APPLICATION OF SEMANTIC WEB IN TOURISM INFORMATION SYSTEMS

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Abstract - *Tourism service providers are faced with many challenges due to service complexity and diversity, higher customer expectations, and nonintegrated heterogeneous information systems. This paper presents a model which utilizes semantic web technologies for an improved exploration and rating of hotels for business customers in order to reduce thesearch time and costs. The main topic of this paper is to describe system architecture of the semantic web portal KG Hotel Info. Portal allows customers to review and booking hotels available in Kragujevacin a very simple and intuitive way. The search is performed by specifying the various search criteria, in combination with SPARQL, one of the most relevant query languages for web ontologies. The paper also presents a part of the ontology, developed within Protégésoftware tool, which was used for development of the web portal.The proposed model offers many benefits such as easier search and more accurate search results based on individual customer preferences.*

1. INTRODUCTION

In the last decades business information systems are going through a real expansion. It's becoming a more significant role that they realize in domain of e-business, and tourism market as well as its current part is largely developed and experiencing great changes. The emergence of new information technologies and global competitiveness of tourism require a maximum efficiency of e-business. In order to preserve the loyalty of customers and satisfy their needs, travel agencies must follow the latest trends in the development of new technology and information systems.

The main problem of tourism information systems is the existence of a large number of different information sources. Also, the rapid development of the Web's impacts the increasing amount of decentralized data, and the emergence of a large number of information sources only further extends this problem. One of the major challenges in the field of e-tourism is to establish interoperability between information systems, which would lead to easy exchange of data between heterogeneous sources. The Semantic Web [1] has been proved as an excellent candidate for the solution of this problem. It provides a new approach in the way of integration of information systems, because it provides that data is stored in a structured machine-readable form. This presentation includes the use of semantics, which contributes to interoperability between information systems.

Ontology, as a core technology of Semantic Web, plays a very important role in the integration of information systems [2]. It is used as an ideal solution to the problem of semantic heterogeneity of data, and working with these types of data often requires a high degree of knowledge about the domain, as well as agree on a precise description of formal concepts and terminology.

Most of today's tourist information are available through travel agencies Web portals. There are represented portals on the internet, that offer access to a large number of resources and provide links to other resources, and other web portals. However, the main problem of the portal is nonintegrated and unregulated information, and the user based of the obtained solutions must decide on one of them. To reduce this problem as a potentially good solution imposes the Semantic Web. The main characteristic of semantic web portals [3] is to provide applications and end users easy access to data contained in heterogeneous sources.

This paper describes the architecture of semantic web portals KG Hotel Info, which allows clients, by formulating and combining the different search criteria, to get information on available hotels in the city and to make their reservation. The focus is on the development and use of ontologies to integrate tourism information portal.

The paper is structured so that the second chapter gives an overview of literature that is critically analyzed. The third chapter presents the basic principles of integration of tourism information systems based on semantic technologies. This chapter describes the system architecture and ontology developed for this study. The fourth chapter contains an overview and explanation of part of the interface for KG Hotel Info portal. In the fifth section the conclusion is exposed and future work on the development of a given semantic portal.

2. LITERATURE OVERVIEW

Tourist information is generally available through the official web portal of tourist agencies. However, due to the volume and heterogeneity of data, tourists are often faced with difficult problems in finding wanted information. In order to reduce disintegration of data it is necessary to implement a system that will ensure that the data is stored in a form that is understandable to machines. Doing so will ensure the integration of tourism resources, which will result in the adjustment of portal content to end users in order to facilitate you locate

information. To save the data in a form that is understandable to machines, it is necessary to use the Semantic Web technologies. Ontologies, as the core of the Semantic Web, have the potential to improve the search quality of information in accordance with the requirements of end users. In the following will be analyzed papers that describe the role of semantic technologies in order to improve the quality of e-business in domain of tourism.

The main focus of the author in [4] is to generate the ontology, for the TamilNadustate in India, which will include sufficient knowledge of tourism, so that users can find the desired destination by specifying various search criteria such as housing, costs, activities, shopping, etc. User profile is created for the purpose of extracting user information, needs and interests. Data entered in the form is stored in the database using the JENA interface and used to set up queries over DL ontology in order to obtain the desired results.

In the paper [5] is described Travel Guides web portal, which aims to unite all the arrangements from various travel agencies. For the needs of this system was used PROTON ontology. This is a domain independent ontology with more than 300 classes and 100 attributes. It is relatively easy extensible and contains concepts that represent real-world terms such as location, organization, person, etc. Given portal illustrates how the Semantic Web affect the increase of interoperability in electronic tourism, how to provide better user interaction and systems and how to provide intelligent reasoning in tourism. The system is implemented in Java, using a web framework like Struts and Hibernate and the JENA for interaction with the database.

Reisewissen project that was developed in [6] is a semantic search for hotels in the world. This system optimizes the search process and increases the quality of tourist services. The authors put the information in two main ontology. One is used as the basis for the semantic representation of a wide range of hotels. This ontology includes concepts for expressing general and contact information, as well as information about the prices at the hotel. Other ontologies describe users and their interests. Also, the authors developed three sub ontologies, which are intended to describe the hotel characteristics, geographic information and the possible means of transportation to the hotel. The portal was developed in Java, and JENA is used for the implementation of semantic technology.

Providing the relevant information is a major challenge for most travel agencies. In the paper [7] is developed a mobile application STAAR. The basic idea of this system is the use of ontologies for knowledge representation and information about travel and which is designed to be connected with Linked Data repositories.

The system presented in [8] dynamically creates a package that uses the previously annotated data on the basis of ontology. The term annotation is often compared with the term metadata. This provides a service that determines the type of travel based on user's desire. The author believes that the tourism standards are not well defined and that the ontology can compensate for this deficiency.

Generally, the solution offered by the Semantic Web in order to guarantee interoperability is not yet precisely defined, but the semantically-based information systems is certainly a revolution in the field of tourism. Ontologies in the process have a very important role. They define the concepts of tourism and their interrelationships, and can improve the quality of representation and search data. The ontology will allow achieving interoperability through the use and sharing of common dictionary.

3. INTEGRATION BASED ON SEMANTIC TECHNOLOGY

The tourism industry is an important segment of e-business. Its core consists of dissemination and retrieval of relevant information. The Semantic Web technology has a promising role for achieving this goal because they provide a better machine processing of tourist information on the web. Thereby, tourist concepts are becoming aware of their content, and users and software agents can ask questions and draw conclusions quickly and automatically. Future generations of tourist information systems will increasingly depend on semantic technologies. They will provide interoperability and reusability and sharing of knowledge.

Tourist Web portals often rely on existing Web technologies, which represent serious constraints to search, access and process information. This impedes the access to data, and end users do not receive relevant information. The Semantic Web technology has the potential to reduce these drawbacks. Semantic Web portals focus on flexible presentation and use of data. Their biggest challenge is to process available information.

The purpose of semantic portal KG Hotel Info is a flexible display and providing relevant information to end users. Data are stored in the ontology, so it is necessary to choose appropriate technologies for implementation and portal development. The architecture of software solutions portal is shown in Figure 1. Software components are represented by colored triangles. The components of the upper layer are placed on the client side, and the lower layer components are located on the server side. The arrows indicate the flow of data between software components. Red arrows indicate the flow of data from the server to the client, while the blue shows the flow of data from client to server.

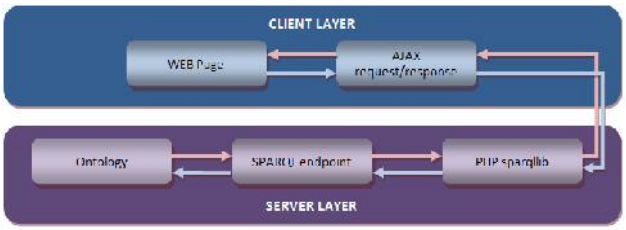

Figure 1.Portal's architecture KG Hotel Info

Ontology processing is performed using SPARQL [9] queries. I this way, the necessary information from ontology are taken. These queries are quite powerful and flexible, and their syntax, although quite complex, has a form similar to SQL queries. For the needs of this paper is used SPARQL SELECT query type. Queries are created on the PHP server side, based on the received AJAX requests, which forms the client by setting the various search criteria. In order to perform, created queries are routed to SPARQL endpoint which is implemented as a SPARQL JOSEKI server. In order to request is forwarded JOSEKI server needs to contain PHP code library sparqllib. SPARQL returned data is displayed on the client side.

Semantic portal KG Hotel Info was developed as a prototype system that just illustrates the application of Semantic Web technologies and, as such, does not contain a large amount of data. The main contribution of this portal is to establish interoperability in the field of e-tourism, re-use of content and increase user interaction with the system in order to facilitate search and retrieval of information about hotels in Kragujevac. This approach is quite different from the traditional information systems, as it allows the integration of a large number of tourist resources execute at one place. The advantage of this portal is that after finding the relevant information customers can make a hotel reservation without the need to access their official sites.

Ontology development, as key a components of the Semantic Web, has a fundamental role in the integration of data from different information sources. Ontologies are a promising technology in order to solve semantic heterogeneity of data [10]. They can cope with such a problem because of its potential to describe the semantics of information sources.

The main role of ontologies in the integration of data information systems is an explicit description of the contents of information resources. Ontology KgHotel developed for our work integrates various types of data, such as hotel, location and contact information, which are taken from the official websites of hotels. The ontology also includes historical information about the hotels, which are taken from Wikipedia.

Ontologies data are generally divided into static and dynamic. Static data are relating to the general characteristics of the hotel, such as contact information (address, phone, fax, e-mail), data related to the capacity of the hotel (number and types of rooms), data describing the specific features of the hotel (the hotel ranking / number of stars, internet, parking, SPA, restaurant, exchange office, air conditioning...) and historical data. In contrast to the static data which are relatively less variable, dynamic data are changeable and related to the current booking rates. These data should be updated in the ontology, and in this way the users would have had an accurate insight into the current prices of hotel accommodation. In our opinion, the exchange of data between hotels, portals and end-users should be based on a shared and shareable vocabulary that provides terms for describing the relevant tourist information. Precisely from this reason the ontology proved to be as the perfect and intrusive solution.

An approach that was used for the development of ontology KgHotel is known as single ontology approach [11]. This is the simplest process in which develops and uses only one global ontology, and all sources of information are associated with her. Relations are expressed by mapping which determine correspondence between each information source and the ontology. The main challenge in the using of this approach is the sensitivity of ontology to the changes in the information sources. Changing only the one source can imply the changes in the ontology.

In order to determine the consistency of the ontology it was used reasonerHermiT 1.3.6. Ontology was created in RDF / XML [12] syntax format and has 31 classes and 23 properties. Ontology is quite flexible and is designed to be easily extensible, in the sense that it is very easy to add new classes / subclasses or new properties /subproperties.

Class hierarchy is defined by creating a subclass of the most general class Thing. Its direct subclasses are ContactData, Features, Hotel, PriceList, Rooms, Stars and Topics. For instance, classes Address, Email, Phone and Fax are direct subclasses of class ContactData.In Figure 2the class hierarchy is presented in a software tool Protégé.

The ontology contains two types of properties: object and datatype. Properties can be specified by domain and range. In this way, properties connects instance of domain with the instance of range. Object properties are used to connect two instances.For example, the domain of object properties hasFeatures, which determines the characteristics of the hotel, will be an instance of class Hotel and the range will be instance of class Features. In this way it will be associated instance of class Hotel and class Features.Datatype properties enable instances to have the specific value of its own data (embedded or user-defined). For example, property nameOfHotel, which specifies the name of the hotel, allows instance of class Hotel to have data value which is type of string. Figure 3 shows all properties that have been used in the ontology.

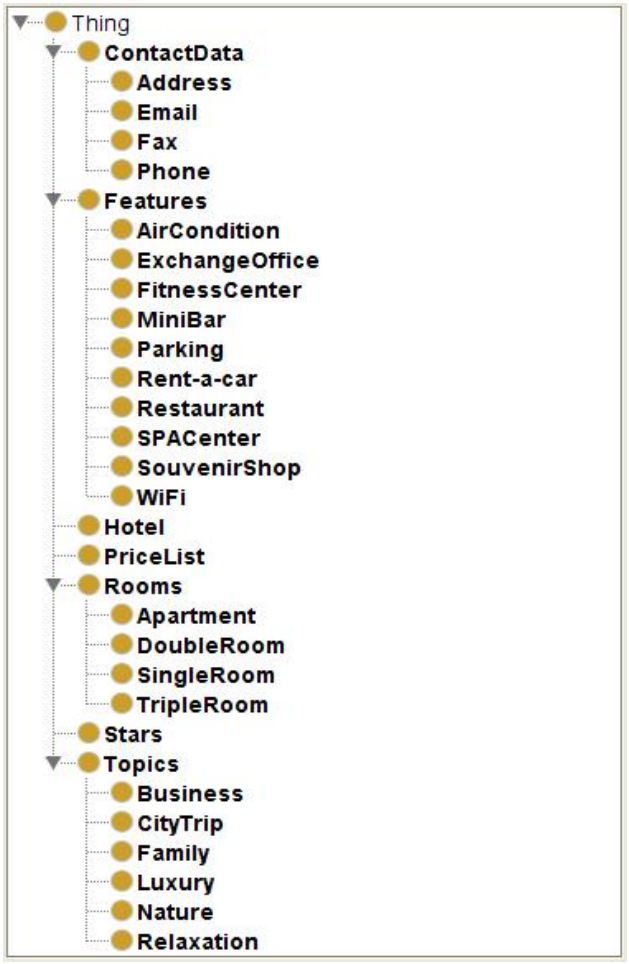

Figure 2.Hierarchy ofclassesforKgHotelontology

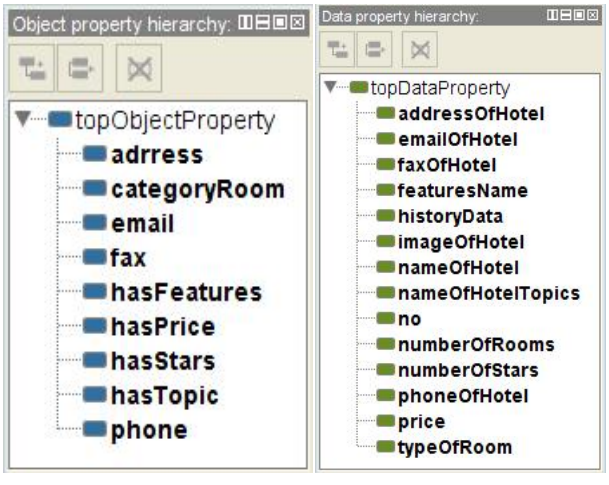

Figure3.Hierarchy ofpropertiesforKgHotelontology

The structure of semantic portal KG Hotel Info is modeled using ontologies KgHotel.It is in its background and represents support and starting point. Ontologies are the most appropriate for representing knowledge and its structure, which is according to the authors in [13] just a sufficient condition for the representation and processing of information in the portal.

4. INTERFACE OF SEMANTIC PORTAL KG HOTEL INFO

Tourist semantic portal can be observed as a web application, which allows access to tourist information but in the semantic way. This portal offers information providing semantic search and relevant answer that will satisfy the needs of the end user.In this way, the interaction is increased between system and end user.

To search hotels easier, interface of portal KG Info Hotel is quite flexible and customizable by the user himself, figure 4. Behind the interface, which is easy and understandable, is hiding semantic search, which allows it to perform functions that are happening in the background, and that in no way hinder and hamper searching. Thus, the obtained result makes more sense, and the search is quite effective because it is semantically enriched.

Test cases were run using the actual data from the KgHotel ontology. The data are divided into areas: Accommodation rating, Rooms, Hotel Features and Topics. The user specifies a variety of search criteria by checking the available fields. Clicking on the button "Search Hotels", the user gets the result, as shown in figure 5. If the user did not select any search criteria, results will not be returned.

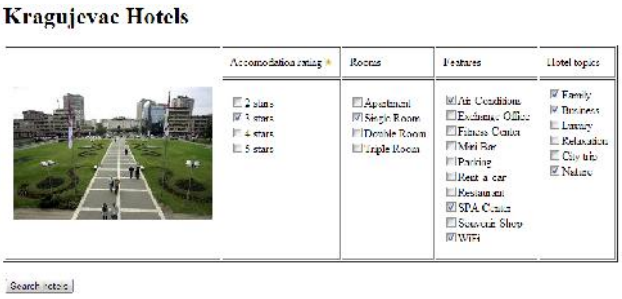

Figure4. Interface of portal KG Hotel Info

Figure5.Results of searching portal KG Hotel Info

The results showed that a semantic technology provides a better and more comprehensive result than a simple ranking by price. The user can make a hotel reservation.Each hotel will be rich describe with data from the ontology. By clicking on the button "Reservation", it opens a form for reservation. The client could in a very simple way and in a given time period make a hotel reservation, figure 6.

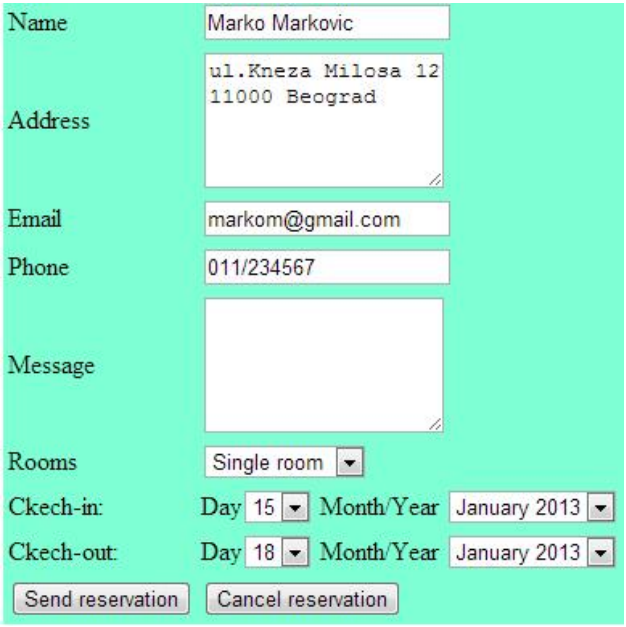

Figure 6.Form for a hotel reservation

After entering the basic data and the selection of terms in which he wants to reserve a hotel room, user forwards the reservation by clicking on the button "Send reservation". Further by entering the registration code which is sent to e-mail, the user will confirm his reservation. The user can cancel the reservation clicking on the button "Cancel reservation".

Unlike traditional limited solutions, semantic portal KG Hotel Info provides centralization of information. Clients will thus save time in the process of finding relevant information and avoid the need for access to official hotels websites. Portal aims to demonstrate the benefits of systems that contain embedded technologies of Semantic Web. Reducing time in finding perfect tourist information, the increasing interoperability between systems, reusability of knowledge and overcoming the passive attitudes of users in communication with the system are the key features that enhance the performance of the portal KG Hotel Info.

Although built as a prototype of a system that illustrates the use and importance of the Semantic Web technologies, portal KG Info Hotel has excellent conditions to be applied in electronic tourism andcommercialized. It would be necessary to test it with a larger quantity of data, in order to become aware of its advantages and disadvantages, but tourists would undoubtedly get a quick and efficient retrieval of relevant tourist information.

5. CONCLUSION

Many information systems are now adapting to customer requirements. Tourist agencies are adapting their web portals according to the client's needs. Their biggest problem is the heterogeneity of the information sources. With the help of the Semantic Web, semantically rich data can be created, which successfully overcomes this problem, and the application of e-tourism in this way can significantly improve their performance.

Ontology, as a key component of the Semantic Web, enabling standardization of the way in which tourism can present their data sources.This process would lead to the integration of data, and that would mean the tourist information search just in one place.Our ontology is used to aggregate and utilize the given information from different sources.

Portal KG Hotel Info is based on a single ontology, which enables the process of adding semantics to data. The main motive of portal is to provide a semantic connecting isolated data from different information sources in order to achieve interoperability, which would provide users to find relevant information.Results demonstrated that the semantic technologies offer better and more extensive results.

Future directions in the development of the portal are related to idealization of search interface, but so that he does not lose the function of their simplicity, which would otherwise lead to confusion during the search and further, confuse the end user. One of the objectives of improving is personalization of system, which allows the creation of user profiles, which will free users of unnecessary content. For that it would be necessary extend KgHotel ontology with data related with the interest of user's. Such data could be used for reasoning, and the result would be to draw conclusions based on the type of user profile.

In addition to the search domain, the presented model also provides a convenient framework for enhancing interoperability in supply chain networks [14] and better coordination.

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