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Semantic web service discovery system for road traffic information services

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ABSTRACT

We describe a multi-agent platform for a traveller information system, allowing travellers to find the road traffic information web service (WSs) that best fits their requirements. After studying existing proposals for discovery of semantic WS, we implemented a hybrid matching algorithm, which is described in detail here. Semantic WS profiles are annotated semantically as an OWL-S and also the traveller request is represented as a OWL-S profile. The algorithm assigns different weights and measures to each advertised WS profile parameter, depending on their relevance, type and nature. To do this we have extended Paolucci's Algorithm and adapted it to our scenario. We have added new similarity measures, in particular, the use of the 'sibling' relationship, to improve the recall, allowing relevant services to be discovered by the users yet not retrieved by other algorithms. Although we have increased the similarity concept relations, we have improved the run-time using a pre-process filter step that reduces the set of potentially useful WS. This improves the scalability of the semantic matching algorithm.

1. Introduction

Organizations operate in a global environment in which national business compete within a global economy and society. Information and data can be used as a strategic advantage by providing customers with specialized services tailored to suit their individual needs. Web Services (WS) enables the interoperability between information systems in real time. WS semantically annotated are handy plug and play services accessible on the Internet. As the number of WS over Internet is rising, the number of clients demanding to reuse services is also increasing. These clients ask for services using queries specified by functional (FPs) and non-functional parameters (NFPs).

In Samper-Zapater, Llidó, Durá, and Cirilo (2013) we proposed a Traveller information architecture as a multi-agent platform system (Fig. 1) to allow advertisement, request, discovery, invocation and execution of WS within it.

In this paper, we are going to describe a hybrid matching algorithm to automatic discovery road traffic information WSs. User requirements and WS, were both represented as a WS profile semantically annotated with the same ontologies.

An Automatic WS Discovery is an automated process to locate WS that can provide a particular class of service capabilities, considering the constraints specified by the client. To achieve this goal, it is quite important to match appropriately the different properties or capabilities of the desired WS, specially the outputs. The use of matching semantics is very important in this context, so we are going to use OWL-S descriptions[1] (Martin et al., 2005; Pedrinaci, Maleshkova, Zaremba, & Panahiazar, 2012).

To help providers annotate semantically WS profiles with OWL-S, in Samper, Tomás, Carrillo, and do PC Nascimento (2008) we proposed the OntoService web tool. This tool is also useful to help clients to specify their requirements semantically as an OWL-S profile and it facilitates the user interaction establishing a semi-automatic guidance. Due to the lack of specific ontologies on this domain, road traffic information, we have developed two ontologies (Samper-Zapater, Zambrano, & García, 2006): The first one, a Road Traffic Ontology to specify the road information concepts and relations. The second one, a Road Traffic Services Categorization Ontology (Fig. 2) to categorize the services on our scenario.

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[1] <http://www.w3.org/Submission/OWL-S/>

http://dx.doi.org/10.1016/j.eswa.2015.01.005
0957-4174/

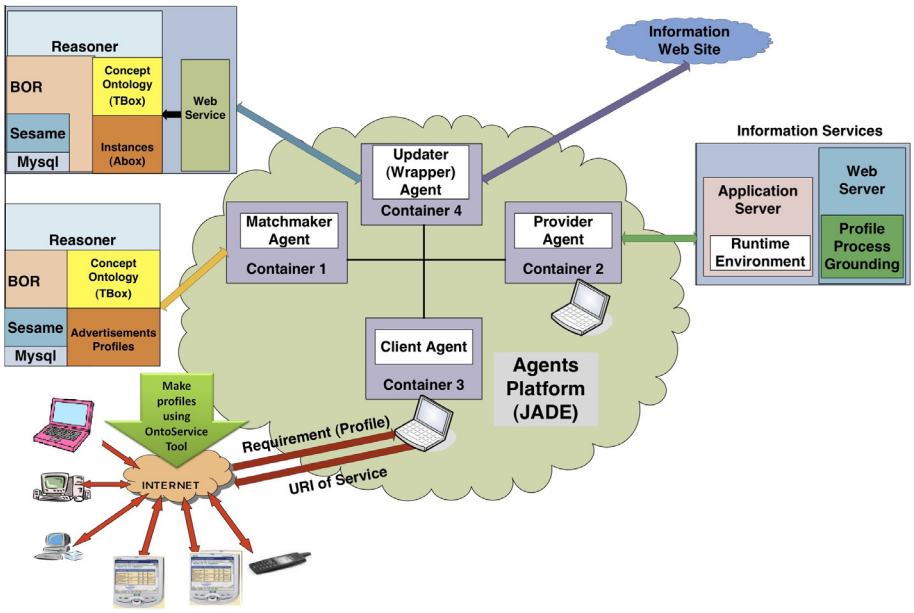

Fig. 1. Traveller information architecture.

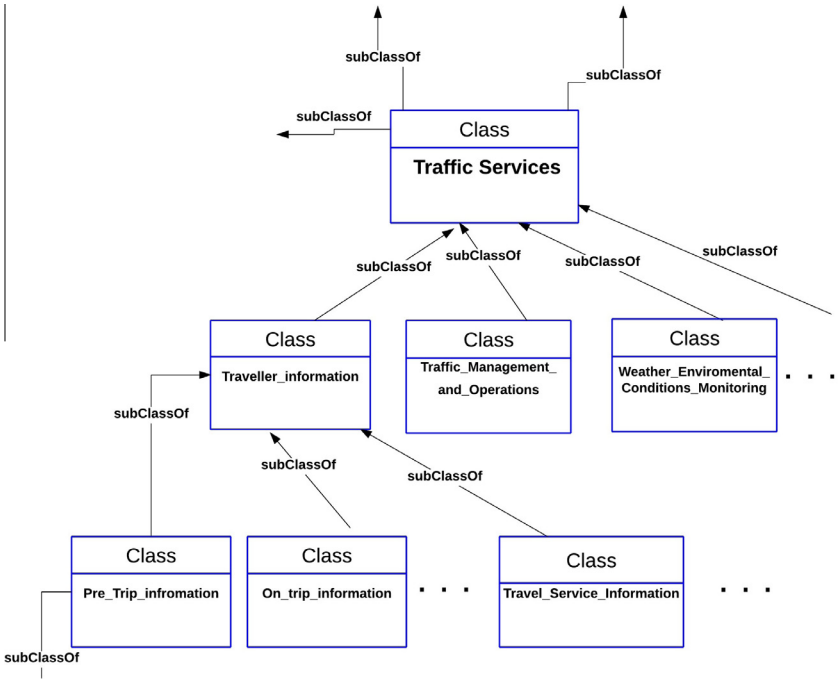

Fig. 2. Part of road traffic services categorization ontology.

Finally, the hybrid algorithm has been validated through the development of a software prototype of our multi-agent platform traveller architecture. It has allowed the assembly of all elements (road traffic ontologies, matching algorithm, information web services). Using the prototype, the algorithm has been evaluated and the functionality verified as a whole by studying the relationships between each one of the elements and results.

The paper has been organized as follows: Section 2 provides an overview of the background. Section 3 introduces our traveller information architecture. Section 4 deals with the matchmaking algorithm proposed in our system. Section 5 presents the results and discussions with some test cases. Section 6 analyzes the run-time improvements. And finally, in Section 7, some conclusions and future work are exposed.

2. Background

As indicated by Trastour, Bartolini, and Gonzalez-Castillo (2001), service profiles describe the capabilities of a service and, thus, they can describe both the capabilities of the services offered by providers (advertisements) and those expected by clients (requests). The formal OWL-S ontology enables users and software agents to automatically discover, invoke, compose, and monitor