Automatic composition of semantic Web services-based alignment of OWL-S

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***Abstract.** Web services transform the Web into a platform for distributed components, heterogeneous, loosely coupled and integrated automatically. This technology is now widely used as a support for interoperability between distributed applications, which operate independently of the design features and technical specifications in order to achieve a feature previously established. The creation of a complex distributed application can be obtained by the composition of Web services. To build our platform-based semantic Web services, we strive to establish an architecture in which the semantic Web services interact with each other only, so they allow compositions of Web services to meet the up a different user requirements. The aim of our work is to achieve semantic interoperability in a heterogeneous, distributed architecture, based on the automatic dialing services Semantic Web. The special feature of this architecture is to place the alignment of OWL-S in the heart of this process, depending on the quality of services (QoS).*

***KEY WORD:** automatic composition, Semantic Web services, semantic interoperability, ontology alignment OWL-S, QoS.*

1 Introduction

Web services are as stateless software entities, betting provided by suppliers on the Internet and invoked by clients (users or other Web services). The architecture and Web services technology define a set of specifications for the description (WSDL), publishing (UDDI) and communication (SOAP) Web services between to promote interaction in an open, heterogeneous, and is versatile Web **[2] [12]**.

The composition of Semantic Web services is the process of building new Web services to add value from two or more Web services are already present and published on the Web. The study of the composition of Semantic Web services is handled by several scientific communities **[17] [18]**.

The ontology alignment is a very promising to enable semantic interoperability. It is the heart of this interoperability. The purpose of ontology alignment is to establish links, or semantic correspondences between entities belonging to different heterogeneous ontologies, to enable their semantic interoperability in a distributed and heterogeneous. The ontology alignment based on the calculation of similarity measures.

The evaluation of the similarity between concepts in an ontology is a known problem in many areas. There are different measures of similarity, categorized according to the techniques used (terminology, Structural, linguistic, extensional semantics,…) **[6] [7].**

In this paper, we focus on the use of technical alignment of OWL-S, for the automatic composition of semantic Web services in distributed and heterogeneous. In cases where multiple Web services can meet the needs of users at the same time, we take into consideration the service that has a better quality of service parameter.

The rest of the paper is organized as follows. In Section 2, we present the problem with the objectives. Subsequently, in Section 3, described in detail our approach and presents our main contributions. In Section 4 illustrates the application of our approach through an implementation, and we end with a conclusion and give some perspectives in Section 5.

2 Problem and Objective

WSDL specifies the interface of a Web service: the operations performed, the types of messages sent and received, the formats of inputs and outputs. However, these specifications were insufficient for an automatic use of Web services (discovery, composition, … etc.). The WSDL specification is too low-level operation of a Web service **[10] [11].**

Really, it is not always easy to find Web services that pair up with user requests. Therefore, the composition of Web services satisfying the query is a growing need today. To resolve this problem, the idea is to enrich the descriptions of Web services with other information understandable by machines. The description of the interface of a Web service can be completed with the OWL-S.

The current trend for the automatic composition of Web services is to enable semantic interoperability between Web services. There are other ways to automatically dial Web services, such as workflows, the calculation of situations, but planning is currently one of the most suitable and most studied by the community of this area **[18] [19].**

The objective of our work is to develop a system approach that aims to automatically dial the Semantic Web Services. For this, we propose to use the techniques of alignment of ontologies in the context of automatic scheduling to meet the problems described above. Indeed, support for the alignment during the composition, will minimize false responses, and significantly improves the overall quality of results.

3 Presentation of the proposed architecture

The architecture we propose is divided into the following modules (see Figure 1):

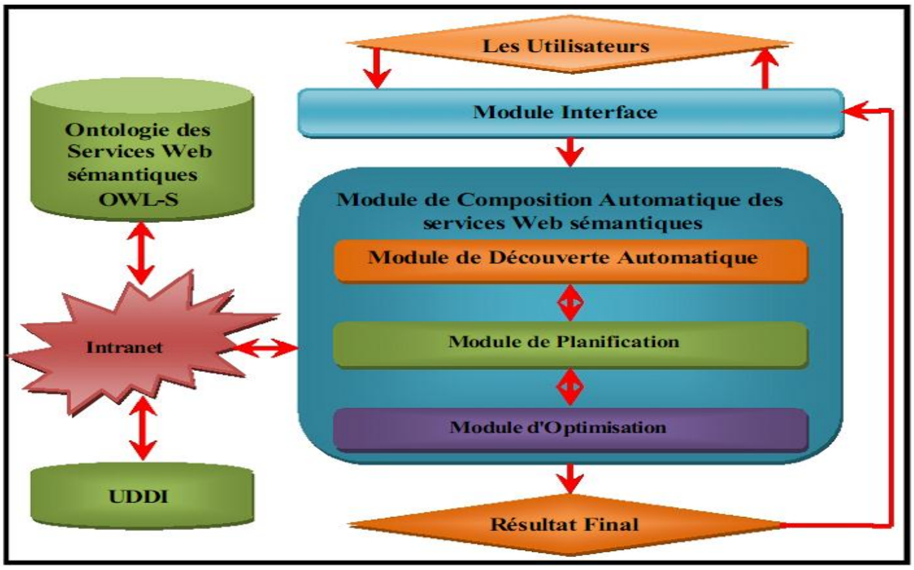

Fig. 1. Architecture for the Automatic Composition of Web Services.

3.1 Interface Module

The module interface is considered as the first window system to the world of users, it is the visible part of the architecture. The user has at its user-friendly interface, simple and allowing it to make its application according to their preferences in terms of quality of Web service (in our case, we are interested only in the following parameters: response time, the execution time and cost). Similarly, the user formulates his needs through the parameters Input, Output, Precondition, Result and TextDescription.

For this, we present in detail the architecture of automated dialing module, which is based on the following modules (see Figure 1):

3.2 Interface Automatic discovery of semantic Web services

We propose an algorithm for automatic discovery of Web services that is based entirely on two technical alignment of OWL-S **[1].**

3.3 Planning Module

Arrange Web services with inputs and outputs is very similar to a planning problem automatically, and this to find the correct order in the Web services automatic composition of Semantic Web services. Indeed, the role of planning is to find a sequence of actions, or plan to, from an initial state, reaching a goal state, expressed by the user.

In this context, we propose an algorithm for automatic scheduling of semantic Web services, which is based on two technical alignments of ontologies: the technical terminology and technique extrinsic **[1]**.

```
Paramètre :={ Input, Output, Precondition, Result et TextDescription} ;
Algorithme Alignement_Ontologie () ;
I := 1 ; Similarité := 0 ; N := Nombre des ontologies OWL-S découverts ;
M := Nombre des concepts de (Paramètre) d'une ontologie ;
L := Nombre des concepts de (Paramètre) d'une autre ontologie ;
Début
Tant Que (I ≤N) faire
J := 1 ;
Tant Que (J ≤M) faire
        Terme1 := Paramètre_Requete [J] ; K := 1 ; MaxTerm := 0 ; SimTerm := 0 ;
        SimilaritéTerm := 0 ; MaxExtre := 0 ; SimExtr := 0 ; SimilaritéExtr := 0 ;
        Tant Que (K ≤L) faire
                Terme2 := Paramètre_OntologieI [K] ;
                SimTerm := Similarité_Terminologique (Terme1, Terme2) ;
                SimExtr := Similarité_Extrinsèque (Terme 1, Terme 2) ;
                Si (SimTerm > MaxTerm) alors MaxTerm := SimTerm ; Fin Si
                Si (SimExtr >MaxExtr) alors MaxExtr := SimExtr ; Fin Si
                K := K + 1 ;
                Fin Tant Que
                Si (MaxTerm > SimilaritéTerm) alors SimilaritéTerm := MaxTerm ; Fin Si
                Si (MaxExtr > SimilaritéExtr) alors SimilaritéExtr := MaxExtr ; Fin Si
J := J + 1 ;
Fin Tant Que
Similarité := SimilaritéTerm × PoidsTerm + SimilaritéExtr × PoidsExtr ;
Tab_Paramètre [I] := Similarité ;
I := I + 1 ;
Fin Tant Que
Retourner (Tab_Paramètre) ;
Fin
```

Algorithm. 2. Ontology Alignment.

This algorithm is based on the function Similarity_Terminology (word1; word2): It compute a similarity measure for the concepts of input parameters and output, between two ontologies OWL-S. The measure used is the metric Jaro-Winkler **[15].**

In this algorithm, the parameters (Precondition, Result and TextDescription) are often in the form of a long text including phrases, sentences or even paragraphs. For this reason, the similarity measures designed to deal with short strings, such as Jaccard, Hamming, and Jaro are no longer appropriate. Instead, we propose a measure that is based on a hybrid method to compare the length **[8].**

Similarly, this algorithm is based on the function Similarity_Extrinsic (word1; word2). It is used to compute a similarity measure for the concepts of the above parameters between OWL-S ontology concepts with two ontologies OWL-S to describe Web service semantics. There are several methods to calculate semantic relations in WordNet, among these methods; we chose to use the Jiang-Conrath measure **[9].**

The construction of a plan is based an Algorithm for automatic discovery of semantic Web services; we have shown previously to find the similarity between two different ontologies OWL-S. That is to say, the plan starts from the first Web service in which its parameters (Input, Precondition, Result and TextDesciption) are semantically similar to the same parameters of the user query. Then Output parameter of the first Web service is semantically similar to the Input of another semantic Web service. Then, the parameters (Input, Precondition, Result and TextDesciption) of the second Web service are semantically similar with the same parameters of another semantic Web service.

This process continues until the last Web service, such as its Output parameter is semantically similar to the output parameter of the user request. At the end of this algorithm, we finally get a plan or several plans of automatic composition of semantic Web services.

3.4 Optimization Module

In fact, if the automatic discovery process is complete, a large number of semantic Web services can be found. As a result, the number of Web services increases and thus candidates for automatic composition process of Web services can take a long time. Under these conditions, the following criteria: Input, Output, Precondition, Result and TextDescription are not sufficient to allow a selection of Web services. We must use other criteria and parameters such as Quality of Web service (QoS) to distinguish between these Web services.

It is necessary to add an optimization phase whose goal is to provide the user with the best semantic web services according to certain criteria. This step takes into account user preferences in terms of quality Web service it wants, since each user has different needs and preferences, so it would be interesting to customize the dialer to to provide improved results to users' needs. For example, a user prefers a web service with response time less than 12 ms execution time greater than 30 ms, and a cost of 13 cents per call, in this case, we select only the Web services that have these properties.

4 Implementation

We have developed a web application using JSF technology Eclipse Galileo, to show the proper functioning of our architecture in a distributed and heterogeneous. With regard to the different similarity measures that are implemented in our architecture, we used the Java API SIMPACK. We use two APIs to query WordNet 2.0, the API's functionality JWNL extracted for each lemma the list of its corresponding synsets in WordNet ontology and the API JWordNetSim to measure the similarity between synsets in WordNet. And to manipulate OWL-S, we used the OWL-S API provides a Java API to access programs, in addition, the Jena API is a Java framework for building Semantic Web applications.

5 Conclusion and Future Work

It is important that our proposed architecture for the composition can be made in a clear manner. From the perspective of the user, once the request is set, the platform began to compose semantic Web services automatically required existing and propose at the end of the compositions found.

We intend in the near future enrich our approach using optimization techniques such as heuristics and meta heuristics to select the best candidate Semantic Web Services in terms of quality of service after the stage of automatic discovery. This work can be completed by the introduction of a formal semantics for verification of a composition.

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