm>
- [4]. T. Berners-Lee, J. Hendler, and O. Lassila, "The Semantic Web", *The Scientific American*, vol.284, pp.34–43, 2001.
- [5]. J. Heflin, and JA Hendler, "Portrait of the semantic web in action". *IEEE Intelligent Systems*, vol.16, pp. 54-59, 2001.
- [6]. A. Gómez-Pérez, and O. Corcho, "Ontology languages for the semantic web". *IEEE Intelligent Systems*, vol.17, pp.54-60, 2002.
- [7]. SA McIlraith, TC Son, and H Zeng, "Semantic web services". *IEEE Intelligent Systems*, vol.16, pp. 46-53, 2001.
- [8]. O. Lassila, "Web Metadata: A matter of semantics". *IEEE Internet Computing*, vol.2, pp. 30-37, 1998.
- [9]. T. Berners-Lee, M. Fischetti, and TM Dertouzos, "Weaving the web: The original design and ultimate destiny of the world wide web by its inventor". San Francisco; Harper,1999.
- [10]. H. Hassanzadeh, and MR Keyvanpour, MR, "A Machine Learning Based Analytical Framework for Semantic Annotation Requirement", *International Journal of Web & Semantic Technology (IJWesT)*, vol.2, issue 2, pp. 27-38, 2001.
- [11]. S. Decker, S. Melnik, F. Harmelen, D. Fensel, et al., "The semantic web: The roles of XML and RDF". *IEEE Internet Computing*, vol.4, pp.63-74, 2000.
- [12]. W3C site. Available at: (www.w3.org/XML, www.w3.org/RDF, www.w3.org/TR/2004/REC-owl-features-20040210/) and (<http://www.w3.org/2000/10/swap/Primer.html>).
- [13]. Y. Sure, et al. "Methodology for development and employment of ontology based knowledge management applications". *ACM SIGMOD Record*, (31) 18-23, 2002.
- [14]. C. Brewster, et al. " Knowledge representation with ontologies: The present and future". *IEEE Intelligent Systems*, vol.19, pp. 72-81, 2004.
- [15]. L. Stojanovic, S. Staab, and R. Studer, "eLearning based on Semantic Web". *World Conference on the WWW and Internet*.
- [16]. Wikipedia website. Available at: <https://en.wikipedia.org/wiki/XML>
- [17]. W3CSchools website. Available at: http://www.w3schools.com/rdf/rdf_intro.asp.
- [18]. M. Nilsson, M. Palmer, and A. Naeve, "Semantic Web Metadata for e-Learning - Some Architectural Guidelines". Available at <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.12.7652>
- [19]. W. Guo, and D. Chen, "Semantic Approach for e-learning System". proceeding of IMSCCS'06 at IEEE, 2006.
- [20]. L. Stojanovic, S. Steffen, and S. Rudi, "eLearning based on the Semantic Web". Available at <http://www.aifb.unikarlsruhe.de/~sst>
- [21]. D. Bonino, F. Corno, and G. Squillero, "Dynamic Optimization of Semantic Annotation Relevance". Dipartimento di Automatica ed Informatica, Politecnico di Torino, Torino, Italy.
- [22]. B. Dutta, "Semantic Web Based E-learning". Documentation Research and Training Centre Indian Statistical Institute, Bangalore, 2006.
- [23]. YA Alsultanny, YA, "e-Learning System Overview based on Semantic Web". Graduate College of Computing Studies, Amman, Jordan, 2006.
- [24]. S. Buraga, and M. Cioca, "Modeling Aspects of Semantic Web-based E-learning System". Faculty of Computer Science, Alexandru Ioan Cuza University of Iași, Romania, 2003.
- [25]. Protégé website. Available at <https://protege.stanford.edu/>
- [26]. Jena website. Available at: https://jena.apache.org/getting_started/index.html
- [27]. Introduction to servlet. Available at <http://www.studytonight.com/servlet/introduction-to-servlet>
- [28]. Servlet life cycle. Available at <http://www.studytonight.com/servlet/servlet-life-cycle>
- [29]. U. Kose, and A. Arslan, "E-Learning Experience With Artificial Intelligence Supported Software: An International Application on English Language Courses". *GLOKALde*, an official e-Journal of UDEEEWANA, vol.1, issue 3, July 2015.
- [30]. KN Shamsi, ZI Khan, "Development of an E-Learning System Incorporating Semantic Web". *International Journal of Research in Computer Science*, vol.2, issue 5, pp. 11-14, September 2012.
- [31]. A. Dwivedi, and A. Bawankan, "Development of Semantic E-Learning Web using Protégé". Dronacharya College of Engineering, India.