Ontology Views for Ontology Change Management

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INTRODUCTION

In the literature, ontology change management systems (OCMS) are direct implementation of the concept of "change management" stated by reference (Klein, 2004). Ontology change management combines ontology evolution and versioning features to manage ontology changes and their impacts. Since 2007, many works have combined ontology evolution and versioning into ontology change management systems (OCMS). The evolution subject has been massively studied in these works. They especially addressed the consistence issue for the application of changes on the ontology. These proposals constituted a consequent background for ontology change management but they did not take into account certain specificities of ontologies.

One of them is the fact that ontologies are decentralized data Rajugan (2006). It means that multiple versions of the same ontology evolution are bound to exist over the Web and must be supported. It implies that ontology chronological evolution is not enough to manage ontologies. Actually, managing different parallel versions of a same ontology would bridge this gap.

Another characteristic is that ontologies are meant to grow during their lifecycle and may become too large to be used in its original scale by potential applications. Indeed, ontology development implies a dynamic and incremental process starting from the creation of a brute ontology, which has to be revised and refined (Djedidi, 2009). Refinement often leads to the improvement of the ontology level of detail corresponding to the addition of new elements to its conceptualization. Therefore the ontology size may increase after each refinement iteration, with no guaranty that the ontology is still manageable by applications and understandable by humans.

In the literature, ontology views have been defined to bridge this ontology size issue and improve ontology reusability. Several definitions and implementations of ontology views have been studied in the Ontology View Management specific research field. However no agreement was found. Nevertheless, a view generally is a subset specification on an ontology, which allows to extract a manageable portion of the ontology capable to be used and queried by applications like the whole ontology. The resulting sub-ontology can be generated not only as a sub-graph of the ontology but also as an independent ontology, itself being a new interpretation of the domain. It can be considered as a new parallel version of the actual ontology validating the decentralized quality of ontologies. From the different approaches studied in this article, can be deduced four types of view specification and implementation: query language based, subset extraction based, rule based and other views specifications based on hybrid techniques.

This article aims at giving an overall state of the art on ontology views, their objectives, their different implementations and use, the corresponding advantages and lacks, and finally defining the future research directions to take in the context of Ontology Change Management.

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BACKGROUND

Ontology Views Objectives

An ontology is a common representation of the meanings of knowledge of an application domain.

Reference ontologies are intended to support the domain knowledge requirements of multiple disparate applications. They are often too large or too complex, however, for any specific application (Detwiler, 2010). The problem is the same for large domain ontologies reused by specialized business applications. Automated or semi-automated evolution of these large ontologies is often impossible to realize because of their complexity.

In addition, the "world view(s)" provided by such domain ontologies may not match exactly the views required by particular applications. Also, potential applications will not access to the entire ontology (Noy & Musen, 2004). Access to unnecessary ontology whole can be slow if the ontology is complex. In order to utilize these ontologies, therefore, applications often require custom ontology views tailored for use within their specific context. In this case, views can optimize the access time and query processing of ontology by only loading a small portion of this ontology. In recent years, many academic and industrial research directions have focused on these issues and some of the notable works. Displaying portions of ontologies is then crucial to allow OCMS supporting large ontologies evolution.

In user-centred applications, usually, users just need to use a small portion of their resources or may not have the right to access certain parts of the ontology. Views are used then to manage access policies, profile, context and data security for users (Rajugan, 2006). Moreover adaptation of the ontology to several contexts or uses is one of the change management objectives.

Finally, the overall understanding of a complex ontology by the community may be impossible (Rajugan, 2006). Evolution of such ontologies cannot then neither be realized by a human.

To resolve these issues, views should produce an *understandable and manageable portion of an ontology for local applications and users* as a means of enabling them to use standard well-developed ontologies (Orbst, 2003). This requirement groups all the objectives of views cited above. This is the unique guideline we will retain all along the article, especially to complete change management foundations.

Nevertheless, the definition of an ontological view is still an open question in the literature and its specification has been studied through several approaches.

Ontology View Specifications in the Literature

Major works technically define the view as a specification of a sub-graph of the ontology. Two main approaches exist in the literature to deal with ontology views and are presented below: *ontology query language based approaches*, which use queries to select subgraphs of the ontology, and *subset extraction approaches*, which uses subset extraction techniques to provide sub-portions of the ontology. Other view specifications approaches based on rules, pipes and named graphs are also exposed.

Ontology Query Languages Approaches

General Description

In databases, a view is specified as a query: any instances satisfying this request constitute the view. Researchers from the database field have been working on using views directly responding to requests. Since the views are themselves queries, this field of research reformulated the user query result to express it as physical and searchable data as a database table: the case of materialized views. So it is within the same perspective that ontology views defined by queries are specified on an ontology. Ontology query languages are used and extended for this purpose and provide several features to manage and update the views.

Existing Proposals

Until now, several different RDF query languages have been proposed for querying within the semantic web, including RQL, RDQL and SPARQL. A number of proposals have been made for extending SPARQL's functionality, including Sparklers, ARQ, SPARQL++, CPSPARQL, nSPARQL, NetworkedGraphs and vSPARQL. Below are detailed RQL, RVL and vSPARQL proposals.

RQL is a declarative query language for RDF that allows querying over both resource descriptions and schemas. In this framework, a view represents a new