

# TourTrivia: Semantically Implemented Travel Application for Tourists

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**Abstract—** Tourism plays a vital role in an economy. There has been a clear ascend in the tourism industry with infrastructural developments. To be more specific, a travel application will allow tourists to plan and organize their tours with more comfortably with accurate and reliable sources of information. There exist numerous amounts of tedious travel application in today's world. The massive amounts of travel applications depict more static behaviors; applications developed concerning the implicit relationships are rare to be found. Semantics is the technology to implement implicit relationships in meaningful manner. Semantic web empowers data recovery going for making information widely available in the World Wide Web open to more precise search and information extraction to be effectively decipherable. The applications that convey these new solutions are based on ontology. This paper studies creating sophisticated relationships in an ontology, which can improve the process of searching for perfect travel data by analyzing the user interests. TourTrivia travel application is a semantically implemented solution to cater this trend, utilizing all Semantic web technologies and tools.

## I. INTRODUCTION

When surfing Internet, users are increasing in need of more powerful tools proficient for searching and interpreting numerous heterogeneous information available on the web. Though well-developed tour planning and guiding applications exist at present, applications developed concerning the implicit relationships are rare to be found. The prevailing applications are designed in such a way that depicts more static behaviors. Another aspect is that there are perfectly built, well-structured information repositories maintained at high costs, mostly by providers of tour packages and lodging arrangements. Virtually all of them offer easy access to their systems via the World Wide Web, rarely including detailed information. Also there's World Wide Web as a whole with its many small, detailed pieces of information.

Easy information retrieval along with efficient text matching is profound to be instigated. An application with intrigue and favorable predictions varying as to user preferences and interests with a nook of time is beyond impossible the primarily used technologies. Even with the latest technologies, most of the existing applications are not up to the speed in filtering out relevant data from the huge databases. These particulars delineate a challenging nature, yet successful implementation of such applications fascinates the users exploiting or browsing them. The key to this goal is Semantic web and its technologies. 'TourTrivia' is the solution developed emphasizing on these specifics and implicit relationships using the Semantic Web

technology.

Semantic web is an extension of the current World Wide Web that does not only provide information to human users, but also at a machine understandable, semantic level to machines. The term Semantic Web alludes to an arrangement of best practices for publishing and connecting organized information on the Web. Web is designed for direct human processing but Semantic web aims at machine process, able information. Retrieval of keyword and text matching can only be successfully implemented using Semantic web. Ontologies and ontology-based information retrieval have the potential to significantly improve the process of information search on the World Wide Web. +

Ontology<sup>[1]</sup> is a hierarchy of the most vital concepts related to a particular domain, their relationships and their properties. Ontology is an implicit, formal specification a shred conceptualization. This paper focuses on successful implementation of Semantic web technology in a travel application, in step-by-step approach, which can improve the process of searching for the perfect tour details by analyzing the user interests with the help of ontology for tourists.

## II. RESEARCH METHODOLOGY

### A. Addressing the Challenges and Tools Required for Implementation

The use of Semantic web technology in adding, changing and implementing new relationships or interconnecting programs in a distinct manner can be just as simple as changing the external model that these programs share.<sup>[3]</sup> The central notion of the Semantic web is to extend the current human-readable web by encoding some of the semantics of resources in a machine process able form. Moving beyond syntax opens the door to more advances applications and functionalities on the web. Computers will be better ready to search, process, coordinate and present the content of these resources in a meaningful, intelligent manner.

For the system implementation we analyzed the most common capabilities specific to Semantic web applications. For the efficacious results tools and techniques; Protégé IDE, Jena Fuseki server, Jena API, Sesame, SPARQL, web servlets, restful web services, JSON were used predominantly.

### B. Design Steps

1. The developer creates ontology by using Protégé tool

- and deploys in the web space or domain.
- 2. If any activity is to be added or modified to the ontology, the ontology needs to be updated. The developer updates otology by adding updates.
- 3. The developer tests the ontology created using the Sesame Workbench.
- 4. The developer queries (SPARQL Query testing) by means of Apache Jena and ontology will be transverse according to specifications.
- 5. The developer retrieves the query result and passes the result to GUI or Front end.
- 6. The developer delivers results to the front-end using Web services.

III. SEMANTIC WEB IMPLEMENTATION

A. Initial Ontology Designing and Modeling

Ontology is a specification of the concepts in a domain and the relations among them, providing a formal vocabulary for information exchange. Ontologies provide a common vocabulary to support sharing and reuse of knowledge. The fundamental requirement in the process is the use of RDF as metadata deplete by the applications. Initially mapping a proper relationship of the ontology to be designed, with the aid of an entity-relationship (ER) diagram is crucial.

Ontology is developed using Protégé Version 4.3.0. Protégé [2] is a free, open-source ontology editor and framework for building intelligent systems. The travel ontology was created in order to facilitate the extraction of information about important places or location points in a country. This is an example of single ontology we designed in the process of developing the travel application. User is provided with the opportunity to surf and browse any predefined locations, their areas of interest and to scrap up information as to wish. The Figure 1 shows the class description using protégé. Figure 2 shows full class description of travel ontology.

The mapped relationship is implemented as an ontology using the protégé. Protégé-OWL is seamlessly integrated with classification tools. These tools can be used for revealing inconsistencies and relationships between classes and individuals. The process initiates by providing a meaningful name to the ontology. In the 'Ontology IRI', the URL of the web space or domain to host the ontology needs to be specified along with the ontology name and needs to be saved locally in .owl file

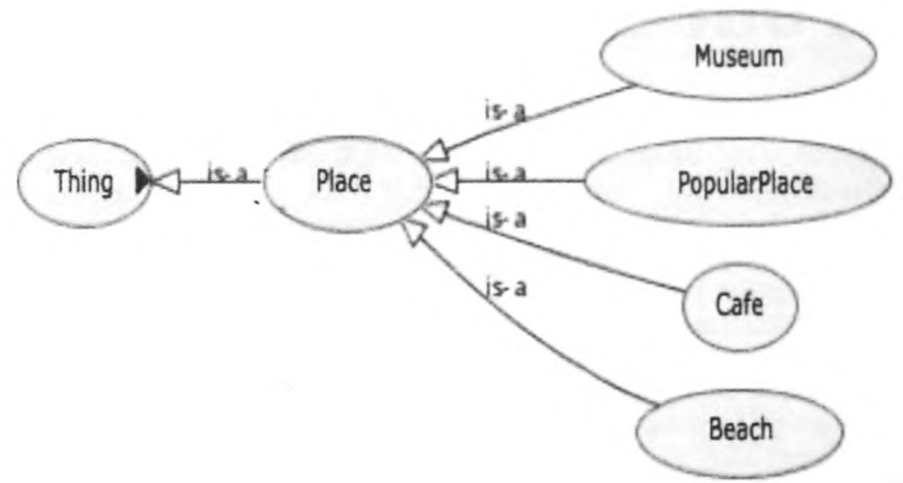


Fig. 1. Class description of Place using OWLViz

format. OWL (Web Ontology Language) is a language for describing web information in structured format. OWL is built on top of RDF and embedded in XML.

The result of the classification is demonstrated on the Classes tab, enabling easy navigation and analysis. These classes and subclasses need to be disjointing with each other in order to avoid multiple inheritance. The Properties tab is used to edit characteristics of properties in the model. The Object Properties essentially provided with a domain and a range, illustrate the relationships between instances or individual classes. Data Properties articulate relationships between instances or individuals and data values and each data property component has to domain with a class and need possesses with a data type (range).

The Individuals tab is used to acquire instance data. Each individual is declared with type of individual, object property assertions, and data property assertions. The modeled ontology is put for reasoning to identify any errors, informalities or inconsistencies. The successful completion of the ontology enables it to be published online on "http://tourtrivial5.comoj.com/travel.owl", being it available for anyone to read online.

B. Semantic Querying for Tourism Information

Process of semantic querying is accomplished via fostering SPARQL Query for retrieval of data from ontology relationship, which is structured based on OWL file format. SPARQL query is based upon triple-store methodology. A triple-store or RDF store is a purpose-built database for the storage and indulges

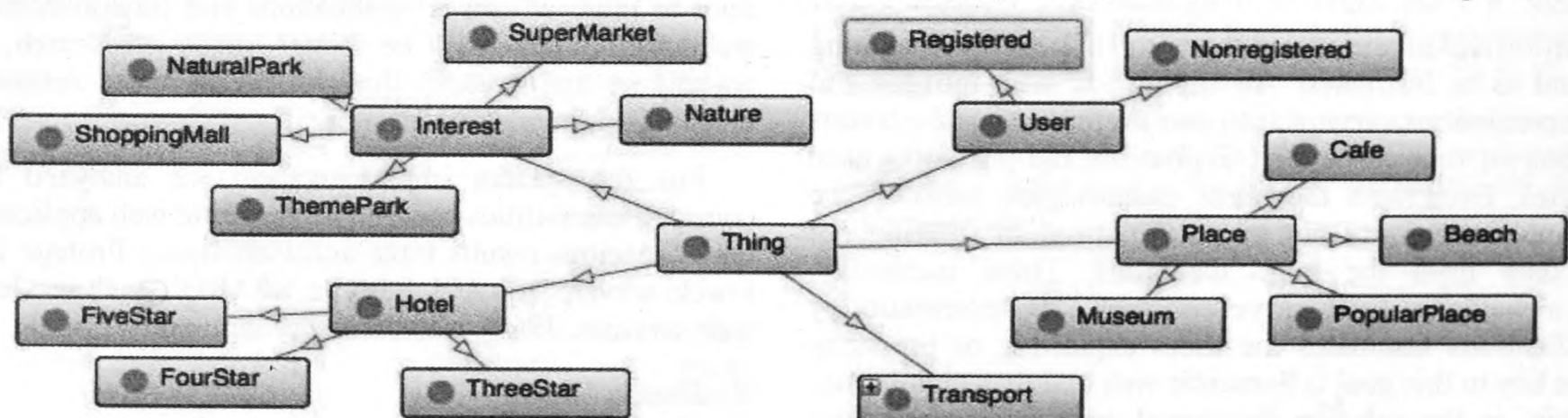


Fig. 2. Class description of travel ontology using OntoGraf

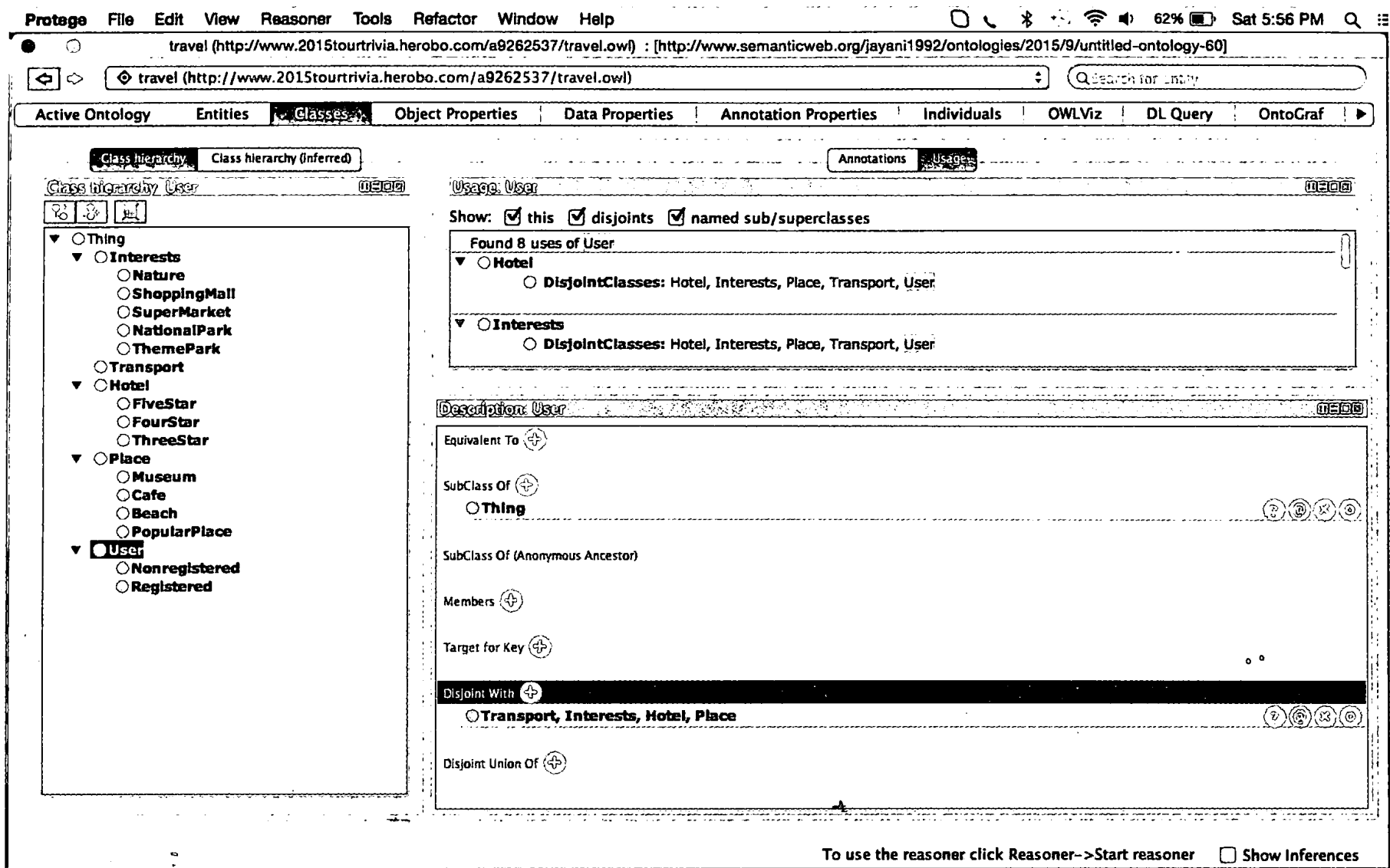


Fig. 3. Protégé ontology development environment

retrieval of triples through semantic queries. A triple is a data entity composed of subject-predicate-object. Unlike a relational database, a triple-store is optimized for the storage and retrieval of triples. In addition to queries, triples can usually be imported or exported using Resource Description Framework (RDF) and other formats. [4]

The term SPARQL defines a standard query language and data access protocol for use with the RDF data model. It works for any data source that can be mapped to RDF. The specification is under development by the RDF Data Access Working Group (DAWG). [5] Testing enhances the accuracy, while checking for anomalies and inconsistencies of the modeled ontology. The readiness of the ontology for semantic querying is tested as well. For SPARQL query testing and process of analyzing the sesame openrdf-workbench or Jena fuseki server is utilized to test and analyze validity of the written query for retrieval of data from RDF or OWL files. It is recommended to follow sesame or apache Jena tutorials when querying.

An environment to process SPARQL query using Jena API on java program is to be developed in order to acquire essential data from ontology into the web applications front-end. Jena is an open source Semantic web framework for java. [6] It provides an API to extract data from and to write RDF graphs, which are represented as an abstract 'model'. A model can be sourced with data from files, databases, URLs or a combination of these. A model can be queried through SPARQL 1.1. Although Jena is similar to sesame, Jena provides support for OWL. This

framework is enriched with various reasoners and the Pellet reasoner, which is an open source java OWL-DL reasoner, works in perfection with Jena.

In SPARQL query execution, initially it's coded to read a file into the model. The SPARQL query is tested using sesame

Fig. 4. Java code for reading an OWL file into a model

```

Str OntModel model = ModelFactory.createOntologyModel(OntModelSpec.OWL_MEM_RULE_INF);

String fileName = "D:/Final_Project/travel.owl";

try {

    File file = new File(fileName);
    FileReader reader = new FileReader(file);
    model.read(reader, null);

} catch (Exception e) {
    e.printStackTrace();
}

```

Fig. 5. Implementation of SPARQL query as a string

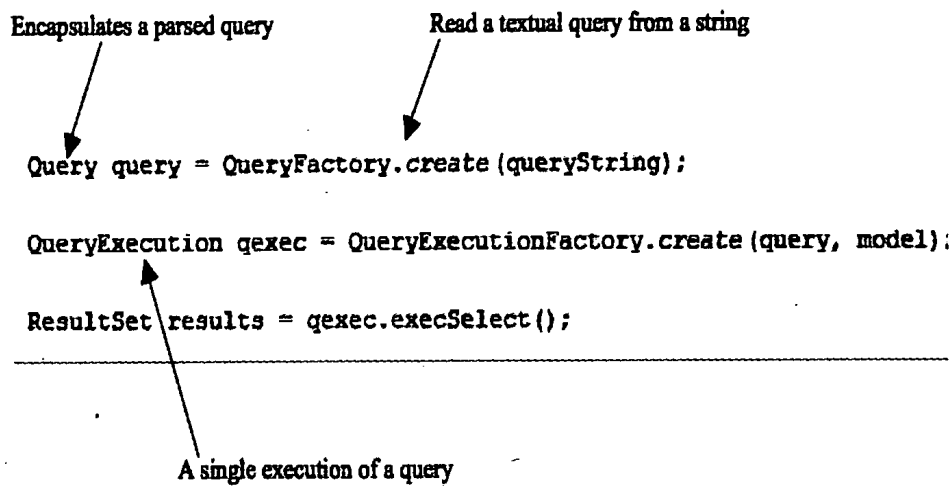


Fig. 6. Code for SPARQL query execution

openrdf-workbench to opt for most suitable query to retrieve data from the ontology. Figure 4 and Figure 5 shows codes for file reading and query execution respectively. Afterwards the relevant SPARQL query, as a string needs to be positioned and executed. The executed query is then coded into the JSON format. Figure 7 shows an example single line of code in JSON format.

C. Semantic Approach to Website

Efficacious HTML (Hyper Text Markup Language) output is accomplished by the virtue of continuing the implementation procedure of processed SPARQL query results. This task is achieved using java web components; servlets and JSP files. The JSON output of the above process is embedded in the servlet. According to articles JSON is an open standard format that uses human-readable text to transmit data objects. [11]

Servlet being a java programming language class is used to extend the capabilities of servers that hosts applications. The

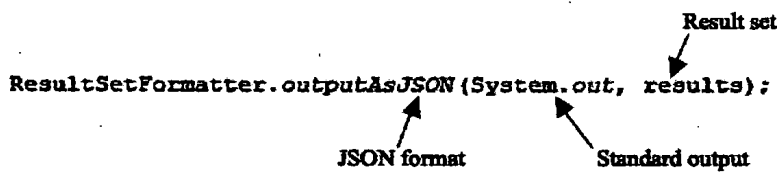


Fig. 7. SPARQL query result in JSON format

coding process of Servlet initiates, storing SPARQL query results in JSON format in a 'ByteArrayOutputStream' object and converting the result into string format. A ByteArrayOutputStream object aids in having several operations in a stream. Servlet provides the function to access ontology data or semantic data while crawling towards the front-end implementation.

JSP (Java Server Pages), a technology used to develop interactive web pages is applied in process of viewing the output by means of a web page. In order of accomplishing this task, JavaScript with 'xmlHttp' request and response method are called within JSP. The splattered JSON object is passed through the inner html response ultimately to the front-end. This phase of development enacts in connecting the ontology data with html.

Semantic web services address mainly SOAP (Simple Object Access Protocol) or WSDL (Web Services Description Language) services, without additional annotations are focused on syntax required for describing exposed functionality. Http REST methods are also proposed for pertaining consistency between a REST resource and its' semantic triple in triple store. This approach also contributes in the ultimate implementation in the front-end.

```

function loadBeach() {
    createXMLHttpRequest();
    document.getElementById('right_div').innerHTML="";
    var div=document.getElementById('right_div');
    document.getElementById('left_div').innerHTML="";
    document.getElementById('aaaa').innerHTML="";

    var url = "Beach";
    xmlhttp.open("GET", url, true);
    xmlhttp.send();
    xmlhttp.onreadystatechange = function() {
        if (xmlhttp.readyState == 4 && xmlhttp.status == 200) {

            //Description
            document.getElementById("aaaa").innerHTML = "Beach";
            document.getElementById("left_div").innerHTML = xmlhttp.responseText;
        }
    }
}
    
```

Fig. 8. JavaScript function in obtaining servlet result and setting it in innerHtml



Fig. 9. Screenshot of travel applications' web page 1

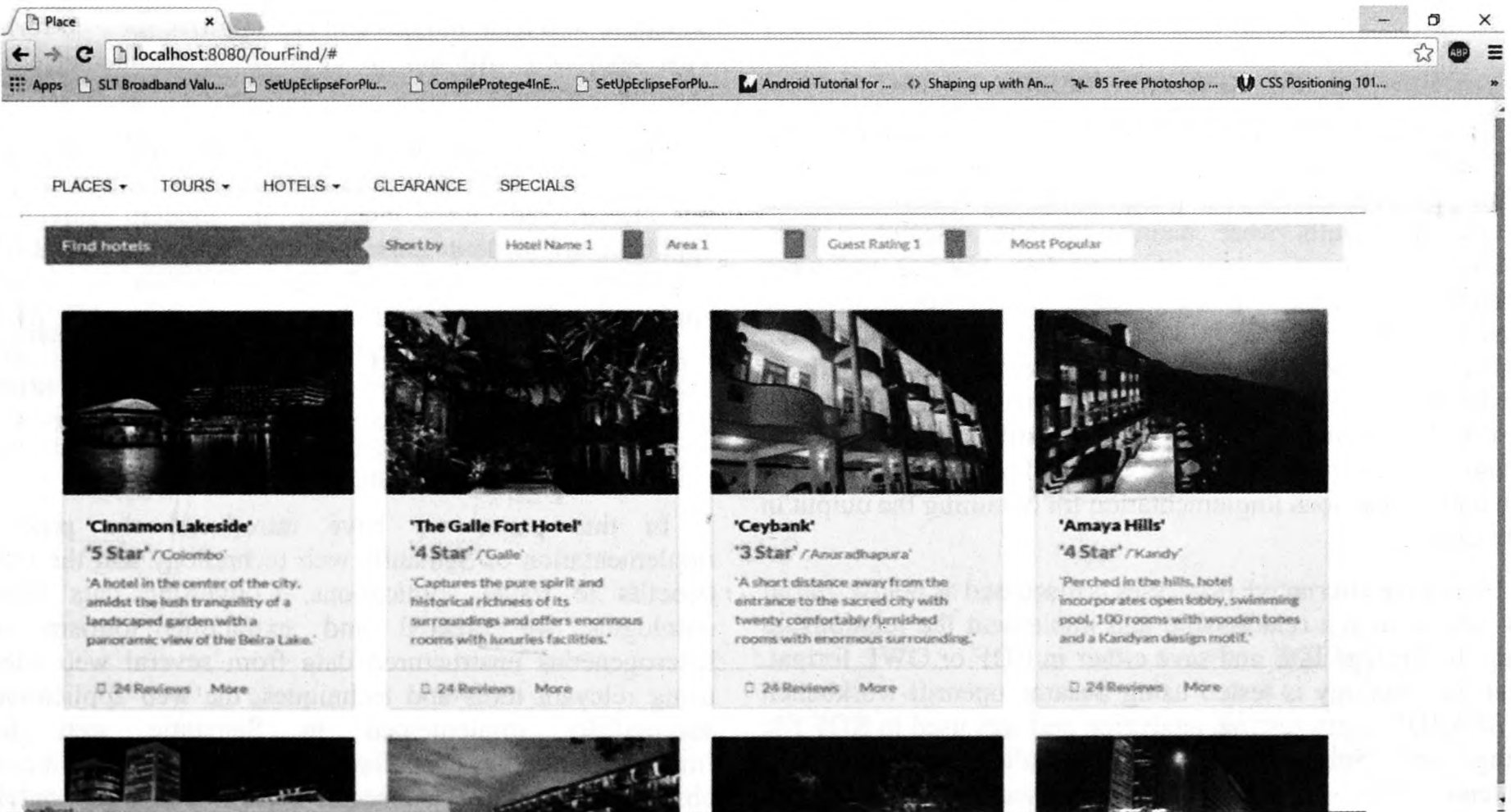


Fig. 10. Screenshot of travel applications' web page of hotels

#### D. Methodology

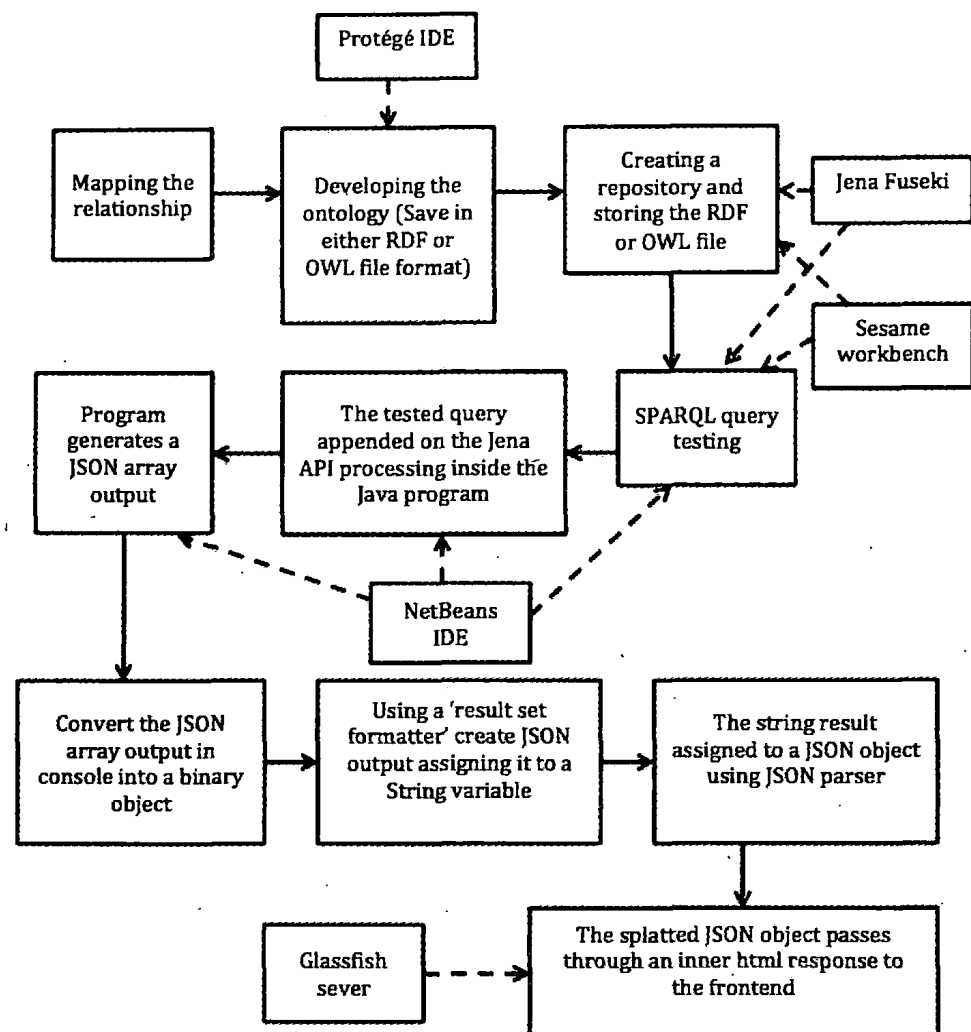


Fig. 11. Process flow of implementation of semantic web in travel application

#### IV. RESEARCH FINDINGS

The core outcome of undergoing the implementation process of TourTrivia is to successfully address the Semantic web technology from developers' perspective. The fundamentals for the prolific results were mainly through research papers, guidance of experts, views of researches, tutorial and other documents, etc. For beneficial results and implementation of Semantic web technology, we found out several alternative methodologies, software, servers, etc. The alternative methods will be discussed below. We compared and practically tested most of the alternative methods and identified the benefits and ambiguities separately. Thereby continued on the most efficient path until efficacious implementation till obtaining the output in front-end.

One of the alternative processes is discussed as below. Initial task was to map a relationship and implement the relationship using the Protégé IDE and save either in RDF or OWL format. Later the ontology is tested using Sesame openrdf-workbench for SPARQL query testing, analyzing and was used in RDF file storage mode. Since we were working on alternative methods of implementation simultaneously, it was successful to proceed with the other alternative at this end.

Proceeding with the same methodology as above till ontology creation using protégé, we tried testing, query testing and storing the ontology as dataset using Jena Fuseki sever. Although it was a success, the drawback was that the Jena Fuseki sever needed to be connected each time of development. Yet it

showed drastic results and the development environment was quite spontaneous.

With the stored dataset and tested SPARQL queries, we came across a method to access the dataset manually via Jena API along with use of java in NetBeans. The RDF or OWL file can be stored locally or in a web space. The result set will be formed as Binary array and as a JSON array respectively. Lately the string value generated was assigned into a JSON object using a JSON parser. Then the JSON object was split and taken into a result set and was sent to the JSP front-end as an inner html response. We could suggest and recommend this method of implementation is a success in the applying Semantic web technologies in a web application.

#### V. LITERATURE SURVEY

Tourism plays an important role in the economic development of a country. The market has diversified the past few years, and applications that assist for each stage of a tour are becoming increasingly available for tourists. In order to cater the massive demand, an automated application customized for tourists is imperative. Most of the applications being build emphasizing explicit relationships are incapable of addressing the demand.

According to Tim Berners Lee, he points out Semantic web has all standards and technologies it needs to succeed and it is time for web developers and content producers to start using semantic languages in addition to HTML. [8] Even the existing systems (specially web applications) can be redesigned with Semantic web technologies and can improve their performance. This approach will aid in eliminating maintenance of the existing e-commerce sites.

Tourism is no longer a group with homogenous characteristics. Several aspects with regards tourism need to be interlinked and interconnected in modern travel based applications in order to cater the needs of tourists effectively and efficiently. The notion of personalization is crucial in application design. Semantics is the key to this dilemma. Ontology based search can be made on tourism sites by modeling tourism ontologies and information can be retrieved as to user or tourists preferences and interests.

#### VI. CONCLUSION AND FUTURE WORKS

In this paper we have introduced the process of implementation of Semantic web technology and the potential benefits to travel applications. Converting data from the ontologies we created and extracting tourism related heterogeneous unstructured data from several web sites and using relevant tools and techniques, the web application was successfully implemented in Semantic web format. Implementation has been done using java. Therefore it could be observed that the tourism sector is an area in which ontologies can be applied in a more applicable and logical basis. Integrating semantic web technology in existing travel based web applications and future application will bestow to massive improvements in future.

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