TOURISM ONTOLOGY AND SEMANTIC MANAGEMENT SYSTEM: STATE-OF-THE-ARTS ANALYSIS

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ABSTRACT

The global importance of tourism is steadily rising,creating new job opportunities in many countries. Today's information management solutions for the complex tasks of tourism intermediaries are still at an early stage from a semantic point of view. This paper presents some preliminary results of OnTourism Project. OnTourism is aimed at (1) applying, concretizing and evaluating Semantic Web technologies such as ontologies, semantic annotation of content, and semantic search to the information-rich and economically important tourism domain, (2) identifying, developing and integrating reference ontologies for the tourism industry, and (3) showing the proof-of-concept in a real-world scenario of the Austrian tourism industry. First results presented in this paper identify publicly available tourism ontologies and existing freely available ontology management tools for the tourism domain. We identify seven tourism ontologies which are suitable as a basis for creating problem-specific ontologies. Furthermore we review and evaluate five freely available ontology management tools that are suited for application in the tourism domain.

KEYWORDS

Tourism ontology, ontology management tool, semantic web, ontology

1. INTRODUCTION

Tourism is viewed as information intensive industry where information plays an important role for decision and action making (Inkpen, 1998). As the Web has changed people's daily life, it has significantly influenced the way of information gathering and exchanging in the area of Tourism. More than 66% of American users believe that eTourism web sites provide better services than travel agents. A third of American travellers book their travel on the Internet (eTourism Newsletter, 2006). Information technology starts to play a challenging role in the domain of tourism, such as Semantic Web and Web2.0 (Werthner & Klein, 1999; Werthner, 2003). Currently, a clear state-of-art view on this direction is missing, such as what are the most popular used ontologies in the tourism domain, and does there exist some tool support to handle different tourism ontologies and related instance data. This paper focuses on the state of the arts analysis on the existing tourism ontologies and the requirement analysis of ontology management tools for tourism domain. We present several existing tourism ontologies which are suitable to serve as a basis for problem specific ontologies. Furthermore we review and evaluate freely available ontology management tools for their suitability for tourism specific semantic information management tasks. The paper is structured as follows. Section 2 outlines important tourism ontologies and their key features. Section 3 evaluates selected existing ontology management tools according to tourism domain requirements. Section 4 provides conclusions and future works.

2. TOURISM ONTOLOGIES

In tourism domain, there already exist different in-house taxonomies and catalogues which are designed and used internally by tourism agents to help them to manage heterogeneous tourism data. Efforts are made to generate global standards to facilitate inter and intra tourism data exchange (e.g., by the World Tourism Organization). Ontologies play an important role to facilitate semantic integration of heterogeneous data (Gruber, 1993). In this section we identify severalpublicly available formal tourism ontologies which show the current status of the efforts and may serve as a basis for problem specific tourism ontologies.

Harmonise Ontology
The Harmonise Ontology was created within the EU Project Harmonise (Figure 1). It is specialised to address interoperability problems in the area of tourism (e-tourism) focusing on data exchange. The goal of the ontology is to support tourism organizations with exchanging data and information without changing their local data structures and information systems. Harmonise is based on mapping different tourism ontologies by using a mediating ontology. This central Harmonise ontology is represented in RDF and contains concepts and properties describing tourism concepts, mainly dealing with accommodation and events.

Mondeca Tourism Ontology
Mondeca (www.mondeca.com) Tourism Ontology includes important concepts of the tourism domain which are defined in the WTO thesaurus (www.world-tourism.org) managed by the WTO (World Tourism Organization). The WTO Thesaurus includes information and definitions of the topic tourism and leisure activities. The dimensions which are defined within the Mondeca Ontology are tourism object profiling, tourism and cultural objects, tourism packages and tourism multimedia content. The used ontology language is OWL and the ontology itself contains about 1000 concepts.

OnTour Ontology
The OnTour Ontology (http://ontour.deri.org/ontology/ontour-02.owl) is an ontology created especially for the tourism domain and was developed by DERI (Digital Enterprise Research Institute). In addition to normal tourism concepts (location, accommodation…) it also includes concepts that describe leisure activities and geographic data. The used ontology language is OWL-DL. A documentation of the ontology is available at http://e-tourism.deri.at/ont/index.html.

OTA Specification
The OTA (OpenTravelAlliance) members are organisations that represent all segments of the travel industry, along with key technology and service suppliers. The OTA Specification defines XML Message Sets packages that contain about 140 XML Schema documents corresponding to events and activities in various travel sectors.

Other Ontologies
A Tourism Ontology (http://ontobroker.semanticweb.org/ontos/comparing.html) developed by the University of Karlsruhe contains four different sub-ontologies for the tourism domain defining about 300 concepts and more than 100 relations. The EON Travelling Ontology (http://opales.ina.fr/public/ontologies/EON-TravellingOntology-v0.2.daml) is mainly designed for the travel domain. The TAGA Travel Ontology (http://taga.sourceforge.net/owl/travel.owl) is another travel-focused ontology that provides typical concepts of travelling combined with concepts describing typical tourism activities (Bachlechner, 2004).

3. ONTOLOGY MANAGEMENT TOOLS FOR THE TOURISM DOMAIN

As we see from Section 2, there does not exist one single ontology which matches all the needs of different tourism related applications. Therefore some ontology editing, mapping, versioning and querying supports should be provided in order to facilitate the knowledge engineers to manage ontologies. Based on the requirement of ontology management tool published by Ding and Fensel (2001), we evaluate the existing ontology management tools with the consideration of the tourism domain. We identify the following tools:

DIP Ontology Management Suite OMS, WSMT, WebOnto, and Ontolingua. Clearly we might miss some important tools in this survey. But the coverage of the selected tools should be able to represent the key effort in this area.

DIP Ontology Management Suite OMS

The DIP Ontology Management Suite was developed by the Project group DIP (Data, Information, and Process Integration with Semantic Web Services) and the final release was in June 2006 (Henke, et al., 2006). The main goal of the OMS is the development of a tool suite which supports editing, maintaining and managing WSML (www.wsmo.org) ontologies. Furthermore OMS offers versioning support, ontology mappings and a reporting tool which was especially designed for external browsing and community-enabled ontology development. *Editing, Maintenance and Versioning*: The application layer consists of four end-user tools: the editing and browsing facilities for ontologies, the versioning tool for ontology evolution management, the mapping editor and the ontology reporting tool. OMS also supports versioning which is done with selecting between two states: uncommitted (in progress) and commit (frozen). If a user gives the ontology the status "commit" it receives a new non-functional property to indicate that the ontology is frozen. *Mapping and Merging*: The OMS Mapping Editor supports editing ontology mapping documents. The Mapping Language proposed is abstract from the ontology language. This provides the advantage that ontologies and mapping become uncoupled. *Storage, Retrieval, Reasoning, Querying*: There is a storage layer where two ontology repositories are provided: FOR and YARS. The storage layer allows scalable ontology management and features persistent data storage. The data interchange is supported by ORDI (Ontology Representation and Data Integration) which in turn extends WSMO4J. Another useful service of OMS is the Reporting Tool.

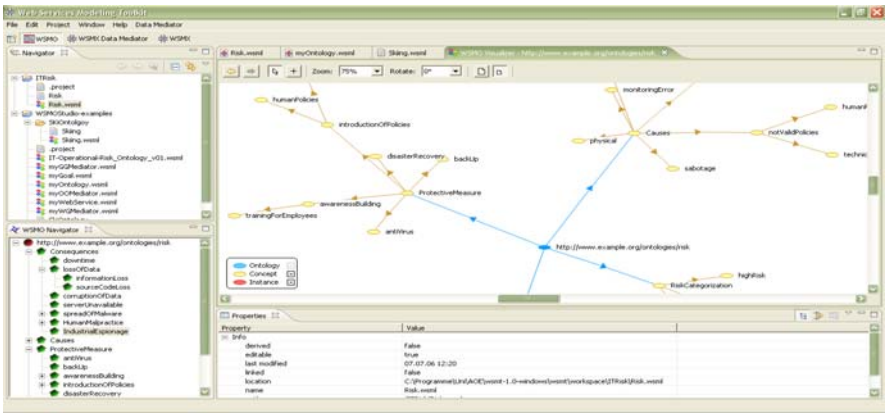

Figure 1: Visualization of Ontology in WSMT

WSMT

WSMT was developed at DERI (Digital Enterprise Research Institute) at the University of Innsbruck in 2004/2005 (Kerrigan, et al., 2007). The main goal of WSMT (Web Services Modeling Toolkit) is the coverage of all the functionality concerning WSMO (Web Services Modeling Ontology), WSML (Web Service Modeling Language) and WSMX (Web Services Modeling Environment) [6] (Figure 1). *Editing, Maintenance and Versioning*: WSMT provides a graphical visualization of the ontology. It is possible to edit the ontology directly in the graphical visualization. The zoom, rotation and the filter are some of the helpful features within the WSMT Visualizer. WSMT provides a validator which validates ontologies. Unfortunately there is no versioning supported in the current release but it is planned to integrate it in a later version. *Mapping and Merging*: The mapping in WSMT is done with the Abstract Mapping Language AML. An AML Validation, AML Text Editor, AML View Based Editor, AML Mapping Views and MUnit Testing View are provided. *Storage, Retrieval, Reasoning, Querying*: WSMT can be used to store and retrieve ontologies. The WSML Reasoner View helps to check whether the ontology and its semantic descriptions are correct. The WMSL2Reasoner framework is able to transform semantic descriptions to an underlying

reasoning engine, i.e. WSML-DL can be translated to OWL-DL. In the current release there is access to a Datalog reasoner called MINS through the WSML2Reasoner framework and additionally access to the Pellet reasoner for WSML-DL.

WebOnto
WebOnto was developed by the Knowledge Media Institute of the Open University (UK) and is an ontology library system developed to support ontology tasks like creating, editing and browsing. With help of a graphical interface, ontological expressions are displayed in a clearly arranged way. *Editing, Maintenance and Versioning*: The searching of ontologies is limited to ontology navigation or ontology browsing. The ontologies and their structure can only be displayed graphically. It supports synchronous and asynchronous editing of ontologies on a web based tool called Tadzebao. However, there is no support for versioning. *Mapping and Merging*: Webonto only supports two kinds of mapping constructs supported by OCML: *relation mapping* and *instance mapping. Storage, Retrieval, Reasoning, Querying*: The ontologies are stored using a *Module* and are then divided into smaller units, as opposed to being classified according to some existing categories. The reasoning in WebOnto is done rule based.

Ontolingua
Ontolingua was developed at the Knowledge Systems Laboratory of Stanford University. It is an environment which allows creating, browsing, editing, modifying and using ontologies. The Ontolingua server is able to handle more than 150 active users. *Editing, Maintenance and Versioning*: Maintaining and building ontologies is possible via remote distributed groups. It is possible to search for terms within ontologies in the library. The Ontolingua environment does not feature any versioning functions. *Mapping and Merging*: Mapping and merging is not possible in Ontolingua directly but it provides a software system for implementing these tasks, called Chimaera [1]. *Storage, Retrieval, Reasoning, Querying*: The reuse of ontologies is supported via a modular library system based on several functions: inclusion, polymorphic, refinement, and restriction. The organization of the ontologies stored in Ontolingua is based on the lattice theory. A special feature of Ontolingua is the idiom-based retrieval which returns instances of a sentence and employs a so called Purpose Reasoner and Classifier.

Ontology Management Tool Evaluation
Several ontology management tools are evaluated based on the identified requirements. Table 1 gives an overview of strengths and weaknesses of these tools. Concerning the tasks of editing, maintenance and versioning the tools WSMT, WebOnto and Ontolingua got less points because they are missing an efficient versioning functionality. All tools are well developed with respect to editing. All of them provide user friendly interfaces. Mapping and merging is well supported in DIP OMS, WSMT and WebOnto. Ontolingua itself supports neither mapping nor merging but provides a tool called Chimaera, which explicitly handles mapping and merging.

Table 1: Evaluation summary of Ontology Management Tools

ONTOLOGY MANAGMENT TOOLS	EDITING MAINTENANCE VERSIONING	MAPPING MERGING	STORAGE RETRIEVAL REASONING QUERYING
DIP OMS	++	++	+
WSMT	+	++	++
WEBONTO	+	++	+
ONTOLINGUA	+	~	++

4. CONCLUSION AND FUTURE WORK

Semantic technologies provide methods and concepts facilitating effective integration of (tourism) information originating from various sources on top of so-called ontologies (formal domain conceptualisations) representing basic notions and conceptual relations in tourism for actual information

[1] http://www.ksl.stanford.edu/software/chimaera/

linkage – something achieved hitherto by knowledgeable tourism-experienced staff tediously feeding incoming or searched-for material into file cabinets or databases set up for very specific uses. In contrast to this, semantic technologies offer a significant potential for better cross-system integration and a more versatile linkage of available multi-media tourism data based on ontology references and other types of semantic mark-up (such as geo-referencing of data) for the benefit of increased flexibility, accuracy, and timeliness of information offered to the tourism market.

In this paper, we presented some early stage work of OnTourism project on identifying tourism domain ontologies and proper free available ontology management tools. Based on this, OnTourism will further explore the balance and proper mixture of semantic technology with Web 2.0 technologies. It will identify how social tagging can help to build up light-weight ontologies (folksonomy) to enhance the community-effort in tourism domain. Furthermore, it tries to find the proper way to optimize the benefit of the searching based on formal semantics (ontology) and social semantics (folksonomy) and the normal keyword-based searching.

ACKNOWLEDGEMENT

This work has been funded by Austrian Research Society (FFG) under Project OnTourism.

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