IDEA GROUP PUBLISHING
701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.idea-group.com

ITB12645

This paper appears in the book, *Emerging Trends and Challenges in Information Technology Management, Volume 1 and Volume 2* edited by Mehdi Khosrow-Pour © 2006, Idea Group Inc.

Web Ontology as E-Business Information Exchange and Decision Support Tool

Yefim Kats, Computer Science Dept, Southwestern Oklahoma State University, 100 Campus Dr, Weatherford, OK 73096, yefim.kats@swosu.edu

James Geller & Kuo-chuan Huang
Computer Science Dept, New Jersey Institute of Technology, University Heights, Newark, NJ 07002, {geller, kh8}@njit.edu

ABSTRACT

This paper is based on the ongoing research grant from the National Research Council and partly funded by the National Science Foundation. This study is also linked to our foreign partner's project for the Ukrainian Government - *Development of Knowledge Base Architecture and Knowledge Discovery Methods for Intelligent Information Systems in Economics*. The study can serve as a practical testing ground for the development of generic as well as domain specific business oriented Web based knowledge resources, using ontology languages such as OWL. The overall objectives of the study include development of *the standard consensual terminology*, *conceptual framework*, and *the required mappings* for a cluster of business-oriented ontologies to facilitate information exchange and e-commerce transactions between Ukraine and USA.

INTRODUCTION

Ontologies are often defined as conceptualizations that "provide a shared and common understanding of a domain that can be communicated between people and heterogeneous and widely spread application systems" (Fensel, 2003). Thus, by definition, the study of ontologies requires cooperation between the parties belonging to the different social, economic, and linguistic environments. The use of Web Ontologies as well as ontology languages such as OWL should contribute to our ability to improve both the data exchange and the decision-making processes (including, crucial for certain businesses, the ability to make decisions dynamically) involving users communicating in a multicultural environment. The Web Ontologies are being developed as an integral part of the *Semantic Web* project aimed at reshaping the Web into the complex *semantic* infrastructure. The essential elements of this infrastructure include:

- Web Ontologies explicitly representing the semantics of typical knowledge domains.
- Agent enabled new markup languages, capable to work with the Web Ontologies.
- Ontology enabled security and trust infrastructure.

The overall objectives of this project are being implemented in several steps:

- Identifying the standard ontology vocabulary covering generic terms for the major e-commerce models involved in economic exchange.
- Identifying domain models, including classes, relations and attributes with the corresponding semantic constraints.
- Identifying specific ontological commitments for (intelligent) agent based automatic processing.
- Development of metrics to measure and assess the degree of similarity between related ontologies developed in different cultural environments with possible semantic diversions within the class of related domains.

ONTOLOGY IMPLEMENTATION

At the current phase of the project we developed a Multilingual Ontology Based E-commerce search engine implemented in JAVA and in the currently de facto standard ontology design language OWL. OWL is categorized into three sub-languages: OWL-Lite, OWL-DL and OWL-Full. OWL-Lite is the syntactically simplest sub-language; OWL-DL is much more expressive than OWL-Lite and is based on Description Logics; OWL-Full is the most expressive OWL sub-language. OWL-DL is a better choice than OWL-Lite for our project because of its automated reasoning capability.

As a convenient software tool to implement the bulk of the project, we chose Protégé (Protégé) – free software developed at Stanford University. It has useful plug-ins, such as the Protégé-OWL plug-in, which can save the Ontology in OWL format. Another useful tool is Racer (Racer) - a stand-alone semantic reasoning tool for RDF/OWL to be used to check for possible ontology inconsistencies.

The sample graph below (fig. 1) represents the first design step in identifying typical E-commerce vocabulary:

This graph is based largely on the XML Common Business Library version 4.0 modules and can be treated as a rudimentary E-R type model to be refined iteratively as the project progresses (XCBL). The iterative nature of this process is due to the fact that the overall structure, the entities with their attributes and the relationships between entities have to be adjusted to the diverse business practices in different countries (in our case – Ukraine and USA). Accordingly, as we continue to accumulate more vocabulary, we are forced to readjust the semantics of our model.

Fig. 1. E-Business terminology Structure

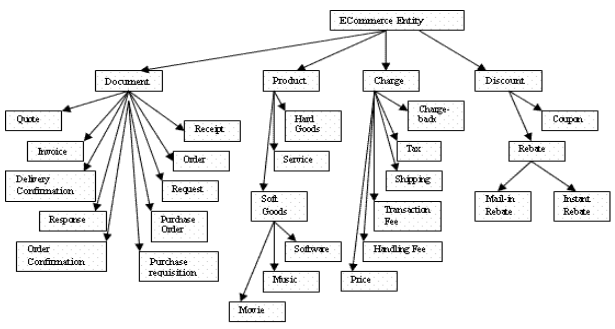
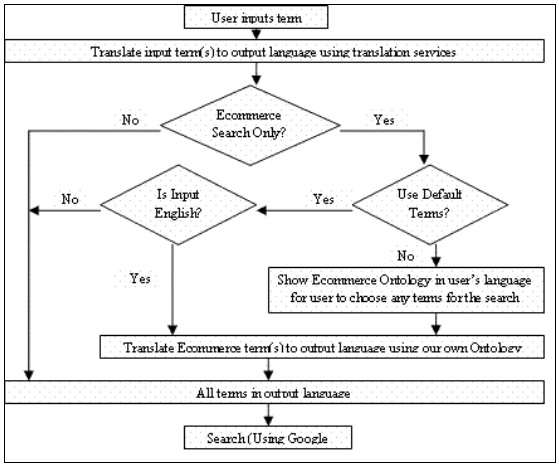


Fig. 2. Flowchart for Web Search Interface



Essentially, the international nature of the project makes it difficult (or impossible) to apply any straightforward modeling technique.

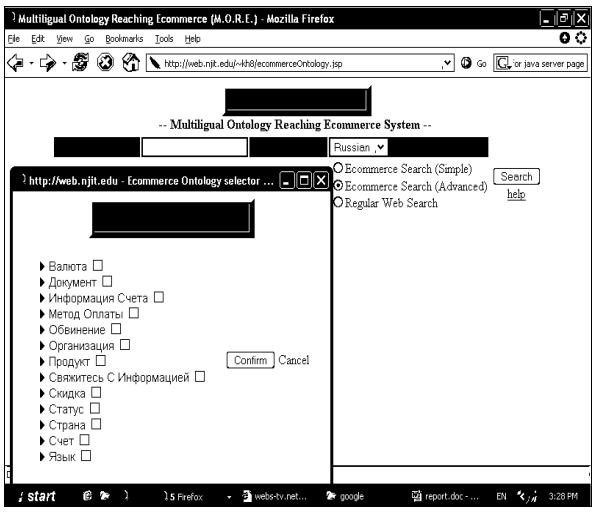
At this phase of project implementation we first created the 'central' English language ontology. The English terms were directly translated into several languages and, consequently, the three ontologies of e-business terms – in English, Russina, and German - have also been created as a first draft; the users may append those terms (in the correct language) to their own search terms. The conceptual problem with this approach is that all ontologies have the same semantic structure. However, this structure depends upon the business practice in a particular country. Thus, not only the vocabulary for each ontology needs to be refined and expanded, but also, as the project progresses, we may need to modify some (or all) of non-English ontologies.

INTERFACE DESIGN

The functionality chart for the JAVA-based *Multilingual, Ontology-Based E-Commerce Browser* is shown on figure 2 (M.O.R.E).

The logic of search process is as follows. The search interface allows the user to input e-business terminology in his native language and to request the output in several languages such as Russian or German. If the user makes a 'simple' search choice, the input term is directly translated into the output language using the built-in ontologies. Then the translated input term is combined with an appropriate default string from the 'central' English language ontology. The final combined string – input term AND 'ontology context string' – is submitted to the Google API. The output consists of the translated input string as well as a list of relevant Web links. In case of the advanced search, the user will be presented with an *ontology pop-up window* offering him to place his input term into the context of the available (in his native input language) E-Commerce ontology. Then the input term and the 'ontology context string' will be translated into the chosen output language and submitted to Google. The following figure presents the Russian version of the 'ontology choice window' presented when the user chooses the advanced search option.

Figure 3. Russian Ontology Pop-up Window



In many cases, ontology based search in the E-commerce domain proved to be more efficient than the straightforward Google search. As an example, the string 'international money order' submitted to Google returns over 900 hits, while our search engine, still using Google, returns just over 100 hits.

CONCLUSION

Our study showed that ontology based search provides a considerable enhancement to e-business. Sellers should be able to present information in their language of choice, while customers will be able to search for information in their language of choice. Thus, not only ontology based interface engine enhances search efficiency but it also brings to the next level international or/and multilingual seller-buyer interaction.

The use of ontology driven menus can be also expanded to benefit online sellers. In particular, customers may be presented with ontology based pop-up windows to help them both navigate their current Web site and direct them to related sites in order to enhance their shopping experience.

Finally, the goal of searching transparently in different languages would require a large amount of computing power, which is currently not practical. However, we are planning to include heuristics that connect a variety of languages with particular subject areas. Then the browser will be enabled to use such heuristics to locate the country and language most likely to result in a successful purchase. It will then, transparently to the user, search the Web pages of that country for pages that contain both the translated search terms and the e-commerce terms appended to them by choice of the user (and also translated transparently). Currently our implementation already makes use of the Google API, and considering that Google supplies an approximate translation capability, we can make use of it to further enhance our cross-country translation facilities.

REFERENCES

Spinning the Semantic Web (2003), ed. by D. Fensel et. al. Cambridge, MA: MIT Press.

Protégé, available at: http://protege.stanford.edu

Racer, available at: http://www.sts.tu-harburg.de/~r.f.moeller/racer

M.O.R.E., available at: http://web.njit.edu/~kh8/ecommerceOntology.jsp

XCBL, available at: http://www.xcbl.org

SELECTED BIBLIOGRAPHY

Kats Y. Enabling Intelligent Agents and the Semantic Web for E-Commerce. *Computing*, (2, 3), 2003, pp. 153-159, ISSN: 1727-6209.

Ontology Learning for the Semantic Web by A. Maedche, Kluwer AcademicPublishers, 2002, ISBN: 0792376560.

The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management, by Michael C. Daconta et al, John & Sons, 2003, ISBN: 0471432571.

Towards the Semantic Web: Ontology-driven Knowledge Management, ed. by John Davies, Dieter Fensel, Frank Van Hamelen, John Wiley & Sons, 2003, ISBN: 0470858060.