Determination of Heavy / Light Weight Mapping of Ontologies for Web Service Discovery

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Abstract—Web Service discovery is the key step for service selection and service composition. Different approaches are available for web service discovery. This work proposes ontology mapping to discover web services using mapping pattern as building blocks. Depending on the requirement of service, Heavy/Light weight mapping is performed. As one of the application, the results of Heavy/Light weight mapping have been used to discover most appropriate web service as per the requirement/need.

Index Terms—Web Service, Service Discovery, Ontology, Ontology Mapping, Mapping Pattern

I. INTRODUCTION

Web service technology offers a potential solution for developing distributed business processes and applications which can be accessible via the Internet. When individual Web services are not able to meet complex requirements they can be combined to create new value added composite services for those requirements. “Ref [6]” Web service discovery is a key step in such service composition process. Web services are described by using standards like WSDL and then service descriptions are published in some UDDI registries. When a service request is issued, the service request description and available Web service descriptions are matched to find candidate Web services which can provide expected functionality. However, only Web service functional descriptions are not sufficient for service discovery process. Firstly, a key advantage of Web service technology is to enable Web services to be dynamically and automatically discovered and selected at runtime. In this case, an automatic mechanism is needed to support a service system determining the best Web services to be chosen. Secondly, as more and more Web services are available, there is often a case where many of them can satisfy functional requirements of a service request. Therefore, it leads to the issue of selecting of the best Web services for a service request among a list of candidate Web services having similar functionality.

Ontologies clarify the structure of domain knowledge and enable knowledge sharing, and they play a crucial role in dealing with heterogeneous and computer-oriented huge amount of data. Ontologies have been used popularly in many fields such as knowledge representation, information retrieval, natural language understanding, biology, e-Science and Web Services.

“Ref [1]” In recent years, the Semantic Web, which aims at providing high-quality intelligent services on the Web, exploits ontologies to model the knowledge of various semantic web applications. In turn, the Semantic Web promotes the researches of ontology greatly. Usually, ontologies are distributedly used and built by different communities. That causes many heterogeneous ontologies in similar domains or relative domains, which is the major obstacle to realize semantic information sharing. “Ref [5]” Ontology mapping is one of the approaches to solve the problem of web service discovery through capturing the communication rules between heterogeneous ontologies.

In this work, we have considered the web services have been represented as ontologies. “Ref [2]” For mapping two ontologies nearly 16 different mapping patterns has been devised. But, service discovery from available web services is done using concept-to-concept mapping pattern. Mapping result is classified as Heavy weight and Light weight mapping based on availability of similar children nodes. Users query can be answered from either Heavy weight or Light weight mapping result.

The organization of this paper is as follows: Section II describes some of the existing work related to ontology mapping for web services, Section III depicts various mapping patterns and discusses the concept-to-concept mapping pattern, Section IV explains this work with example of www.Amazon.com and www.Ebay.com and Section V concludes with future enhancements.

II. RELATED WORK

Ontology mapping is an open problem. Even though ontology mapping solutions for all domains have been proposed in recent years, this paper reviews only the specific work related to utilization of semantics through ontologies for web service discovery domain.

Zhang Duo., et al “Ref [7]” proposed an approach that aims to enrich WSDL with semantics using ontologies described in OWL. Their approach is divided into three steps: Translate XML schema into a temporary ontology is first step, as the second step mapping is done with temporary ontology and existing shared ontologies and the final step preserves the mapping result and use it to generate OWL-S files from the WSDL file.
Dru McCandless, et al “Ref [4]” developed a different approach for dynamic web service assembly that takes advantage of the formal structure inherent in web services that are defined by WSDL documents. The XML Schema definitions are extracted from the WSDLs, and the schemas are then converted into OWL. The resulting OWL files are aligned using ontology alignment tools, which allows for semi-automated mapping of the service input and output messages at the semantic level. A theorem prover is then used to construct a service chain based on the aligned service inputs and outputs which meets some information goal.

“Ref [3]” A middleware architecture has been proposed based on distributed web service discovery. Their approach is on context aware service discovery stands out in three aspects: (i) presented a new domain ontology based context model, (ii) context interpreter which provided a dynamic and it deduced the contextual information for providing more useful services to the user. (iii) Used similarity/logic based semantic matching technique to enhance the relevancy and precision of returned set of services.

As the survey indicates the potential of the ontology mapping to the domain of service discovery, this work proposes a methodology using mapping patterns for the discovery of the similar concepts in the service library considering the heavy/light weight mapping.

### III. MAPPING PATTERN

Mapping between ontology elements are usually expressed as pairs of related entities in some mapping expressions, which can range from simple equivalences to complex correspondences. Ontology Mapping is found to be the basic operation for all ontology management operations. The general definition of ontology mapping is as: Given two ontologies O1 and O2, mapping one ontology onto another means that for each entity (Concept C, Relation R, or Instance I) in ontology O1, try to find a corresponding entity, which has the same intended meaning in ontology O2.

Ontology mapping can be done either manually or using semi-automated/automated tools. Manual mapping becomes impractical as the size and complexity of ontologies increases. Different mapping patterns can be formulated for ontology mapping as: concept-concept, attribute-relation, relation-attribute, concept-relation, relation-concept, relation-relation, attribute-attribute, concept-attribute, attribute-concept, concept-value, value-concept, relation-value, value-relation, attribute-value and value-attribute. Based on the level of requirement of the task to be completed, the patterns may be used.

This work limits its perspective, only to the concept-to-concept mapping for web service discovery. Figure 1 shows the pictorial representation of mapping two concepts from two ontologies.

#### A. Concept-to-Concept Mapping Pattern

Concept A in ontology1 is at level 0, whereas the same concept is at level 1 in ontology2. The grey arrow shows the mapping between concepts from both ontologies.

This mapping pattern includes similarity measures such as syntactic, semantic and structural for evaluation. Syntactic similarity includes measure of word similarity and edit distance value. WordNet’s synset is used to evaluate knowledge resource similarity value for semantic similarity measure. Parent/Children similarity and depth of concepts in taxonomy is indicated as level number is involved in structural similarity measures. The similarity value for each concept pair is stored in matrix format. Finally, average weighted sum of all the values are computed. Concept pair with maximum measure is written into mapped meta xml file. The mapping could be classified as Heavy weight and Light weight mapping.

Heavy weight mapping between concepts of two ontologies shows that there exists more similar semantic correspondence between those two concepts. Light weight mapping indicates that least similar semantic correspondence between concepts of two ontologies.

#### B. Heavy weight Mapping

During the mapping of two ontologies, if parent and more than 50% of the children are same then it is concluded as Heavy weight mapping. This determination is based on the percentage of children of each parent as shown in Table I.

#### C. Light weight mapping

Light weight mapping is controversy of Heavy weight mapping. If the number of children to any parent is less than 50% then it is decided to be Light weight mapping. Table I shows this clearly.

The following section clearly depicts how this classification of weight mapping could be used for web service discovery.

### IV. SCENARIO

As an example scenario we worked out for www.Amazon.com and www.Ebay.com, where both sites are well known for online shopping. They offer huge number of online web services to consumers. But, in this work we have taken only computers, electronics and travel services offered by both sites.

Heavy weight and Light weight mapping is performed on taxonomy of www.Amazon.com and www.Ebay.com based on the percentage classification given in Table I. Number of children for Computer & Office, Electronics and Travel concepts in www.Amazon.com are 8, 9 and 9
respectively. With this number, percentage value of children for all the three concepts is evaluated. Similarly for level 1 concept in www.Ebay.com is also evaluated. Based on Table1 mapping is done for Concept-to-Concept mapping pattern and classification of mapping is obtained.

The similarity matrix for the concepts of level1 in both www.Amazon.com and www.Ebay.com is given Figure. 2a. Since similarity matrix for this scenario is sparse, it is reduced into matrix as in Figure. 2b. For example the user may need to have all the available current software version. User’s need can be fulfilled by Heavy weight mapping. Since, both www.Amazon.com and www.Ebay.com have highest similar correspondence the user can discover the web service either from www.Amazon.com or from www.Ebay.com.

As another example the user may wish to have the games for PC. This detail is not available in www.Ebay.com. Therefore with Light weight mapping the user can discover the service from www.Amazon.com.

Even though the concept name travel is same from both web sites, the mapping is Light weight because the number of similar children correspondence is less. Likewise, if the mapping result is Heavy weight then the user can choose any one service from the availability as it gives most similar correspondence. Else, if the mapping result is Light weight then the user has no option of selecting as there may no existence of most similar correspondence.

The example scenario tackles only one level of mapping between web services. If it is extended in depth, more accurate mapping result will be produced. The resultant mapping may be used for precise web service discovery, which in turn provides a new room for web service selection. And also this work can be enhanced with other domain of web services.

V. CONCLUSION

The proposed methodology discovers the web services through ontology mapping using mapping pattern as building block. Tabulation has been given for Heavy and Light weight mapping classification. The scenario has been worked out based on the classification for www.Amazon.com and www.Ebay.com online shopping web sites and the mapping results were shown. However, this methodology provides only level one mapping of two ontologies. The work can be extended in depth to obtain more accurate mapping results. In future, this methodology can be applied to different domain and the mapping results may be evaluated.

REFERENCES
