Semantic Web and E-Tourism

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INTRODUCTION

Offering tourist services on the Internet has become a great business over the past few years. Heung (2003) revealed that approximately 30% of travelers use the Internet for reservation or purchase of travel products or services.

Classic sites of tourist agencies enable users to view and search for certain destinations and book and pay for vacation packages. At a higher level of sophistication are tourism Web portals, which integrate the offers of many tourist agencies and enable searching from one point on the Web. Still, when using this kind of systems one is forced to spend a lot of time analyzing Web content with destinations that match his/her wishes. This problem is identified by Hepp, Siorpaes and Bachlechner (2006) as the "needle in the haystack" problem.

Applying artificial intelligence (AI) techniques in E-tourism could help resolve this problem by providing:

1. Data that are semantically enriched, structured, and thus represented in a machine readable form;
2. Easy integration of tourist sources from different applications;
3. Personalization of sites: the content can be created according to the user profile;
4. Improved system interactivity.

As an example of using AI in e-tourism, we present *Travel Guides*—a prototype system that offers tourists complete information about numerous destinations. They can search destinations by using several criteria (e.g., accommodation type, food service, budget, activities during vacation, and user interests: sports, shopping, clubbing, art, museum, monuments, etc.). He/She can also read about the weather forecast and events in the destination.

In a way, Travel Guides complements traditional information systems of tourist agencies. These systems require a lot of maintenance effort in order to keep the huge amount of data about tourist destinations up-to-date.

Travel Guides is created to minimize the user's input and his/her need to filter information. It shows how usage of semantically enriched data in a machine readable form can

- Increase interoperability in the area of tourism,
- Decrease maintenance efforts of tourist agents, and
- Offer tourists a better service.

Nowadays, there are just a few e-tourism systems that use AI techniques. We briefly discuss them in the next section. In this article, we explain why it would be good to use such techniques and how Travel Guides does it. Specifically, using Semantic Web technologies in the area of tourism can improve already existing systems (which are mostly available online) that do not use Semantic Web techniques yet. Likewise, the Semantic Web approach can help decrease the maintenance efforts required for existing e-tourism systems and ease the process of searching for vacation packages.

Travel Guides was initially developed as a large-scale expert system. Over time, it has evolved into a modern Semantic Web application.

BACKGROUND

According to Aichholzer, Spitzenberger and Winkler (2003), e-tourism comprises electronic services which include:

- Information services (e.g., destination, hotel information);
- Communication services (e.g., discussion forum);
- Transaction services (e.g., booking).

Transaction services are offered at many places on the Web, such as Expedia, Travelocity, and so forth. These Websites include some of the information services, but for complete details about certain destination (e.g., activities, climate, monuments, and events) one must search for other sources. Some Websites even help in planning the whole itinerary (e.g., HomeAndAbroad). Apparently, there is an "information gap" between these online services, and no interoperability. Semantic Web technologies can be used to overcome this problem and thus increase the quality of e-tourism.

Cunningham (2002) presents GATE (General Architecture for Text Engineering) as an infrastructure for developing and deploying software components that process human

language. It can annotate documents and recognize concepts such as: locations, persons, organizations and dates. GATE can annotate documents with respect to a particular ontology. Some of the recently built Knowledge Management Platforms, like KIM (Popov, Kiryakov, Ognyanoff, Manov, & Kirilov, 2004**),** use GATE for information extraction and retrieval.

Similar to other AI technologies, Semantic Web is not frequently used in real-time tourism applications. Integrating AI tools into mainstream applications can result in benefits to both sides (Djuric, Devedzic & Gasevic, 2007). Standard organizations like the Internet Engineering Task Force and the World Wide Web Consortium (W3C) are making major efforts at developing languages for sharing meaning (Shadbolt, Berners-Lee & Hall, 2006). Speaking at the WWW2006 conference in Edinburgh in May 2006, W3C director Tim Berners-Lee pointed out that Semantic Web has all the standards and technologies it needs to succeed and that it was time for Web developers and content producers to start using semantic languages in addition to HTML (Bennett, 2006).

Cardoso (2006a) addresses the lack of standards in the tourism domain: the prices for tourism activities are expressed in different currencies; the time units also do not follow the standards. He argues that use of Semantic Web and ontologies could overcome this problem. In Cardoso (2006b) he describes the ontology developed to achieve integration and interoperability through the use of a shared vocabulary and meanings for terms with respect to other terms in the area of tourism. His system creates vacation packages dynamically using previously annotated data in respect to the ontology. This is performed with a service that builds itinerary by combining user preferences with flights, car rentals, hotel, and activities in a single price. Similar to this, Jakkilinki, Georgievski and Sharda (2007) presents a tool for tour planning that is intelligent in the meaning that it generates travel plans by matching user preferences and available tourist offers from different travel agents in respect to the ontology which enables reasoning.

To use Semantic Web in e-tourism, two approaches could be applied. One is to make applications from scratch, based on the existing standards. The other one is to enrich already existing content with annotations based on ontology. The first approach is not cost-effective for tourist agencies. Although the second approach sounds more reasonable, it seems that there are not enough data in the domain of tourism on the Web. Hepp et al. (2006) made a research in this field using a sample of 100 accommodations in Austria. Their results showed that neither some of the hotels had their Web pages, nor the biggest Austrian portal for e-tourism (Tiscover) had any information about them. An additional problem they noticed was the incompleteness of the details such as the availability of the accommodation and the prices.

Many e-tourism portals store their data internally, and not on the Web. This means that even a perfect annotation of the Web content would not be sufficient enough; hence, it is limited to persistently published information (Hepp, 2006). To exceed this problem Stojanovic, Stojanovic and Volz (2002) developed a mapping mechanism for migrating relational database schemas into ontologies in order to form the conceptual backbone for metadata annotations which are automatically created from the database. A better approach would be to use Semantic Web services, for example, Web Service Modeling Ontology-WSMO (Roman et al., 2005) or OWL-based Web service ontology - OWL-S (Smith & Alesso, 2005).

Dell'erba, Fodor, Hopken, and Werthner (2005) present the Harmonize project that integrates Semantic Web technologies and merge tourist electronic markets using ontology as a mediator. Their ontology was taken over by the E-tourism Working Group (2004) at Digital Enterprise Research Institute (DERI). This group plans to develop an advanced e-tourism Semantic Web portal, which will connect the customers and virtual travel agents. This portal could be of importance to the travel industry in Austria, whereas for the rest of the world it could be an example of using Semantic Web technologies in a real business system.

In 2001, the industry tried to address the interoperability issue by forming a consortium called the Open Travel Alliance. OTA is producing XML specifications (schemas) for messages to be exchanged between the trading partners, for example, availability checking, booking, rental, reservation, query services, insurance, etc. The precondition for this improvement method to succeed is that each travel agent's application can produce and consume OTA-compliant messages.

Dogac et al. (2004) present the SATINE project as a peer-to-peer network that enables peers to deploy their semantically-enriched travel Web services and allows others to discover these services semantically.

In addition to attempts to semantically enrich tourism sources on the Internet, it has been very popular to develop Location Based Tourism Systems (LBTS). LBTS are computerized systems that depend on an automated location of a target which either deliver or collect information. Currently, LBTS applications are being used by mobile phones, iPods, and PDAs (Hawking et al., 2005). LBTS provide search for hotels and ATM machines near by the user's current location and additional information when the user visits a city for the first time. An example of such a system is "Mobility Agent" (Edwards, Blythe, Scott & Weihong-Guo, 2006). This system delivers Internet-based travel and tourism-related services through fixed and mobile devices. Intelligent agent technology (Devedzic, 2003) was used to provide European visitors the dynamic, mobile, personalized, location-based information and services, especially related to travel in complex urban environments. Kanellopoulos