ATTIQ UR RAHMAN A SEMANTIC PORTAL FOR ACCESSING NEU ENGINEERING FACULTY NEU 2019

A SEMANTIC PORTAL FOR ACCESSING NEAR EAST UNIVERSITY ENGINEERING FACULTY

A THESIS SUBMITTED TO THE GRADUATE SCHOOL OF APPLIED SCIENCES OF NEAR EAST UNIVERSITY

By
ATTIQ UR RAHMAN

In Partial Fulfillment of the Requirements for the Degree of Master of Science in Computer Engineering

NICOSIA, 2019

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Approval of Director of Graduate School of Applied Sciences

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We certify this thesis is satisfactory for the award of the degree of Master of Science in Computer Engineering

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last Name:

Signature:

Date:

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ABSTRACT

Recently in education technology has played a vital role and big amount of work has been done in the semantic web portal to grant users to learn or access besides the conventional websites. The emerging of Semantic Web technologies allow the experts to develop an intelligent portal system easily and also allow the users to access and learn the contents available on the Web portal. Generally, when the materials are presented as a semantic portal, the users engage more with the contents, and thus access quickly and easily. Significant amount of work have been done in developing ontology based portal system but some of them combine Semantic web technologies. The Semantic Web is an ideal framework portal system because the use of ontologies increases the reusage of the system. Also different users have different backgrounds and learning and accessing the sites, so there is always a need of developing a system which adapts itself according to the user's knowledge and preferences. In this work, we developed a semantic portal for accessing that using Semantic Web technologies which allow users to learn and access information quickly and easily.

Keywords: Semantic Web; Jena; semantic portal; SPARQL; User Interface

OZET

Eğitimde son zamanlarda teknolojiler hayati bir rol oynadı ve sementik web portalında kullanıcıların geleneksel web sitelerinin yanı sıra öğrenmelerini veya erişmelerini sağlamak için büyük miktarda iş yapıldı. Semantic Web teknolojilerinin ortaya çıkması, uzmanların akıllı bir portal sistemini kolayca geliştirmelerine ve aynı zamanda kullanıcıların Web portalında mevcut olan içeriklere erişmelerini ve bunları öğrenmelerini sağlar. Genellikle, malzemeler sementik bir portal olarak sunulduğunda, kullanıcılar içeriklerle daha fazla ilgilenir ve böylece hızlı ve kolay bir şekilde erişir. Ontolojiye dayalı portal sistemi geliştirmek için önemli miktarda çalışma yapılmış, ancak bir kısmı Semantik web teknolojilerini bir araya getirmiştir. Semantik Web, ideal bir çerçeve portalı sistemidir çünkü ontolojilerin kullanımı sistemin yeniden kullanımını arttırmaktadır. Ayrıca farklı kullanıcılar farklı geçmişlere ve sitelere erişip sitelere erişebiliyorlar; bu nedenle, kullanıcıların bilgisine ve tercihlerine göre kendini uyarlayan bir sistem geliştirmeye her zaman ihtiyaç duyulmaktadır. Bu, kullanıcıların bilgileri hızlı ve kolay bir şekilde öğrenmesini ve erişmesini sağlar.

Anahtar Kelimeler: Semantic Web(Anlamsal ağ); Jena; sementic portal(semantik portal); SPARQL; User Interface (kullanici arayuzu)

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CHAPTER 1

INTRODUCTION

One of the best development and extraordinary accomplishment in the twentieth century is the World Wide Web (Web 1.0). Its prosperity is genuinely founded on its effortlessness of finding (URIs), distributing (HTML), and perusing (HTTP) data on the PC systems.In any case, Web 1.0 succumbs from distributing constraints, which requires huge measure of programming speculations to distribute data.Web 2.0 has altered this by giving simple to utilize web devices to empower individuals to generate information and distribute it effectively on the web**.** Also, this brought about a blast of the web content, a huge number of individuals are producing web content in web journals, informal communities, and so forth**.** Presently the issue of the web is that it is extremely hard to locate the pertinent data in the wide web.To address this issue "semantic web" has been recommended as an augmentation to the present web [6].

Web access point that is capable of accumulating data, web pages intosolitary sorted out website is called a Web portal.To overcome the limitation of Web portals with information access, search, integration and sharing, Semantic Web portals (aka semantic portals) have been introduced (Lara et al., 2004). Semantic portals contain collections of semantically structured information that are conformed by ontologies (Shadbolt et al., 2006). Since the contents of semantic portals are represented with machine-readable semantics, their content is availablehumans.

The today web ıs the gathering of records and computer are stating these records. From Google or web the users or end clients look for records by posing questions . Computer get or understand the HTML code word by word and show or give the result regarding to it . However the computer can not understand the meaning behind those records which the users are giving to the system. Lets take an example “I love playing games ”.The search engines get it or understand ıt just the combinations of words however if we change the structure or syntax of words then the computer will not understand what does ıt mean. In semantic web the computer will always get or understand the meaning behind the sentences that the client or users like to know about games and the equipment for games and all others things related to games . Semantic web are always the same regardless of change ın structure or syntax of words e.g. “ I love playing games ”ıs same as “ I ♥ playing games ”

At present, metadata generation is not a fully automated process and necessitates an overhead. Most of the research in semantic portals thus focuses on ontology creation, metadata population, sharing and maintenance. However, there are problems with some of these approaches, such as that newly, added content cannot be seen at run-time and Web interfaces pose difficulties for inserting information. On the other hand, according to Semantic Web premise, presentation of information in semantic portals can be improved by using semantics of the content and reasoning, thus providing better user support.

However, most of the current semantic portals do not take into account the full benefits of Semantic Web technologies for better user support. When the user reaches an interesting information item, finding relevant content may not be an easy task since often hyperlinks between relevant items may be insufficient within a semantic portal. Many semantic portals use explicitly defined ontology-based links for linking. However, this approach is not always adequate since users are often not aware of the ontology specification and relationships between concepts within ontology's. Relying only on explicitly created ontology-based links may result in poor navigation within the portal.

1 Motivation

The inspiration behind this research work is to explore the potential favorable circumstances of semantic web within the plan of Near East University website and to appear how different innovations can be joined to form applications in light of ontologies.

1.1 Problem Statement

Deliberately the tremendous advantage that are experienced within the utilization of semantic web in making search system, there are still some mistakes in the site of Near East University in the successful and productive utilization of search system. The purpose of this research work to investigate the semantic web concept to improve the structure of searching of Near East University Website.

1.2 Objectives of the Study

Some particular objective of this study is as follow,

1. To update the search structure of Near East University Engineering faculty website.
2. The information and data will be process and assemble which is placed at different places (likeNear East University Engineering faculty Website) on individual system just like (OWL ontology).
3. To execute queries on information gathered on OWL ontologies.
4. The queries will be execute on gathered information on OWL ontology.

1.3 Importance of the Study

It is expected from this study to provide a program in which the students of Near east University will be able to search the data or information about lecturers, courses, publications of a teachers and students in each departments etc.

The interface of the proposed work will make it possible for the clients to communicate with the ontology in moderate and friendly manner. By this proposed system student can make questions and find their required information's as they doing usual web pages when they are searching for data.

CHAPTER 2

LITERATURE REVIEW

In this chapter, we briefly describe about Semantic Web, and Semantic portals

2.1 Semantic Web Technologies.

Here, we briefly explain what Semantic Web is and how it differs than the current Web. At the end, few of the Semantic Web technologies are explained such as RDFS/OWL, RDF Semantic Rules, and SPARQL.

2.1.1 Current Web

Current Web is developed by Sir Tim Berners-Lee. It is the combination of interconnected Web pages, called hypertext documents which span over the Internet. These Web pages contain text, images, audios, videos and can be accessed using hyperlinks and viewed by using Web browsers (Wikipedia 2006). All of these data can be accessed and exchanged using Hypertext Transfer Protocol (HTTP). The Web pages are written in HTML and can be accessed using URL (Uniform Resource Locator).

A newer version of the current Web, so called Web 2.0, has taken users into new generations as compared to the original Web. With the rise of social media sites like Facebook and Twitter, has enable development of new concepts like blogs, wikis and other social media Websites. Therefore Web 2.0 also allows easier sharing and rating of part of knowledge on websites without uploading the whole page.

Since there are millions of different web pages connected to each other via hyperlinks, getting the right information at right time is a tedious job in the current Web applications. For example, if we ask computer to “Show me all programming language books written by Wrox authors, whose price is less than $100 and number of pages less than 500”. This is beyond the capability of the current Web applications and to hit this search, we have to give the search engines intelligence and make it smarter. This is the reason its emergence in the 2000.

2.1.2 Semantic Web

As defined by Sir Tim Berners-Lee, “The Semantic Web will convey structure to the important substance of Web pages, making a domain where programming specialists meandering from page to page can promptly do complex errands for clients[SW00, 2000].”

Its basic priciple is simple: Making itunderstandable rather than machine readable. The current Web is only understandable by people, and applications cannot understand it. Thus

an application cannot communicate with other applications. Semantic Web provides standards to represent data in machine-understandable way. Thus reasoning about the users can be assisted by bringing them the relevant information. In the Semantic Web, it is also possible to re-use the existing vocabularies. For example, a book written by an author can be described by two vocabularies: book title described by Dublin Core (Dublin Core Initiative) and author described by using the FOAF (Friend-of-a-Friend) vocabulary (Dodds 2004).

The Semantic Web does not replace the current Web, rather it is an extension of the current Web in which information has been given a well-defined meaning and thus data could beunderstood(Stumme, 2006). According to John Mark off, Semantic Web is an innovation that provide a more productive and better approach to enable PCs to arrange and make inferences from online information.It'score is the semantic layer cake which provides different components in layers to develop Semantic Web applications (Elena, 2010). One of the important components of the semantic layer cake is the "Rules" which allows computers and applications to reason about the Web content and infer new knowledge based on the existing one.

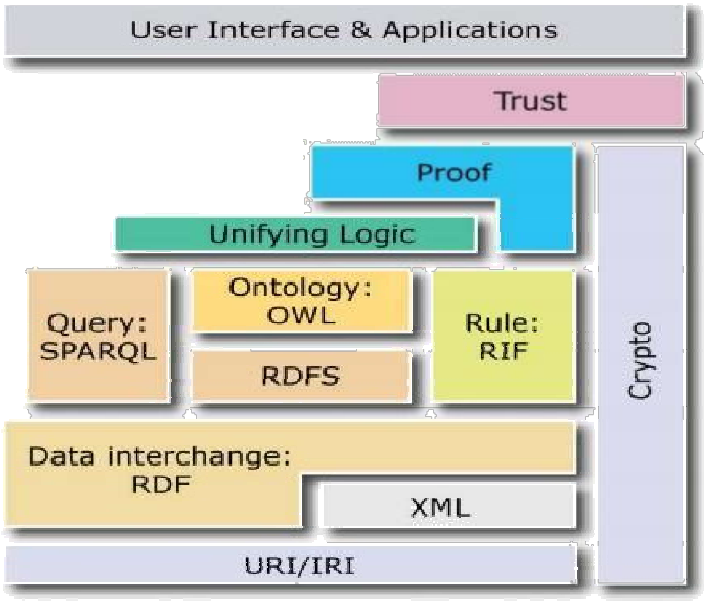

Figure 2.1 A sample XML syntax

2.1.3 Unicode and Uniform Resource Identifier (URI)

A scheme which help developers to create software applications working in any language of the world is referred to as Unicode. It contributes a different digit for each castregardless of any language.

Uniform Resource Identifier (URIs) are the addresses which uniquely recognize a system. A resource can be anything like a city, person, file, disease, food, etc.

A URI could be a Uniform Resource Locator (URL), a Uniform Resource Name (URN) or both. In addition to recognize a source,a URL couldalsobe used to locate the resource and describe its primary access mechanism. If the access mechanism or network location is given in a URI, like “http” or “ftp”, then the URI becomes URL.

A typical URL is given below:

http://www.example.com/myfile.txt

ftp://filelocation.com

URN is also a subset of URI and identify the resource by name. URN can be used to refer to book names by identifying its International Standard Book Number (ISBN).

Urn: ISBN: 08764653

```
<? xml version="1.0"?>

<book id="book1">

    <author>John Horton</author>

    <title>Introduction to XML</title>

    <genre>Programming</genre>

    <price>30</price>

</book>
```

Figure 2.2 A sample XML syntax

2.1.4 Extensible Markup Language (xml)

Extensible Markup Language (XML) is a meta-language for documents markup and allows us to define our own tags. XML gives syntax for documents markup and syntax to the structure of documents.

XML derived from Standard Generalized Markup Language (SGML). XML has a smaller and simple syntax than SGML which help developers in creating, managing and displaying documents.

A simple syntax of XML describing a book is shown in Figure 2

Some of the key advantages of XML are:

XML providescomprehensive format.

It can be used in aassortment of platforms and with aassortment of instrument and hence provide interoperability.

It is extensible and new tags can be created with less effort compared to SGML and an XML tag can contain any number of attributes.

XML is W3C standard.

The hierarchical structure of XML is suited to most types of documents (though not for all types).

It supports multilingual documents using Unicode and information in any human language can be easily communicated.

2.1.5 The Resource Description Framework (RDF)

The Resource Description Framework describes resources on the Web. A resource can be anything like a person, book, country, disease, moon and which can be assigned a URI by which they can be identified. Standardized by W3C, RDF is used to describe the resources and allows to encode, exchange, and reuse the structured data on the Web.

RDF describes the resources in the form of triples, which is just a simple statement. A triple constitutes of a Subject, Predicate, and Object which forms a statement.

A simple triple (statement) is:

Ronaldo is a player

• Subject (Resource): Ronaldo

• Predicate (Property): is a

• Object (Value): player

A subject and predicate in a triple must be a resource and must have assigned a unique URI, where as an object may be a resource or a simple value like name, number etc. In the example as shown in Figure 2.3, object is a resource.

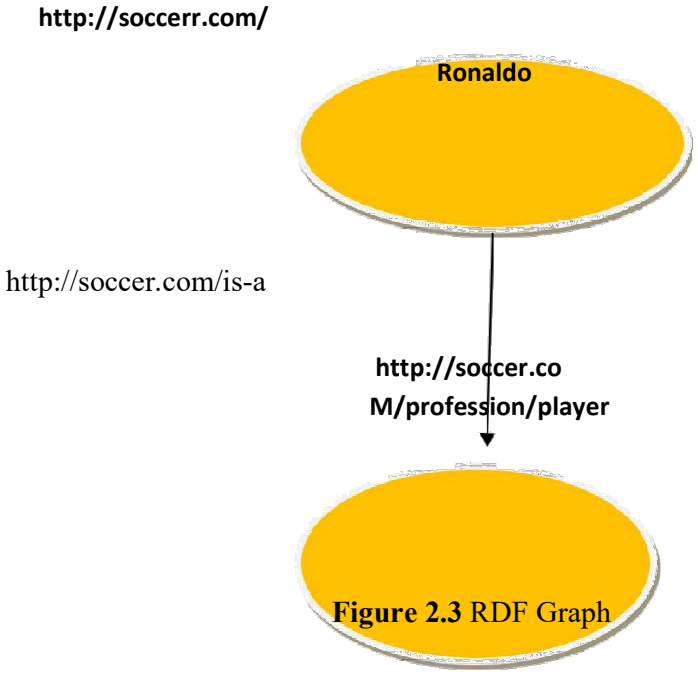

Figure 2.3 RDF Graph

RDF triples can be serialized in several ways:

RDF/XML: It is most widely used RDF serialization which uses XML syntax. It is W3C recommendation since February 2004.

N-Triples: It is also W3C recommendation and uses simple, plain text for exchanging and storing RDF data.

Notation 3 (N3): It is compact and much more human readable than RDF/XML format.

Turtle (Terse RDF Triple Language): After RDF/XML, they are commonly used and is a W3C candidate recommendation.

Resource Description Framework (RDF) provides some basic vocabulary to triples like rdf:type and does not go in detail like what is the sub class or sub property of a particular class or property respectively.

Resource Description Framework Schema (RDFS) defined by W3C, provides more rich vocabulary than RDF. The basic constructs RDFS provides is listed below:

rdfs:Class

rdfs:Resourcerd

fs:subClassOf

rdfs:subPropertyOf

rdfs:domain

rdfs:range

According to RDFS documentation, Brickley, (2004), rdfs:Class is the super class of everything. In addition, rdfs:Resource is anything which can be assigned to a URI and can be placed as subject or object of the RDF triple.

A property/predicate has a domain and range defined by rdfs:domain and rdfs:range. If the property is data property, the rdfs:domain is a class and rdfs:range is a data type like integer or string. If the property is object property, both the rdfs:domain and rdfs:range should be instances of classes. rdfs:subClassOf and rdfs:subPropertyOf shows a class and a property that is the sub-class and sub-property of a particular class and property respectively.

RDFS provides some basic level of reasoning. For instance, if Vitz is a type of Car and Car is the sub class of Vehicle, then the reasoned can explicitly infer that “Vitz is a Vehicle”.

2.1.7 Ontology

Ontology is basically, the study of something which “exists” and its categories. In Computer Science, an ontology is a vocabulary which provides detail of some domain. Ontologies are used to provide a formal and shared understanding of the domain of interest.

Several authors have defined ontology in their own words but we will use how Stanford has defined the ontology. itis a precise express depiction of ideas in a space ofdivision(Natalya , 2000). The ontology with all of its associated data is then called knowledge base.

An ontology can be created using the following steps:

Define the concept (classes) of domain.

Arrange the classes in sub class/super class hierarchy (this hierarchy is called taxonomy).

Describe the relation and attributes of the relation.

Create the real world instances of the classes.

Ontologies have some key advantages which are described by (Natalya , 2000). Ontologies are used to share regularcomprehension of the structure of data,allows reuse of domain knowledge, and make explicit domain knowledge.

2.1.8 Web Ontology Language (OWL)

The web ontology language is the ontology specification of W3C. OWL is a standard knowledge representation language formally recommended by W3C in 2004 and is compatible with eXtensible Markup Language (XML) as well as other W3C standards. OWL extends both RDF and RDFS and provides more variety of vocabularies and reasoning capabilities.

The basic ontology which have two classes is shown in Figure 2.5 below

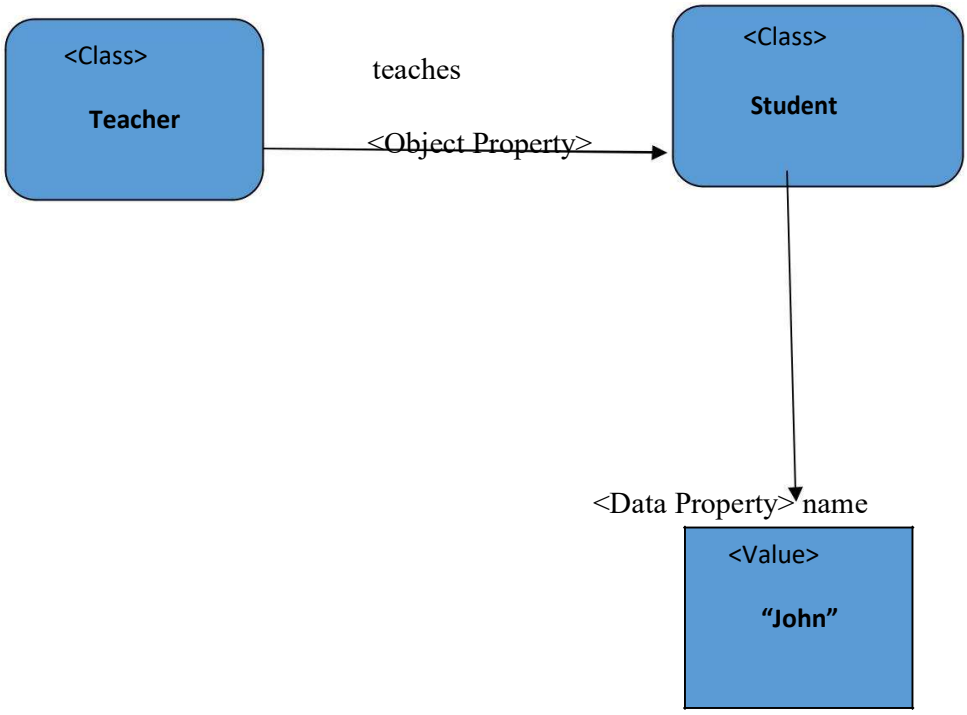

Figure 2.4 An RDF Example

OWL can be used to replace some RDF and RDFS relations such as owl:Class can be used for rdfs:Class. In addition, rdf:Property is replaced with owl:DatatypeProperty when the property is data type and owl:ObjectProperty when it is object property.

OWL has three sub languages OWL Lite, OWL DL and OWL Full, depending on the expressivity.

OWL Full: It is the union of OWL and RDF syntax. It provides maximum expressiveness but with no computational guarantee.

OWL DL (Description Logic): OWL DL has the closest correspondence to description logic which is more expressive without losing computational completeness.

OWL Lite: Users with low requirements and simple modeling need use OWL Lite and include simple constraint features.

An example, owl data in RDF turtle syntax is shown in Figure 2.6

```
@prefix rdf :<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
@prefix owl :<http://www.w3.org/2002/07/owl#>. @prefix:
http://someuri.org/
:Teacher   rdf:type     owl:Class .
:Student   rdf:type     owl:Class .
:name      rdf:type      owl:DatatypeProperty .
:name      rdfs:domain :Person .
:name      rdfs:range       :String .
:teaches       rdf:type   owl : ObjectProperty .
:teaches   rdfs:domain :Teacher.
:teaches   rdfs:range      :Student
:Teacher     :name " John "^^xsd : string.
:Student     :name " Bush "^^xsd : string.
:Teacher      :teaches     :Student .
```

Figure 2.5OWL data in RDF turtle syntax

2.1.9 SPARQL

SPARQL Protocol and RDF Query Language (SPARQL) is the standard RDF query language. Recommended by W3C since 2008, SPARQL resemble the SQL language and have the same SELECT, WHERE, FILTER BY terms. SELECT, CONSTRUCT, DESCRIBE, and ASK queries can be used in SPARQL to query the existing RDF triples or create new ones.

SPARQL is used to query RDF graph which comprise of triples. A typical SPARQL query consists of triples which extract subjects, predicate, and objects from RDF graphs.

mark (?) should be used before the variable name. Prefixes can be used to define the Uris of the triples used.

The Figure 2.7 shows a basic SPARQL query which gets the capital city of Turkey from DBpedia (Semantic Web version of Wikipedia).

```
PREFIX dbr : <http: //dbpedia.org/resource/>

PREFIX dbo : <http: //dbpedia.org/ontology/>

SELECT ?capital

WHERE {

 dbr:Turkeydbo:capital ?capital. }
```

Figure 2.6A SPARQL query example

UNION, OPTIONAL, FILTER BY, ORDER BY etc. are used in the complex SPARQL queries to get data from multiple graph, diminishFigure 2.8 shows a SPARQL query which uses OPTIONAL keyword. It will extract the person name from the graph and if there is person's age in the graph, the SPARQL engine will display it as well. If the OPTIONAL keyword is not used and there is no age information in the graph, nothing can be displayed.

```
PREFIX rdf:<http://www.w3.org /1999/02/22 rdf –syntax-ns#>

PREFIX foaf:http://xmlns.com/foaf /0.1/

 SELECT ?person ?name

WHERE

 ?person  rdf:type  foaf:Person.

 ?personfoaf:name ?name OPTIONAL {

?personfoaf:age ?age .}

                              }
```

Figure 2.7A SPARQL query example using OPTIONAL

2.1.10 Rule Engine/Reasoning

There are two basic types of reasoning used in Semantic Web: Ontology based reasoning and Rule based reasoning. Ontology based reasoning is useful for classification based reasoning and it is based on RDFS and OWL axioms. It does not require any rule engine.

Rules based reasoning need a rule engine and a language for representing the rules. Semantic Web Rule Language (SWRL), Notation 3 (N3) logic, and Rule Interchange Format (RIF) are basic rule definition languages. Jena rules are another type which needs a rule engine.

SWRL's basic form is XML and also support human-readable form. It is supported by Protégé ontology editor and also supported by reasoners like Pellet and Hermit. It provides unary predicates to describe classes and binary predicates to describe properties.
Notation3: It is also called N3 for short, and is considered human readable and support to write formulas inside rules. It supports a reasoning engine CWM, written in Python and is open source.

Rule Interchange Format, RIF in short, is a collection of dialects which intends to share and exchange rules in semantic web based rules system**.** There are many rule languages available and RIF is used to exchange rules between these languages, RIF supports three dialects: Core Dialect, Basic Logic Dialect and Production Rule Dialect.

2.1.11 User Interface

User Interface (UI) is the final layer in semantic web layers cake which provides the users of the system to communicate and interact with the application. Along with Cryptography and Trust, UI is another semantic web technology which is not standardized yet and will be implemented in future.

2.2 Portals

There are many divergent definitions for portals. Definitions vary between functional and technological foci, and range from describing structured websites to complex information systems. According to the definitions summarized in [De05] portals should be considered web-based application systems, or, “system[s] of integrated programs”.

In [Ka01] (community web) portals are defined as systems that "basically give the way to choose, order and access different data assets (e.g., locales, reports, information) for assorted target crowds (corporate, between big business, e-commercial center, etc.)."As summarized in [LW05], portals form “a gateway to the web that allows the plethora of information […] to be organized and customized through a single entry point”, and are “used to consolidate information from a vast array of resources.”An evaluation [Kr06] has shown that the salient property of portals, i.e. to offer a single point of access, has two major implementations.

Portals appear either as self-contained systems that encompass all provided services and contents themselves, or as hubs that collate external resources. With portals like SemanticWeb.org2 (in its current design), however, a third kind of portal has emerged: portals, which integrate sets of community managed RDF statements, i.e. a multitude of assertions about facts.

2.3 Semantic Portals

Semantic portals “exploit semantics for giving and estimating data” [Ma03], and they “generally implement intelligent around a distinct sphere and depend on ontologies to design as well as change this intelligent”[HS04]. Semantic Web technologies are applied to “constructing and maintaining the portal” [Ma03] as well. The degree and the focus of technology usage, however, varies. Examples are given in the next section.

We suppose that semantic portals could take the position of central building blocks in constructing the Semantic Web [Kr06]: By applying semantic technologies, they demonstrate the value of these technologies to a potentially large audience. Because they are reaching many customers, portals could be employed for popularizing ontologies and

establishing naming conventions (e.g., for named entities or domain specific taxonomies) across the internet. New ontologies could be collaboratively elaborated within semantic portals (cf., e.g., [Zh04]).

As was expressed in [Mc05], adding semantic descriptions to contents significantly increases the efforts spent in designing information bases. This observation is especially true for small collections of information, for which the ratio of ontology utilization versus its elaboration efforts is seemingly poor. When portals handle rather large collections this ratio becomes more attractive and the said obstacle less decisive. Interconnecting portals seems to be more efficient than interconnecting diverse small internet resources, since the number of necessary ontology mediations is dramatically reduced.

Not least, semantic portals may mediate between the Semantic Web and the current web by wrapping non-semantic contents with their ontologies thus raising the amount of information that can be located and processed exploiting semantics.

2.3.1 MuseumFinland

It is a semantic Portal for Finnish Museum. It is an application of the semantic web portal generator ONTOVIEWS. “The basic functions are a multi-facet search and combined keyword, and recommendation links (links generated using rules) (Sah, June 2009)”.

2.3.2 SEMPort

The Semantic Portal is a portal in which contents editing are done through RDF file aggregator web interface, protégé. “This search system is an ontology-based search that uses Jena API and Jena reasoner for navigation and search (Sah, June 2009)”

CHAPTER 3
SYSTEM ARCHITECTURE

3.1 Architecture

In this chapter it will briefly discuss various components of the proposed semantic web portal tool that uses Semantic Web technologies.

The Figure 3.1 shows the basic architecture of our sementic portal system. The tools we have used in our work are Protege editor, Java langaue,Netbeans, Jena APIs and SPARQL queries to get data from ontology. All of our data are stored in sementic web portal ontology, created in Protégé 4.3. We have used Jena methods to connect to our ontology and read data from the ontology. SPARQL queries are used to load the university data in our Java application. After user complete the search, all of his/her data are stored in user ontology.

The university system contains questions from Academic, Course, Faculty, Programme, Publication and Publisher categories.The data is stored in an owl file which is created using Protégé editor.

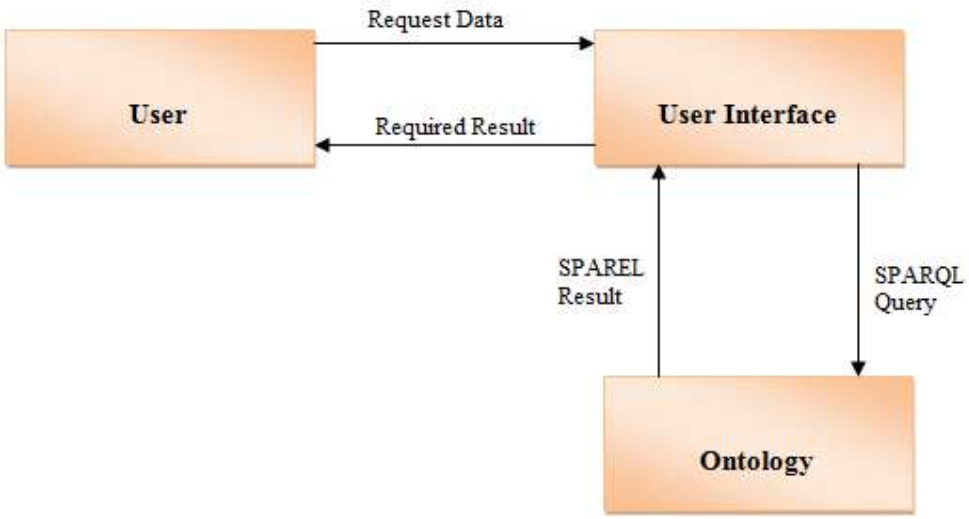

Figure 3.1 Proposed System Architecture

3.2 University Ontology using protege

All the data of the proposed university system are stored in the ontology universityontology.owl. It has classes, data properties, object properties and instances. The following are classes of university ontology.

- Academic: this class describes the staff of the engineering faculty(Prof,Assoc Prof,Assist prof).
- Course: it shows information about the courses.
- Faculty: it shows the information about the engineering faculty.
- Programme:it describes which department have which programme.
- Publication: it gives information about staff publications.
- Publisher: information about publication that who is the publisher

The object properties of the quiz ontology are given below:

- Author: it gives information about the author of publications.
- CourseBelongs:it describes the course related information that which departement it belongs.
- hasDeparment:it gives informations about the teachers that in which department they are teaching.
- HasProgramme:which department have which programmes e.g PhD,Undergraduate and Master.
- HasPublication:it gives a detail information about publications of a teacher.
- HasPublisher:which publication have which publisher.
- HasTitle:its about the title of publication.
- PublishedIn:it shows that the publication published in Journal or Conference.
- Teaches:it describes the teachers which courses they are teaching.

Similarly, some of the data properties of the baseline ontology are given below:

- Abstarct: it showes the abstarct of the publications.
- CourseContent:It gives informations about the course which the students will study during lecture.

- Credit: it showes the credit of the course.
- Email: here it gives the email of the Academic staff.
- FirstName:it showes the first name of the Academic staff.
- LastName:it showes the last name of the Academic staff.

- PublicationYear: it showes the year of publication.
- Title:it showes the title of publication.

Figure 3.2 shows an overview of the sementic web ontology from Protégé ontology editor. 3.2(a) shows sementic web ontology classes, (b) shows object properties, and (c) shows ontology data type properties respectively.

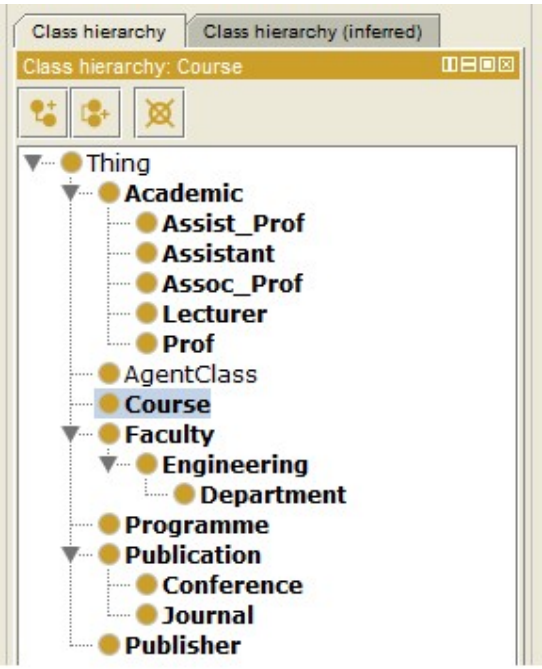

Figure 3.2 (a)Classes of Ontology

Table for object proporties

In this table we took property then we assign domain and range and at last coloumn its gives information about the property.

Table for object properties

Property Name	Domain	Range	Information
Author	Publication	Prof, Assoc Prof, Assist Prof	Author of the publication
Course_Belong	Programme	Department	Bachelor or master course and in which department its offering,
Has_Department	Prof, Assoc Prof, Assist Prof	Department	Give iinformation abot accadamic staff and their depatrment
Has_publisher	Publication	Conference or journal	Publisher of the publication

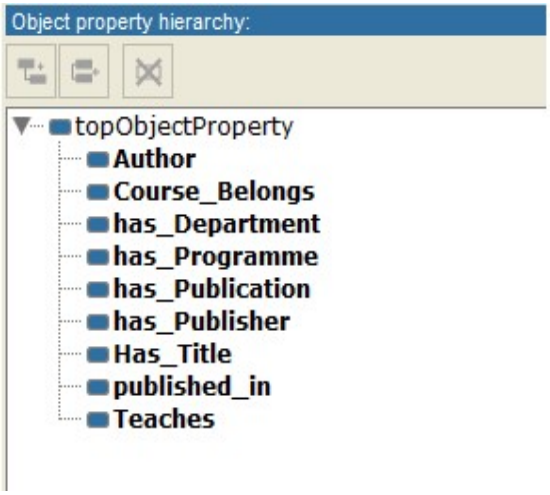

Figure 3.3 (b) Object Properties of Ontology

Table for object proporties

In data proprties we are giving domain and range and it gives information or detail about the classes.

Table for data proporties

Property Name	Domain	Range	Information
Absract	Publication	Text	Abstract of publication
Course Content	Course	Text	Content for course
Credit	Course	integer	Credit for course
Publication year	Publication	integer	Publication year in which it published.
First Name	Acadamic	string	First name of a Prof or Assis prof etc
Last Name	Acadamic	String	Second name of a Prof or Assis prof etc

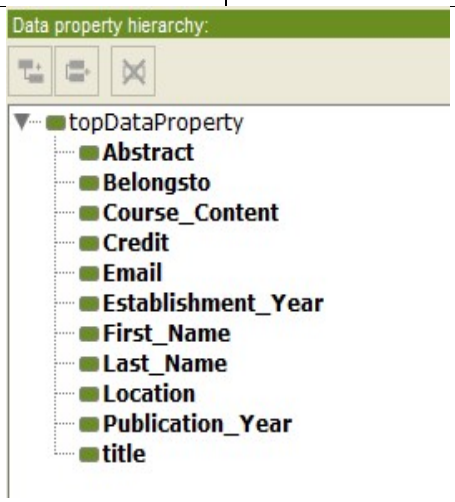

Figure 3.4 (c) Data Properties of Ontology

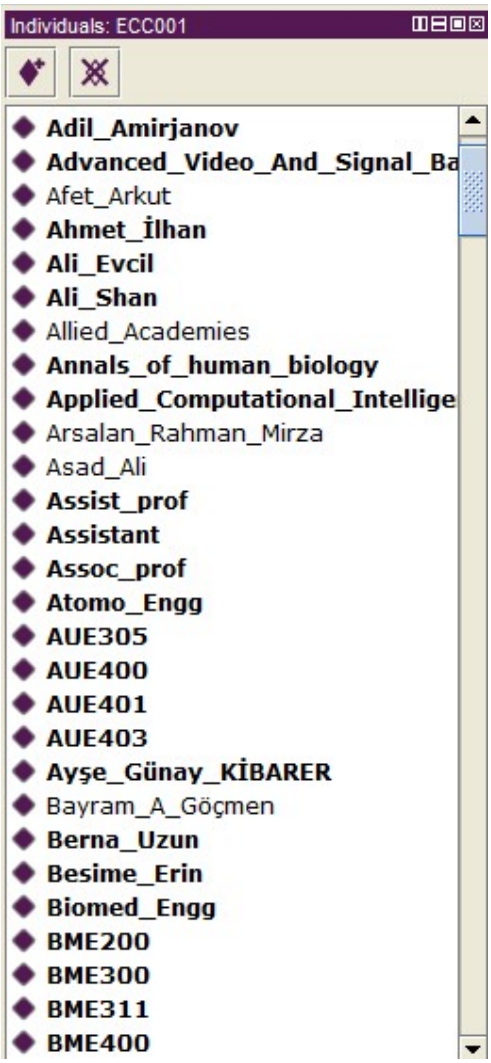

Figure 3.5(d)Instances of Ontology

we have created instances manualy in this case,i put too many instances like course code,teachers name,Authors,departments,Journal names,Conference name

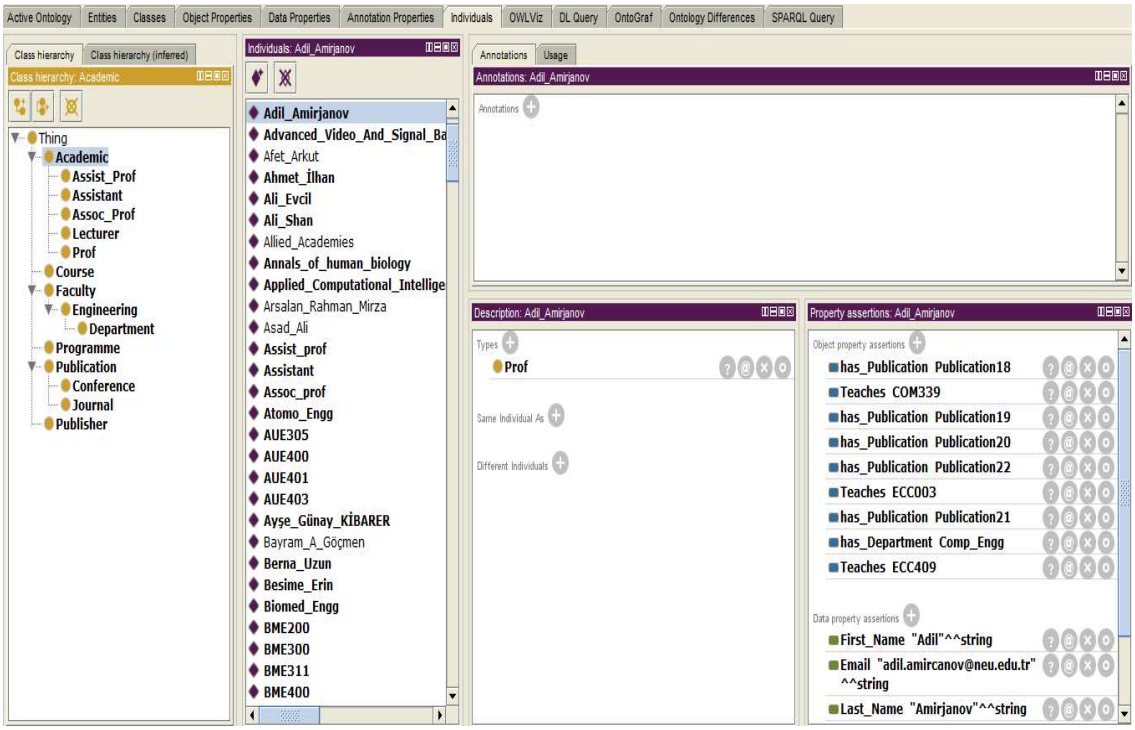

Figure 3.6 full ontology

This is my full ontology structure, In which we have classes, data properties ,object properties ,instances. here I will give one example, from Class academic in which we have select Prof Instance AdilAmirjanov which is a type of Prof which gives a detail about his publication ,his courses which her is teaching ,his department and from data properties shows his names .email etc

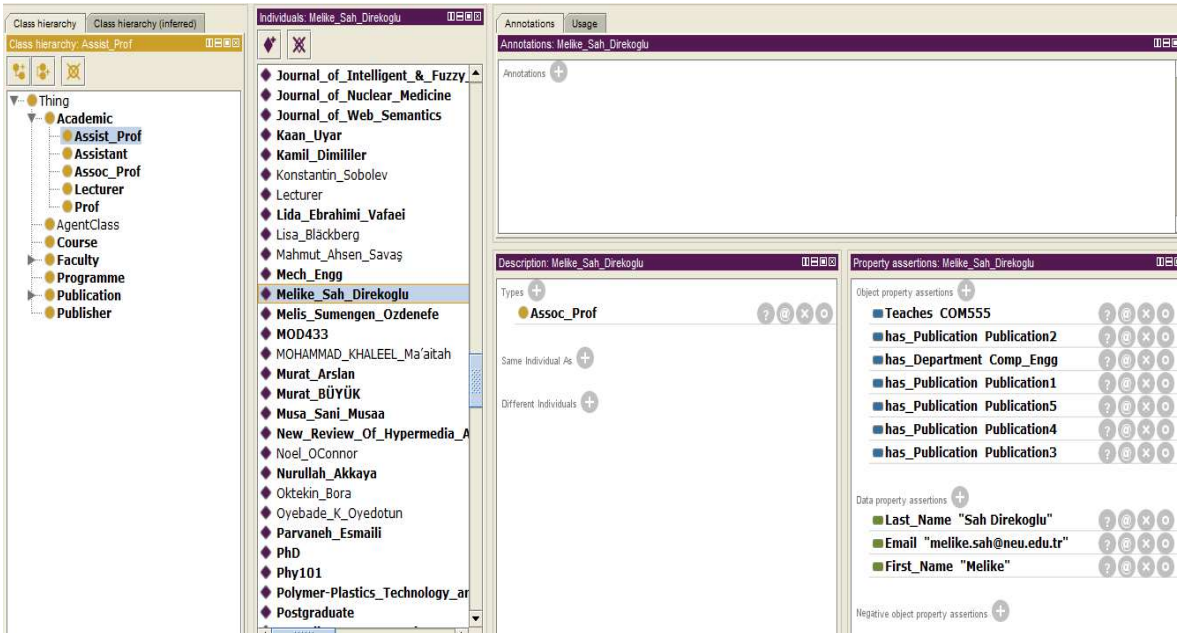

Figure 3.7screenshot from class academic using protégé

from Class academic in which we have select Instance Assist Prof Melikasah which is a type of Prof which gives a detail about his publication ,his courses which she is teaching ,his department and from data properties shows his names .email etc

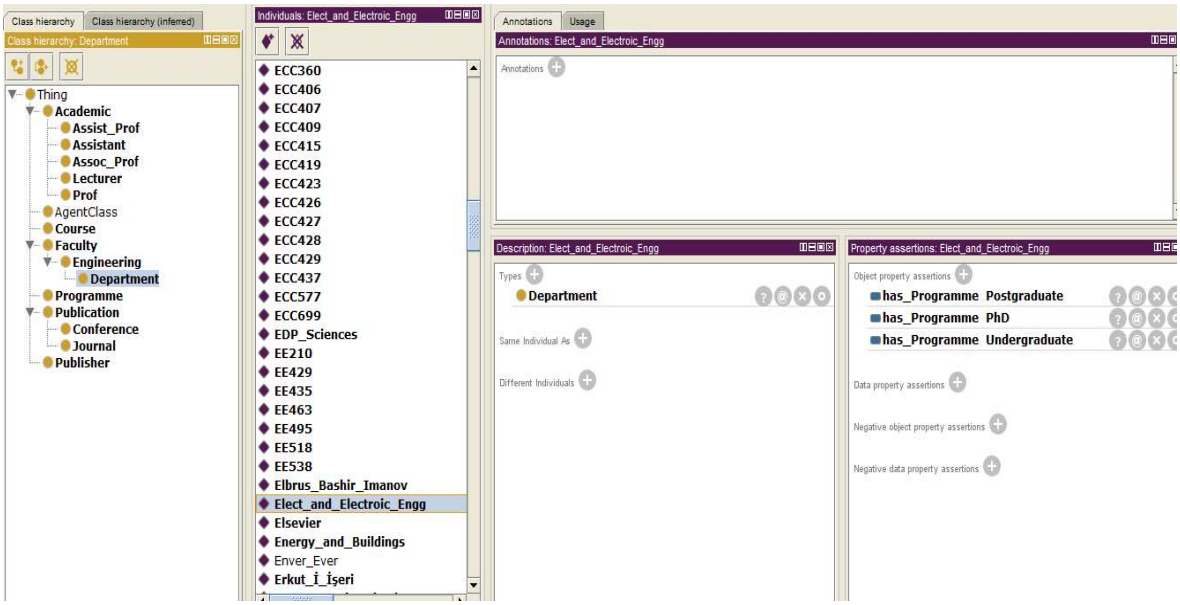

Figure 3.8screenshot from class department usıng protégé

from Class Department in which we have select Instance Electric and Electronic which is a type of department which gives information the programs like post graduate, PhD and undergraduate programs

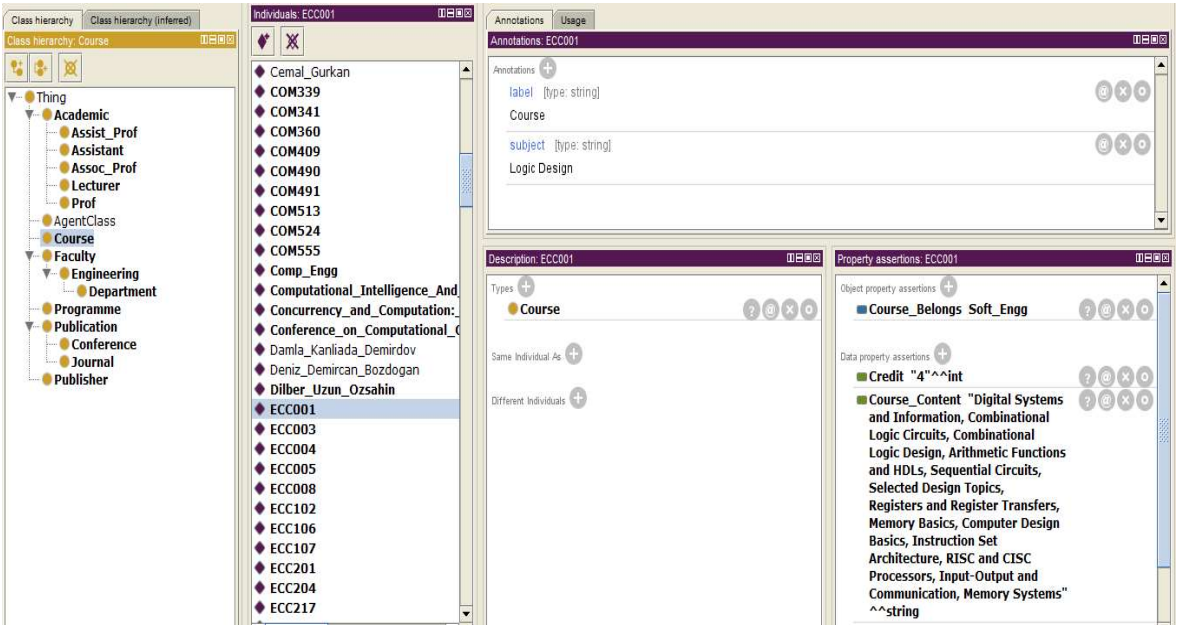

Figure 3.9 screenshot from class course using protégé

from Class Department in which we have select Instance course code which is a type of course which gives information about its course contents ,credit and in which department its offering.

3.2 User interface

User interface is the application that give information's to the end user .we prepared our proposed ontology interface in java. In our interface we have seven buttons by which end users can get their desire information. Semantic search interface has search window. In this search window the user can specifically enter the departments, courses, publications etc

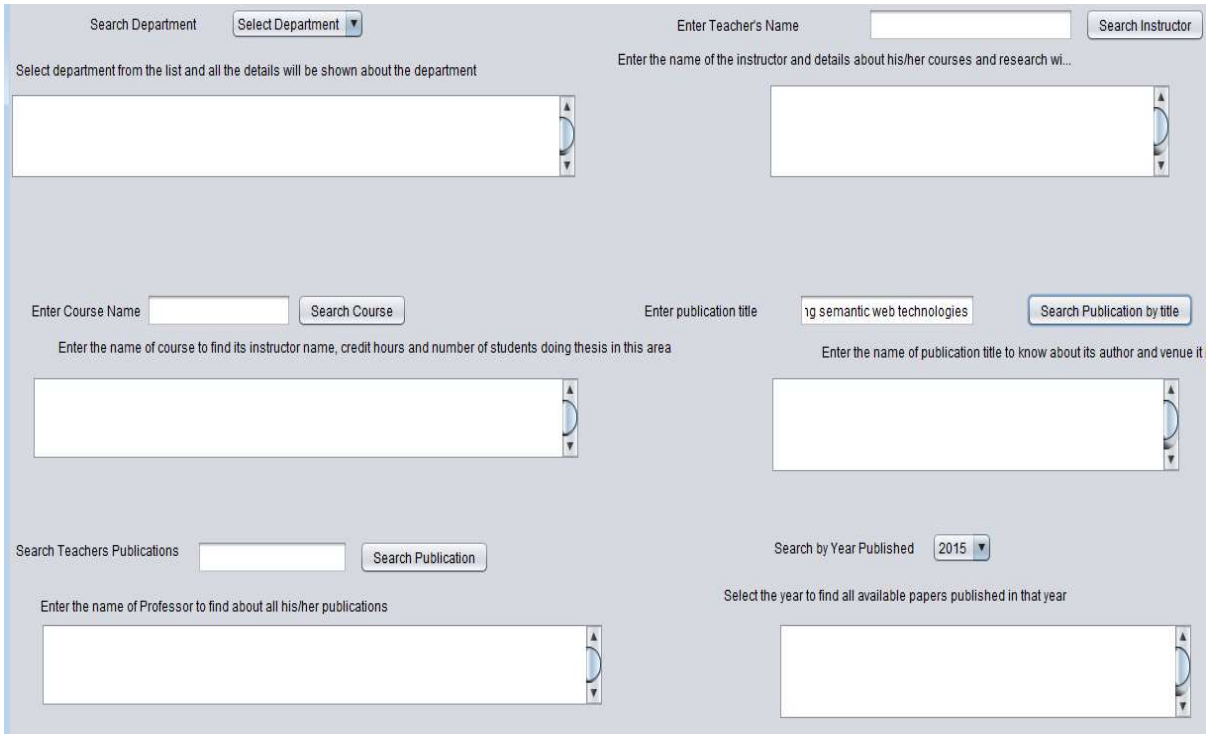

Figure3.10 full interface

This is our full interface in which we have different buttons like search for departments, teacher name ,course name etc. every button or drop box had explained one by one below

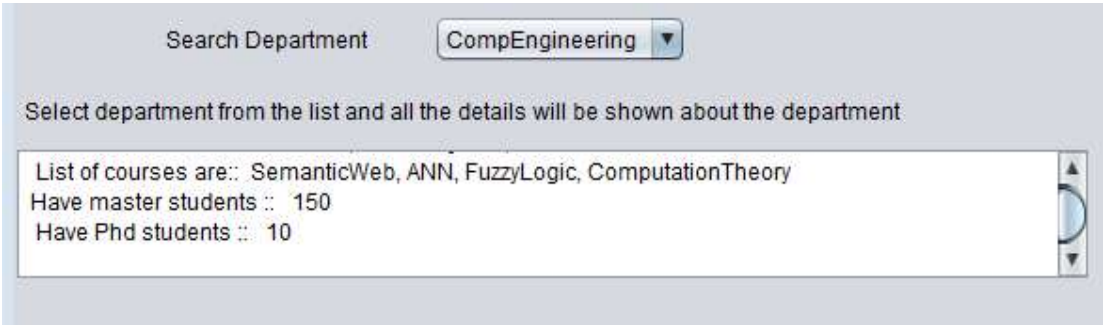

Figure 3.11 Search for department

For the searching of departments we have combo box in which user can select different department, which will give different information related to the searched department. It will give information's about the teachers, offering courses in that department and number of students in different programs like master, phD and undergraduate

Figure 3.12 search for course

By entering course name it will give information's that which teacher is teaching this course, in which semester is offering this course and how many students are doing thesis in subject.

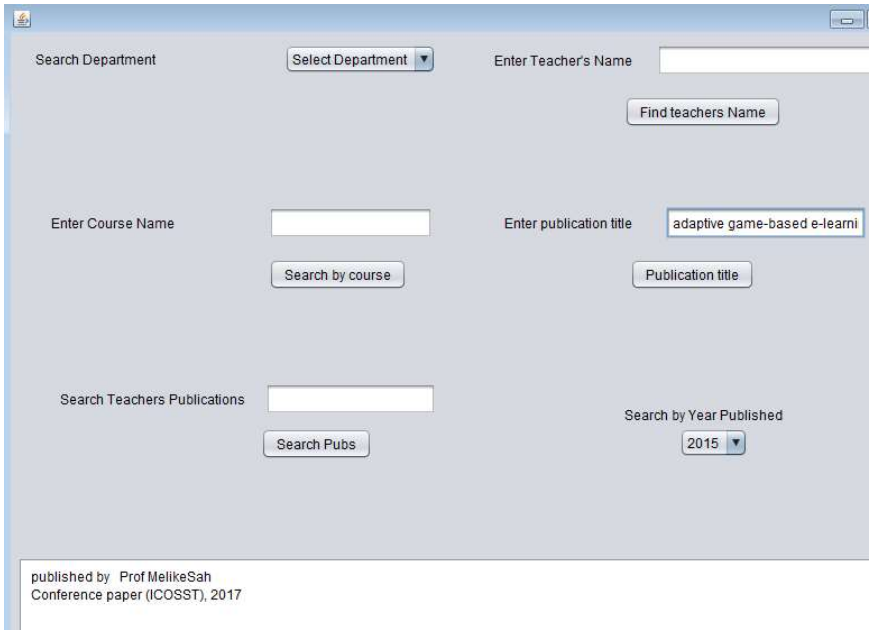

Figure 3.13 search by publication title

If some one know the title of publication ,they will just enter the title and will get the result that who published this paper, in which year it is Published and in which conference or journal it is published.

CHAPTER 4
USER EVALUATION

4.1User studies

We performed a user study in which different users used both the baseline and proposed portal system and have recorded their performance and views. In order to evaluate the performance of our proposed portal system, we have compared it to a baseline semantic web portal structure in an end user study. Inappropriate end user has to search the pair with standard and proposed structure, along with pursuing all inquiries. We swapped the two structures for distinct end user.

4.1.1Tasks

For the conduct of the proposed portal system to be review, several users were requested to execute some Project. Firstly, a training sampling will be assigned to the end user so as to learned the background (i.e. name, age, department, and country).Here, we utilized 17 participants, out of which 70% are bachelors student while 30% represent masters respectively. First of all, an end user will be tasked to try the baseline (NEU website) structure as well as solving the inquiry. Their performance in the search like time (minutes and seconds) was recorded. Immediately the first search is completed, the next system semantic web portal system(proposed system) and also executed.

When the user is done with the search, further inquiry is tendered to obtain an assessment about the system. Users then often share their assessment about the system.

4.2Experimental setup

The evaluation of the system is based on task-based information. Task completion time was followed from the very first displays of the questions right till when users submit their answers. The following below shows the order of the experiment.

First and fore most, students were told to fill a form about their background and experiences in the use of the everyday normal Web search such as Google search, yahoo search e.t.c.

4.3 Experiment with first system called Baseline

The two systems (Semantic search system or Near East University Systems Engineering Website search system) were presented to the students randomly so as to balance the effect of bias. Firstly, we show the students some sample of how the search Baseline (Near East University Systems Engineering Website search system) works. An example query was given to them before finally giving them the real semantic search system task. At that point, the students played out the habituated search effort using the first system called Baseline and were made a request to pen

down the appropriate responses. After filling the form about their search background and experiences, students were given the following to fill:

- A post-survey questionnaire.
- A usability questionnaire.

4.4 Experiment with second system called Proposed system

Secondly, we also show the students some sample of how the search Proposed system (Semantic web portal search system) works. In addition, an example query was given to them before finally giving them the real semantic search system task.After filling the form about their search background and experiences, students were given the following to fill:

- A post-survey questionnaire.
- A usability questionnaire.

4.5 Evaluation of Proposed and Baseline System

The time required to achieve the search is reported immediately the user finish the baseline and proposed system. Comparison is done based on the progress made so far with both the proposed and baseline system. From the study, it was revealed that our proposed portal sysrtm is far more capable than the baseline system. Much more required information is acquired within a short time compared with the baseline.

4.6 About your search experiences and background

This deals with the search experiences and background of the respondents.

Table 4.1: Study Degree Programme of Respondents

SN	Programme	No of Respondents	Percentage %
1	Undergraduate	11	64.0
2	Master	6	46.0
	Total	17	100

In view of the response of the respondents in Table 6.1, it was reveal that 11(64.0%) of the respondents are undergraduate students and 8(46.0%) are master students.

Table 4.2: How often do you use Near East Engineering Faculty Website to search for information (i.e. course information, lecturer information, etc.)?

S/N	Period	No of Respondent	Percentage%
1	"Frequent times in a year"	14	82.0
2	"Frequent times in a month"	3	17.0
3	"Frequent times in a week"	-	
4	"Frequent times in a day"	-	
	Total	17	100

Table 4.2 revealed the students search background and experience. 82.0% of the respondents said they use Near East Engineering Faculty Website to search for information"frequent times in a year" to seek for information while 17.0% of the respondents said they use Near East Engineering Website to search for information "frequent times in a month" to seek for information on the website. This implies that Near East University Engineering Faculty Website search system is not being used often to search for information.

Table 4.3:How often do you use Web search engines to gather information?

S/N	Period	No of Respondent	Percentage%
1	"Frequent times in a year" -	-	
2	"Frequent times in a month"	2	12.0
3	"Frequent times in a week"	1	16.0
4	"Frequent times in a day"	14	82.0
	Total	**17**	**100**

Table 4.3 revealed also some information on how often the users use web search engine to gather information. 14(82.0%) of the respondents reveal that web search engines “frequent times in a day” to seek for information, 2(12.0%)of the respondents reveals that they utilize of web search engines “frequent times in a week” to seek for information, 1(5.0%)of the respondents reveal that they utilize web search crawlers “frequent times in a week” to seek for information and none for frequent times in a year. This implies that search engine (crawlers) is a vital part of everyday online.

Table 4.4: Evaluation Tasks for Near East University Engineering Faculty Website Search System (Basline) and Semantic Search System (Proposed system)

S/N	Task	baseline system	proposed system
		Time (sec)	**Time(sec)**
1	Search department in faculty of engineering	10	3
2	Assuming this year you will take the course "*Semantic Web*" and you are willing to find the lecturer taking the course. Find the lecturer.	11	4
3	Using the system search for the course description, course credit and lecturer for the course *Fuzzy Logic*	16	7
4	Assuming this year you want to take thesis with Prof Melikesah and you want to know the number of students she is supervising.	15	5
5	Using the system search for the Publications by using title of publication.	59	21
6	Using the system search for the Publications of a Specific teacher by using teacher publications.	31	4
7	Search publication of a teacher by year.	33	5
	Average Total	**22**	**6**

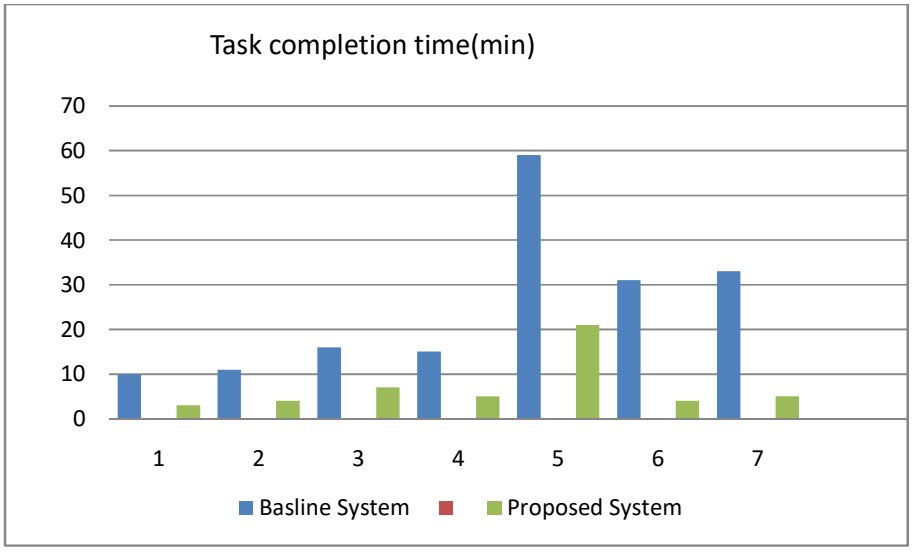

Figure 4.1: Bar chart for task completion times

4.6.1 Task 1

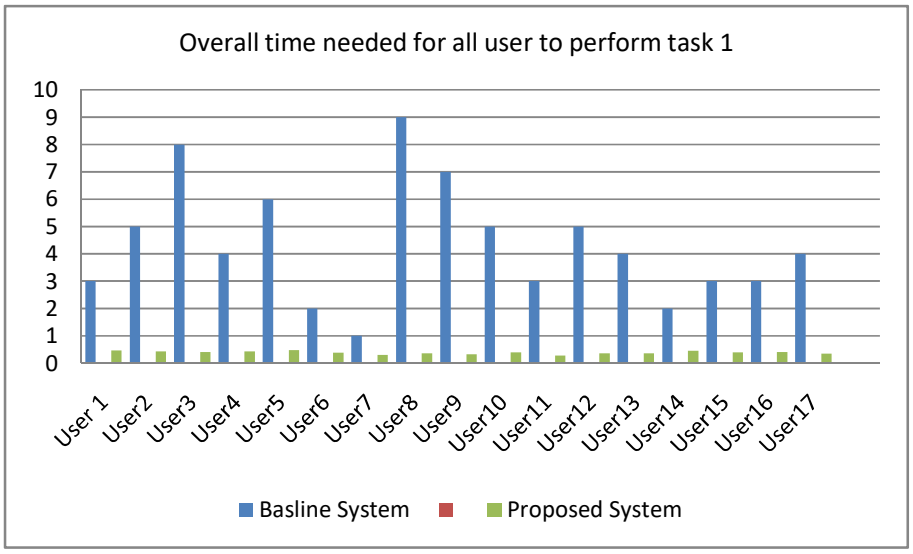

Figure 4.2 .Time Needed For Completing Task for Publication by title search

We can also search the publication of someone by entering the title of publication, for instance we will know the author of publication and year of publication in which it is published.

4.6.2 Task 2

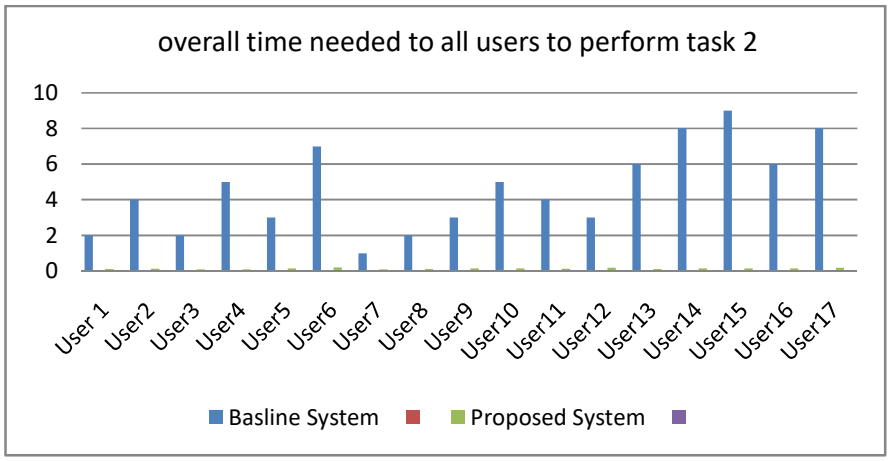

Figure 4.3. Time Needed For Completing Task for course search

In this kind of search one can find a detail information about the course such that course code, course description, credit hour etc and who is teaching the course.

4.6.3 Task 3

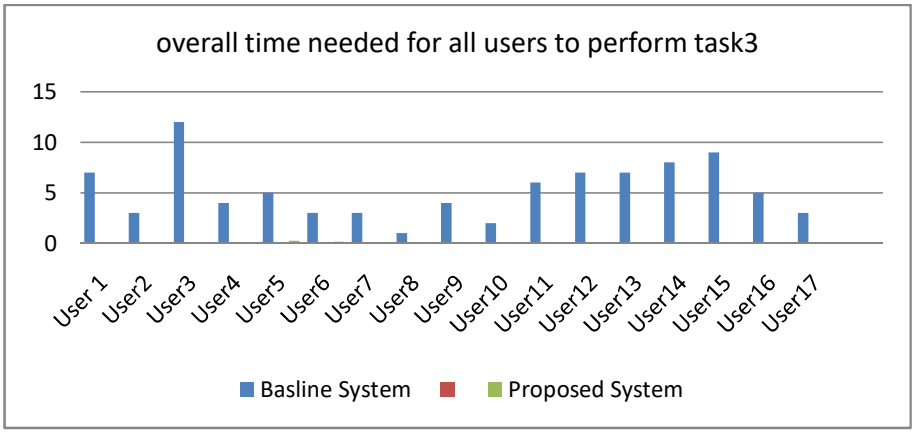

Figure 4.4. Time Needed For Completing Task for Teacher search

4.6.4 Task 4

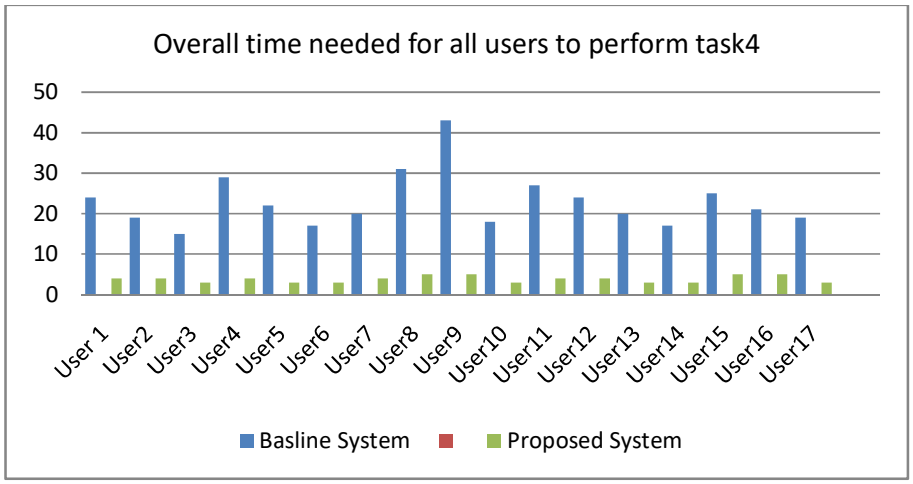

Figure 4.5 .Time Needed For Completing Task for Department search

As indicated in the guesses above, the objective of the Semantic search system is to help a student search for information content better than Near East University Engineering Faculty Website search. The outcome gotten when the task completion time was conducted shows that Semantic search called Proposed System performed more than Near East University Engineering faculty Website search called Baseline system with a mean (average) of 31(secs) vs 4(secs).

The result demonstrates that students achieved their desired information even more effortlessly utilizing Semantic search system. Shorter job finishing times. These discoveries are likewise followed up by post questionnaires questions. The following below are the result analysis of post-questionnaire questions of the both system.

4.7. Post-Questionnaire

In this section, we summarize the results of post-questionnaires. Specifically, we needed to learn clients conclusions about various highlights of the proposed framework. We likewise look at clients conclusions about the benchmark framework with the proposed framework since we posed similar inquiries in the wake of finishing errands with every framework. Clients called attention to that the assignment was mind boggling with a normal of 1.6 in proposed framework when contrasted with 2.4 of the gauge framework. They additionally said that they perform well on undertakings with a normal of 2.9 in the proposed framework contrasted with a normal of 2.2 of the gauge framework. As per clients, they thought that it was anything but difficult to explore in the benchmark framework with a normal of 3.9 contrasted with 3.8 in the proposed framework. At last, members believed that the proposed undertaking was additionally propelling with a normal of 4.5 contrasted with the 2.1 for the gauge framework task. Likewise they have

discovered the proposed undertaking fun with the normal of 3.9 contrasted with 2.4 of the benchmark task.

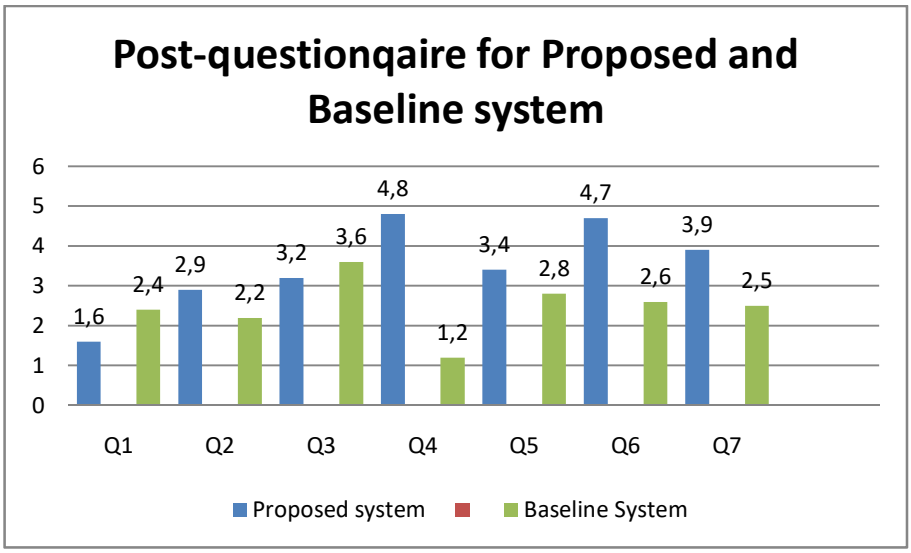

Figure 4.6 Post-questionqaire for Proposed and Baseline system

1. The taskwas difficult ?
2. I did the task well?
3. The guidance manual with the system was helpful to solve the task?
4. I am convinced with the system navigation, conduct and support ?
5. I found the result of the presentation helpful?
6. The collaboration with system is encouraging?
7. I was less exposed to irrelevant content?

Table 4.5: Post-Questionnaire for proposed system and Baseline system(average of all task)

SD = strongly disagree, D = disagree, F = fair, SA = strongly agree, A = agree

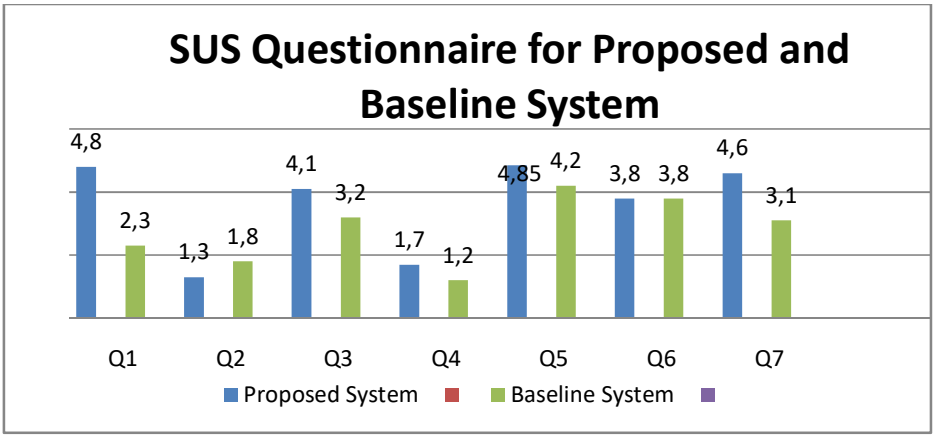

Figure 4.7SUS Questionnaire for Proposed and Baseline System

1. Q1. I feel that I might want to utilize the framework habitually.
2. Q2. I found the framework pointlessly complicated.
3. Q3. I thought the framework was anything but difficult to utilize.
4. Q4. I believe that I would require help to have the option to utilize the framework.
5. Q5. I found the different capacities in the framework were all around incorporated.
6. Q6. I would imagine that the vast majority would figure out how to utilize the framework in all respects rapidly.
7. Q7. I felt certain utilizing the framework.
8. Q8. I expected to gain proficiency with a great deal of things before I could start the framework.

Figure 4.16 Standard usability scale (SUS) Questionnaire for Proposed and Baseline System. (average of all tasks. 1=strongly disagree, 2=disagree, 3=not sure, 4=agree, 5= strongly agree)

We have utilized the SUS to decide the general convenience of both the Proposed and benchmark frameworks. With the normal of 4.8, clients brought up that they will get a kick out of the chance to utilize the proposed framework as often as possible contrasted with the 2.3 for standard framework. The clients found the proposed framework superfluously complex with the normal of 1.3 when contrasted with the benchmark which is 1.8. Also, with the normal of 4.1 clients have discovered the proposed framework all the more simple contrasted with the normal of 3.2 for benchmark framework. For proposed framework clients called attention to that they need help to utilize the framework at the normal of 1.7 contrasted with the gauge framework which is 1.2. With utilizing the proposed framework, clients think they felt certainty at the normal of 4.8 contrasted with the utilizing of gauge framework which is at the normal of 3.2.

CHAPTER 5

CONCLUSION AND FUTURE WORK

In this research, we have developed a sementic web portal System which allows users of different categories to access the portal. Generally, when the materials are presented as a sementic portal, the users engage more with the contents, and thus access quickly and easily. Significant amount of work have been done in developing ontotology based portal system but some of them cominesemantic web technologies. The Semantic Web is an ideal framework portal system because the use of ontologies boost the reusabilityof the system. Also different users have different backgrounds and learning and accessing the sites, so there is always a need of developing a system which adapts itselfaccordingto the usersknowledge and choices. In this work, we developed a sementic portal for accessing that using Semantic Web technologies which allow users to learn and access informations quickly and easily .with less amount of time.

In the future,I will extend my work from the faculty level to the university level and will include the informations about university.I will try to include some inference capabilities by employing the jena rules. For instance,if a course tutor has a certain number of acadamic experience and publications,the system will assign him/her the title of Professor /Assoc Professor/Assist Professor.For example, if the instructor has a experience 6 year and have publication 10 the system will assign title Prof .If the instructor has experience 3 year and has publications 5 the system will assigm him/her Assoc Prof etc.

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APPENDICES
APPENDIX 1
SPARQL QUERIES

NEAR EAST UNIVERSITY

Application Form for Ethical Approval

1. Title of the study
A semantic portal for accessing NEU engineering faculty

2. Primary applicant	
Full Name and Signature	*Attiq Ur Rahman*
Graduate School	*Applied Science*
Department	*Computer Engineering*
Contact e-mail&phone number	*ateeqsalar@gmail.com 05488255873*

3. Research Team	
Full Name and Signature:	Assoc. Prof Dr.Melike Şah Direkoglu
Role:	*Supervisor*
Email:	melike.sah@neu.edu.tr

4. Funding Body
No funding for this project

Name of the Funding Body	*Nil*
Contact Person	*Nil*
Contact e-mail address& phone number	*Nil*

5. Proposed Dates of Research	
Research start date	*05/03/2018*
Research end date	*20/05/2019*

6. Briefly describe the purpose of yourresearch.

The main purpose of this study is to investigate and research the Semantic Web concept and get a solid understanding of the concepts together with its difficulties, problems and the ability to be used in real world applications.

It involves Using Semantic web to build a search system for NEU Engineering Faculty.

7. Briefly describe the method and procedures to be followed during data collection. Please enclose any relevant materials (including interview questions where possible, participant information sheet(s) and participant consent form(s) where applicable).

What kind of data will be collected from the participants? (e.g. qualitative data about drug use, quantitative data about voting behaviour etc.) What sort of data collection tools will be used? (e.g. Semi-structured questionnaires, structured questionnaires etc.)When and where will the data be collected?How long will data collection last?Who are the intended participants and how will they be selected/recruited? (e.g. Age, Gender, intended sample size, representative sampling, convenience sampling etc.) Will the participants be paid for their time and effort? If so, how much and what will be the nature of this incentive/reimbursement be? How do you plan to provide the participant information sheet(s) to participants? When and how exactly do you plan to obtain consent of the participants?

Click here to enter text.

8. Do you intend to collect data from any vulnerable groups (e.g. prisoners, minors, socioeconomically disadvantaged, etc.)? If so, please provide details regarding how you will be accessing these groups and how you intend to protect their rights within the process of your research.

No

9. Does your research necessitate any deception? If so, please provide reasons for this and also provide details of debriefing session you plan to do with the participants. If information will be withheld from the participants at any stage during the research, when and how will they be provided with full information?

No

10. Do you foresee any psychological or physical discomfort for the participants? If so, how do you intend to minimise/overcome these?

No

11. Where and for how long do you plan to store the data? How will you make sure

that personal data will not be obtained by third parties?
We collected data to create portal for NEU engineering faculty and i am assure that no one will use this data by third party

12. Date of Application	*01/04/2019*

Note: Please attach all relevant data collection materials(List of Questions, Participant Information Sheet(s) and Participant Consent Forms) to this application form and make sure that you compile all documents into ONE PDF file before submission.

CONSENT FORM

TITLE OF STUDY
A semantic portal for accessing NEU engineering faculty.

PURPOSE OF STUDY

You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information.

The main purpose of this study is to investigate and research the Semantic Web concept and get a solid understanding of the concepts together with its difficulties, problems and the ability to be used in real world applications.

It involves Using Semantic web to build a *"semantic portal for accessing NEU engineering faculty"*.

RISKS

you may decline to answer any or all questions and you may terminate your involvement at any time if you choose.

BENEFITS

There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study will serve as a yard stick in the implementation of my work in the department thereby benefitting all students at large.

CONFIDENTIALITY

Your responses and participation to this experiment will be anonymous. Please do not write any identifying information. Your comments will not be anonymous. Every effort will be made by the researcher to preserve your confidentiality:

VOLUNTARY-PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand I am free to withdraw without penalty and without providing a reason and have the data collected to that time destroyed.

I understand that the information provided by me will be treated anonymously so that it is impossible to trace this information back to me individually. The data obtained in this study will be used for research purposes only. In accordance with the Data Protection Act, this information may be retained indefinitely.

I understand that the timing of experiment, time used interacting with the system will be recorded anonymously throughout the experiment.

I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature **Attiq-ur-Rahman** Date**:01-04-2019**

Name: Attiq Ur Rahman

Department: Computer Engineering

Phone: 05488255873, Email: ateeqsalar@gmail.com

QUESTIONNAIRE

Computer Engineering Dept.
Near East University,
Lefkosa, North Cyprus.

RESEARCH QUESTIONNAIRE ON:

A semantic portal for accessing NEU engineering faculty

Dear Respondents,

I am a master student of the department of Computer Engineering, Near East University,Lefkosa, North Cyprus conducting a research on "*A semantic portal for accessing NEU engineering faculty* "

Below are some questions designed to enable me collect data relevant to the study. I will be very grateful if you will read through the content of the evaluation properly and tick the correct option where necessary and return same to me. All responses would be treated with utmost confidentiality and used only for the purpose of study. All the collected data is anonymously stored to protect information about participants.

The evaluation is in two parts: hands on evaluation of how the system works and a follow-up questionnaire. The first part will help us understand the interfaces, in order to see errors and improvements while the second part will help us learn if you are satisfied with the interfaces.

Please note we are evaluating the system not your performance with it. Your feed-back will help improve the system.

Thanks for your cooperation.

Yours sincerely,
ATTIQ UR RAHMAN
20166219.

ABOUT YOUR SEARCH EXPERIENCES AND BACKGROUND

1 What programme are you studying? Please state if you are doing your master degree or undergraduate. If undergraduate state your level.

	Several times in a year	Several times in a month	Several times in a week	Several times in a day
2How often do you use Near East Engineering Faculty Website to search for information (i.e. course information, lecturer information, etc.)?	1	2	3	4
3How often do you use Web search engines to gather information?	1	2	3	4

EVALUATION TASKS FOR THE INFORMATION SYSTEMS ENGINEERING WEBSITE

You will be asked to perform a set of tasks, using the system. The evaluator will explain the tasks ahead of time. He will also show you how it work and then you will be given time to try it out yourself before the actual test.

1. Search list of departments in faculty of engineering.

2. Assuming this year you will take the course "*Sementic Web*" and you are willing to find the lecturer taking the course. Find the lecturer.

3. Using the system search for the course description, course credit and lecturer for the course *Fuzzy Logic.*

4. Assuming this year you want to take thesis with melikesah and you want to know the number of students she is supervising.

5. Using the system search for the Publications by using title of publication.

6. Using the system search for the Publications of a specific teacher by using teacher publications.

7. Search publication by year.

8. Search publications in conference of a specific teacher.

9. Search for your departmental secretary and her contact details.

10. In this task you are free to do two tasks of your own. For example you can find any course of your choice, find any lecturer of your choice and the courses they teach etc. Write down this task on the papers provided and comment on it.

    Thank you for your help in conducting the research.

EVALUATION TASKS FOR SEMANTIC SEARCH

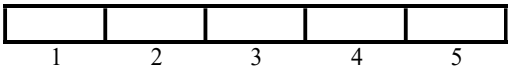
You will be asked to perform a set of tasks, using the system. The evaluator will explain the tasks ahead of time. He will also show you how it work and then you will be given time to try it out yourself before the actual test.

1. Search list of departments in faculty of engineering.
2. Assuming this year you will take the course "*Semantic Web*" and you are willing to find the lecturer taking the course. Find the lecturer.
3. Using the system search for the course description, course credit and lecturer for the course *Fuzzy Logic.*
4. Assuming this year you want to take thesis with Prof Melikesah and you want to know the number of students she is supervising.
5. Using the system search for the Publications by using title of publication.
6. Using the system search for the Publications of a specific teacher by using teacher publications.
7. Search publication by year.
8. Search publications in conference of a specific teacher.
9. Search for your departmental secretary and her contact details.
10. In this task you are free to do two tasks of your own. For example you can find any course of your choice, find any lecturer of your choice and the courses they teach etc. Write down this task on the papers provided and comment on it.
    Thank you for your help in conducting the research.

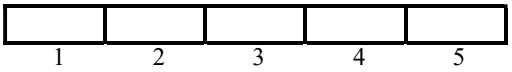
POST-QUESTIONNAIRE FOR INFORMATION SYSTEMS ENGINEERING WEBSITE

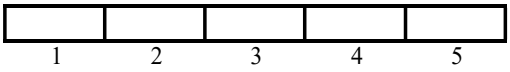
Strongly Disagree Disagree Fair Agree Strongly Agree

1 I had to search a lot before I found interesting content.

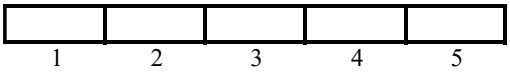


2 I spent less time querying and more time browsing.

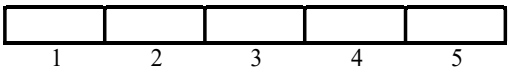




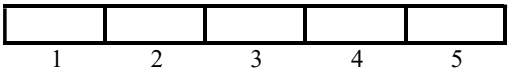
3I was less exposed to irrelevant content. 4 The task was complex.

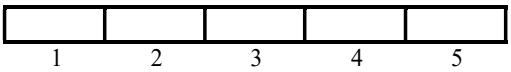


5I did well on tasks.

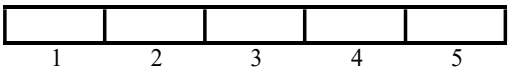


6The guidance manual was helpful to solve the tasks.

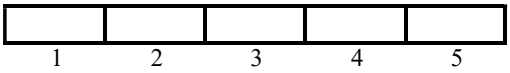




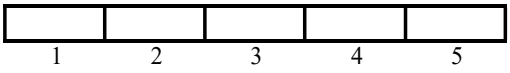
7I am satisfied with the system performance, guidance and assistance.



8I found the presentation of the results report helpful.

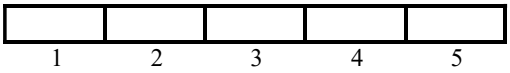


9 I felt guided to invalid results thus I can correct them.

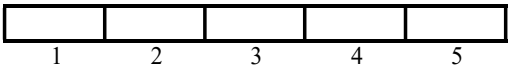


10 I found the interaction with the system motivating.

11 I found the interaction with the system engaging. 12 I found the interaction with the system fun.



12 What features/characteristics did you like most about the system?



Comments?

POST-QUESTIONNAIRE FOR SEMANTIC SEARCH

Strongly Disagree Disagree Fair Agree Strongly Agree

1 I had to search a lot before I found interesting content.

1	2	3	4	5

2 I spent less time querying and more time browsing.

1	2	3	4	5

3 I was less exposed to irrelevant content. 4 The task was complex.

1	2	3	4	5

5 I did well on tasks.

1	2	3	4	5

6 The guidance manual was helpful to solve the tasks.

1	2	3	4	5

7 I am satisfied with the system performance, guidance and assistance.

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12 What features/characteristics did you like most about the system?

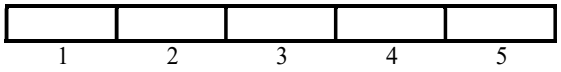
1	2	3	4	5

Comments?

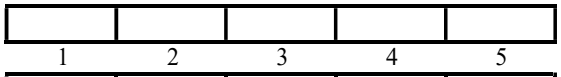
SUS USABILITY QUESTIONNAIRE FOR INFORMATION SYSTEMS ENGINEERING WEBSITE

Strongly Disagree Disagree Fair Agree Strongly Agree

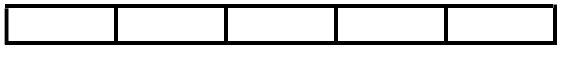
1 I think that I would like to use this system frequently.



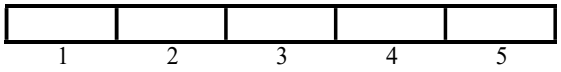
2 I found the system unnecessarily complex.



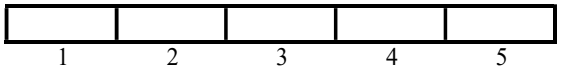
3 I thought the system was easy to use.



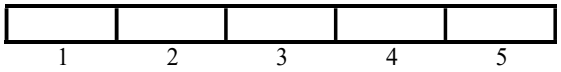
4 I think that I would need the support of a technical person to be able to use this system.



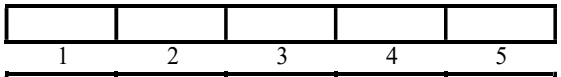
5 I found the various functions in this system were well integrated.



6 I thought there was too much inconsistency in this system.

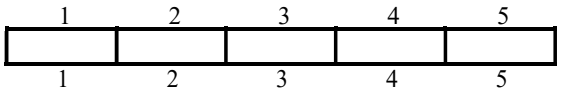


7 I would imagine that most people would learn to use this system very quickly.



8 I found the system very cumbersome to use.

9 I felt very confident using the system.



10 I needed to learn a lot of things before I could get going with this system.

SUS USABILITY QUESTIONNAIRE FOR SEMANTIC SEARCH

Strongly Disagree Disagree Fair Agree Strongly Agree

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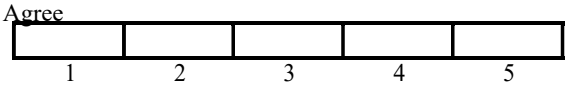

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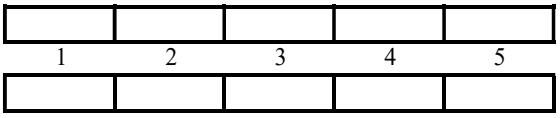

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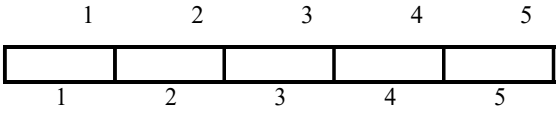

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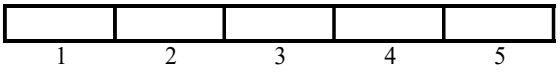

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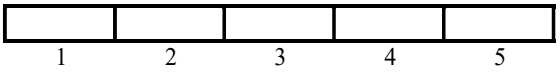

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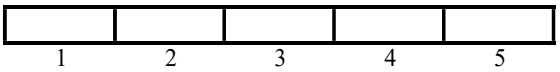

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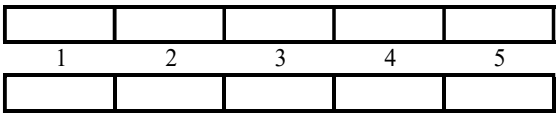

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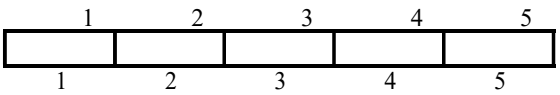

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