Accepted Manuscript

The use of Ontologies for Effective Knowledge Modelling and Information Retrieval
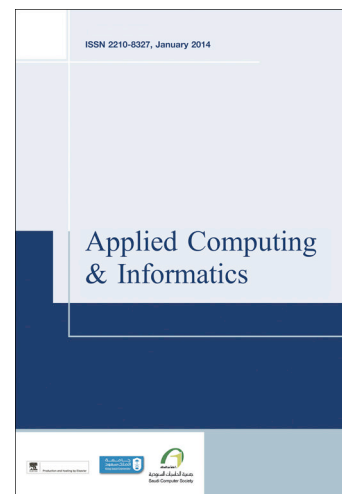
Kamran Munir, M. Sheraz Anjum

The use of Ontologies for Effective Knowledge Modelling and Information Retrieval

Kamran Munir*

Department of Computer Science and Creative Technologies, University of the West of England, BS16 1QY, Bristol, United Kingdom.

M. Sheraz Anjum

School of Electrical Engineering and Computer Science, National University of Sciences and Technology (NUST), H-12, Islamabad.

Abstract

The dramatic increase in the use of knowledge discovery applications requires end users to write complex database search requests to retrieve information. Such users are not only expected to grasp the structural complexity of complex databases but also the semantic relationships between data stored in databases. In order to overcome such difficulties, researchers have been focusing on knowledge representation and interactive query generation through ontologies, with particular emphasis on improving the interface between data and search requests in order to bring the result sets closer to users research requirements. This paper discusses ontology-based information retrieval approaches and techniques by taking into consideration the aspects of ontology modelling, processing and the translation of ontological knowledge into database search requests. It also extensively compares the existing ontology-to-database transformation and mapping approaches in terms of loss of data and semantics, structural mapping and domain knowledge applicability. The research outcomes, recommendations and future challenges presented in this paper can bridge the gap between ontology and relational models to generate precise search requests using ontologies. Moreover, the comparison presented between various ontology-based information retrieval, database-to-ontology transformations and ontology-to-database mappings approaches provides a reference for enhancing the searching capabilities of massively loaded information management systems.

Keywords: information systems, ontology, domain knowledge, database, information retrieval, knowledge management

1. Introduction

In information management systems, structured query formulation languages are one means of retrieving information. Writing structured queries is a powerful method to access data since it allows end-users to formulate complex database queries by learning specialised query languages. However, query formulation with the exception of a few visual query generation and refinement approaches remains appreciatively difficult for the various levels of systems users. In recent years information retrieval has turned out to be more complicated with the increased use of data mining, decision support and business analytics applications. Consequently, researchers focus has been on approaches that include *visual database interfaces* [1] and interactive query generation through graphs [2] and [3], with a particular emphasis on providing *interactive natural language* interfaces to support query generation. Recently, *semantic-based* approaches using domain ontologies have been adapted for data modelling and information retrieval. *Ontology-based information retrieval*, for example as in [4], [5] and [6] mainly aim at improving the interface between data and search requests in order to bring the result sets closer to the users' research requirements. In general, an ontology represents a

shared, agreed and detailed model (or set of concepts) of a certain problem domain [7]. One major advantage of using a domain ontology is its ability to define a semantic model of the data combined with the associated domain knowledge. Ontologies can also be used to define links between different types of semantic knowledge. Thus, ontologies can be used in formulating some data searching strategies.

This paper discusses ontology-based information retrieval approaches by taking into consideration the aspects of:
(a) *ontology generation from database schema(s)*;
(b) *processing of domain knowledge to represent it as ontological knowledge*; and
(c) *the translation of such ontological knowledge into relational database queries*.
Moreover, it provides a comparison between ontology-to-database *transformation* and *mapping* approaches in terms of:
loss of data and semantics;
structural mapping; and
domain knowledge applicability.
The outcomes presented in this paper can be beneficial in bridging the gap between ontology and relational models while attempting to generate precise search requests from ontology expressions. Moreover, the comparison presented between various ontology-based information retrieval, database-to-ontology transformations and ontology-to-database mappings tools/approaches provides a reference for enhancing the

*This is the corresponding author
Email address: Kamran2.Munir@uwe.ac.uk (Kamran Munir)