OntoManager: A Workbench Environment to facilitate Ontology Management and Interoperability

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Abstract. The prime motivation for our research is to enable sharing and reuse of domain knowledge through the engineering and management of ontologies. We contend that there is a need to reconcile ontologies by harmonising mismatches and discrepancies that are present among them. This is a necessary task before any stakeholders can begin to share and/or reuse the underlying knowledge (re)sources. Our key objective is to detect and resolve these mismatches in a consistent and verifiable manner. We have evaluated the state-of-the-art in ontology management tools and selected the best-in-class techniques and methods. We propose implementing a workbench that will integrate these tools and enable interoperability between them in order to facilitate the management of ontologies.

1 Introduction

Researchers have identified various kinds of ontological discrepancies [1, 2, 3, 4] and several types of inconsistencies that are inherent in knowledge and data sources [5, 6]. Also, impediments that are likely to occur during the elicitation of knowledge from multiple experts have been recognised [7]. Further, suggestions have been made about classifications and categorisations of such mismatches [2, 3, 6]. Recently, there has been considerable interest in developing tools and techniques to assist in a variety of ontology management operations, e.g., mapping, merging, alignment, integration, etc. [8, 9, 10, 11, 12, 13]. For any of these processes to be carried out successfully, it is inevitable that mismatches be detected and resolved. None of the available tools tackle all the types of discrepancies we have identified [3]. Moreover, the various tools operate on ontologies expressed in different knowledge formalisms. Essentially, since none of the current approaches are designed to address every type of mismatch, there is a compelling case for providing interoperability between the tools.

2 Background and Motivation

Our focus has been on the engineering & management of ontologies built from knowledge elicited directly from human experts. We make a distinction between *experts'* ontologies (based on inherent conceptualisations) as opposed to *artefact* ontologies.

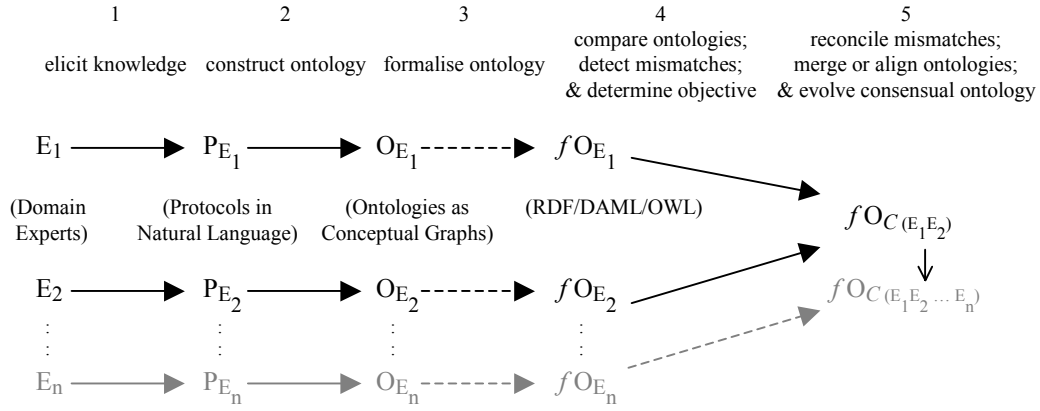

Fig. 1. Stages illustrating our evolutionary approach towards the engineering and management of *Experts' Ontologies*

Knowledge was elicited from domain experts ($E_{1 \ldots} E_5$) (Fig. 1) in the form of natural language protocols ($P_{E_1, } P_{E_{2, \ldots}}$) which were then analysed by a systematic approach

we developed to construct individual expert's ontologies (O_{E_1}, O_{E_2}, …) [14]. These ontologies were represented in a semi-formal notation as conceptual graphs [15]. In order to aid machine-interpretation and reasoning, it is necessary to formalise the ontologies and 'transform' them into a more expressive representation. We are investigating the efficacy of standard knowledge representation forms such as RDF, DAML+OIL, and the evolving OWL [16].

Since we have detected a wide array of mismatches among our experts' ontologies, extending from simple syntactic discrepancies to a range of rich semantic inconsistencies [3], we realised that it is not plausible to evolve an all-encompassing solution. Instead, we propose an approach based on interoperability between various best-in-class tools. This approach will take into account the type of mismatch and suggest an appropriate and feasible resolution process. In addition to the acknowledged approaches in knowledge representation, ontology engineering, and description logics, we are also investigating novel techniques from areas such as design patterns, fuzzy & softcomputing, among other promising techniques.

3 Ontology Management: The *OntoManager* Workbench

We have sought to assess empirically the effectiveness of the state-of-the-art in ontology management tools. Key features of prominent tools such as PROMPT, Chimaera, FCA-Merge, ODEMerge, ONION, OntoView, etc. are being appraised [17]; first with sample ontologies provided by the respective designers, and then with experts' ontologies from a common domain (PC specification) that were constructed from independently elicited knowledge [14].

After experimenting with these tools, we have obtained a clear understanding of both their strengths and their limitations. An analysis of the limitations has helped us focus on developing techniques that should address issues/problems that these tools have not yet tackled. An insight into each of their strengths has also enabled us to identify particular algorithms and techniques that are currently best-in-class.

We are developing an interactive tool to semi-automate the detection and resolution of various ontological mismatches. We now plan to extend this tool into a workbench environment: *OntoManager,* where different 'procedures/methods' can be added to aid in the resolution of specific kinds of mismatches. It is also anticipated that the tool itself could work with existing ontology development systems such as Protégé, OntoBroker/OntoEdit, WebODE, KAON, ConcepTool, etc. It is envisaged that when these tools are encompassed within OntoManager, it would be able to employ or at least recommend the most suitable tool/technique that could help resolve a specific type of ontological mismatch or discrepancy. The system is being implemented in Java. We aim to demonstrate the integration of at least two of the above tools, and show how interoperability can be achieved between the built-in techniques they offer and the heuristic methods that we have developed.

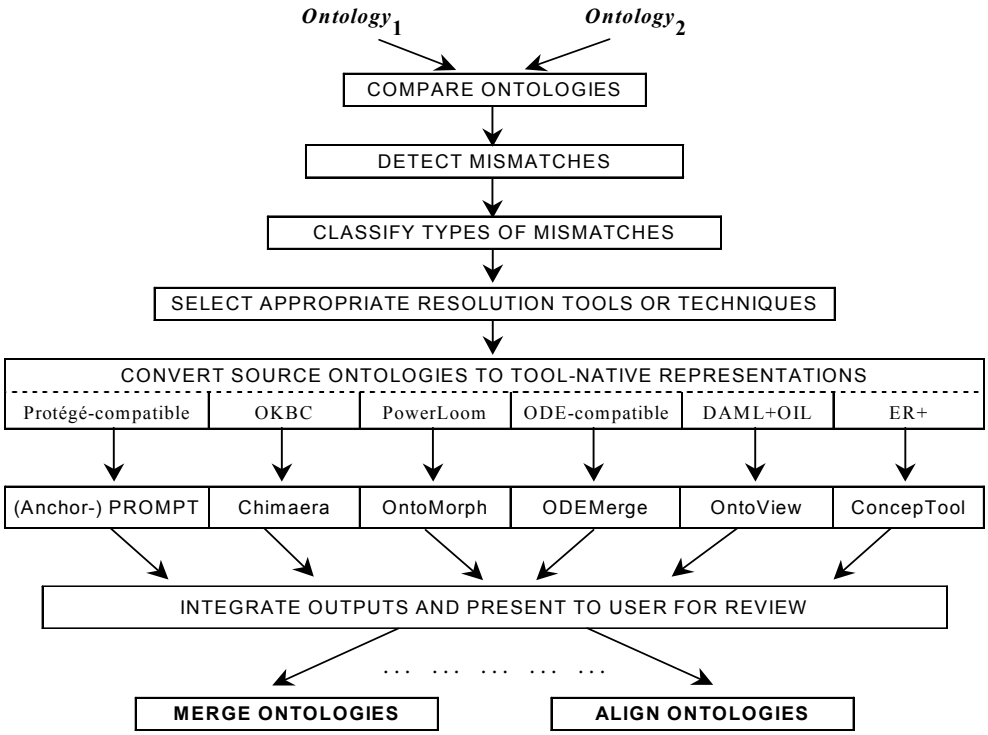

Fig. 2. A schematic diagram of the OntoManager: a workbench environment to facilitate the management of ontologies

Ontology management and interoperability can provide key solutions to the many challenges posed by the progressive transformation of the current WWW into the Semantic Web [18]. Also, the success of the much-advocated Web/Grid Services, which are predicted to proliferate, will certainly depend on successful reconciliation among underlying ontologies.

It is therefore conceivable that when this workbench is deployed in a distributed environment like the Internet, it will provide an innovative and a valuable ontology and knowledge management service for the Semantic Web/Grid.

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