A Novel Method for Building Indexer for Aligning Ontologies in Semantic Web

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ABSTRACT

This article describes how communication, knowledge sharing, and exchange are the new economic stakes of the information society and the semantic web represents the next major evolution in connecting information. It enables data to be linked from a source to any other source and to be understood by computers so that they can perform increasingly sophisticated tasks on our behalf. Ontology plays a very important role in forming a communication between people, organization and software system as it is an agreed vocabulary of common terms and meanings shared by a group of people and computers. However, ontologies are designed and developed by several designers according to their specification and thereby creating redundancies and inconsistencies between the concepts in the domain. So, to create a common knowledge base and to avoid overlapping between existing ontologies, ontology alignment was introduced. The contribution of this article is to provide a new architecture for ontology alignment that result in a complete, coherent global aligned ontology of a domain.

KEYWORDS

Information Society, Ontology Alignment, Ontology, Semantic Web

INTRODUCTION

Ontology (Horridge, 2011) has been realized as the key technology to shaping and exploiting information for the effective management of knowledge, for the evolution of the semantic web and its applications in various domains. In such a distributed environment, ontologies establish a common vocabulary for community members to interlink, combine and communicate knowledge shaped through practice and interaction, binding the knowledge processes of creating, importing, capturing, retrieving and using knowledge. However, it has been observed that developer creates its own ontology according to its specification to add semantics to its content which results in existing more than one ontology even for the same domain. This interferes during query processing due to the gap between conceptualization of the same domain. Therefore, there is a need to bridge the gap between agents with different conceptualization. Ontology alignment is one such process this helps to bridge this gap. Alignment is the process of finding correspondence between concepts of different ontologies.

This work proposes a novel approach to ontology alignment. It unifies concepts, data properties and object properties of different ontologies belonging to the same domain which are syntactically and semantically similar in a concise manner. In the next section, a survey on existing solutions with special focus on methods and techniques used during various ontology management methods is done. Section 3 gives the description of the proposed method by explaining each layer of the architecture. In Section 4 empirical works has been presented to demonstrate the proposed method. Section 5 gives the comparative analysis on the available ontology management methods. At last, Section 6 concludes the paper with some light on future work.

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RELATED WORK

Ontology has become very popular in computer science due to establishing explicit formal vocabulary to share between applications which are playing a vital role in dealing with heterogeneity (Bian, Zhang, & Peng, 2011). As a result of this, developers have started designing ontology using different tools and languages; and preferring to create their own ontology despite of availability of ontologies belonging to that domain which results in collection of a number of ontologies belonging to different levels of detail and granularity of the same domain. Due to this, there is a need to manage existing ontologies on the web at one place and use them for further purpose. A number of operations such as mapping, alignment, matching, merging, and integration are being used which takes different variants of ontologies from different sources and manage them efficiently. Ontology Mapping (Kalfoglou & Schorlemmer, 2003) means mapping one ontology to another. It is the way to express how to translate statements from one ontology to the other one. In the simplest case it is a mapping from one concept of the first ontology to one concept of the second ontology. Ontology matching (Payel & Euzenat, 2013) is the process of detecting links between entities in heterogeneous ontologies. Ontology alignment (Vera & Nagy, 2015) is the task of creating links between two original ontologies. Ontology alignment is made if the sources become consistent with each other but are kept separate and usually have complementary domains. Ontology integration (Pinto & Martins, 2001) is the process of building ontology in one subject reusing one or more ontologies in different subjects. Ontology merging (Predoiu, Feier, Scharffe, Bruijn, & Recuerda, 2006) is the process of generating a single, coherent ontology from two or more existing and different ontologies related to the same domain.

A number of ontology management tools/techniques are available out of which some have been discussed as follows:

1. Figueroa, Yáñez, Rey et al. (2017) proposed instance based ontology matching for open and distance learning materials. It matches two instance based ontologies using associative model of pattern classification. This approach belongs to the supervised learning paradigm and is divided into two stages: the learning phase and the classification phase. The previously classified pattern is used in the training phase of the classifier. This approach requires previous knowledge as well as classifier takes advantage of the similarity function to find additional information;

2. Masri, Zeitouni, Kedad et al. (2017) proposed an automatic matcher and links for transportation dataset. It is an ontology alignment method that integrates the heterogeneous transportation data to construct a broad view of transportation network. It performs integration with two perspectives. First, at the schema level, it targets the automatic integration of datasets with different schema and at the second instance level, it targets the discovery of transportation relations between different entities scattered between the datasets;

3. Xingsi and Tang (2017) proposed an evolutionary algorithm based ontology matching system. It has proposed a problem specific evolutionary algorithm to construct a new optimal model for the ontology matching and mapping extraction problem;

4. Ngo and Bellahcene (2012) proposed YAM++ is a semi-automatic mapping tool to map two ontologies at three levels: element level, structural level and semantic level. At element level, it applies different terminological based metrics on the annotation of each entity. At structural level, it uses similarity flooding algorithm for more detail. At the semantic checking module, it uses global constraint optimization method. The resultant mappings of the matching process are displayed in graphical user interface. The user can judge a mapping as correct or not according to his interest of ontologies’ domain. The user can also modify, remove incorrect mappings or add new mappings with the help of command operations shown in YAM++’s menu;

5. Essayeha and Abeda (2015) proposed SIMTSS, a research process for the alignment between ontologies written in different languages such as RDF, SKOS, turtle etc. including heterogeneous information. The result is new data stored as an XML file stored in inference phases (query
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