International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 10, October- 2014

Enhanced Semantic Operations for Web Service Composition

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***Abstract*— The main research areas in web services are related to security, quality of service and composition. Among all these areas, web services composition turns out to be a challenging one, because it supports business-to-business or enterprise application integration. It provides an effective solution to complex web application. In recent days with the emergence of semantic web the scope for semantic based web services composition increases as it provides better results compared to the traditional method of discovering candidate services for composition. Along with the semantics the nature of composition also needs to be dynamic as the web services and its parameters are changing frequently**

***Keywords Web services composition, B2B, Semantic web, Ontology, Quality of service*.**

I. INTRODUCTION

Web services are considered as self-contained, self-describing modular applications that can be published, located and invoked across the web. There are mainly two reasons for switching from middleware technologies to web services those are (i) involves whole learning curve and (ii) they don't adopt standard rules and specifications. Another important characteristic for web services are they are loosely coupled. Due to the dynamic nature of the web, and rapid development across the internet a large number of web services are emerged in the present day internet. However a single web service i.e. published on the web can not satisfy single user request. The increasing number of web services facilitates not only new technology but also poses new challenges on how to compose or collaborate.

As the core technology web service composition provides an effective solution to complex web application. Challenges related to web services composition include constant changes in business rules, high diversity and heterogeneity of web services [1]. Still the research is going on finding the appropriate services from a set of candidate services, building of compound services, invocation of atomic services and execution of compound services. The description of web service is lack of semantic information due to this web service composition is lack of uncertainty Due to this reason research is towards semantic web.

The necessity for fast service composition systems is directly connected with the emergence of Service-Oriented Architectures (SOA). A SOA is the ideal architecture for such systems [2],[3]. Service oriented architectures allow us to modularize the business logic and to implement it in the form of services accessible in a network. Services are building blocks for service processes which represent the workflows of an enterprise. They can be added, removed, and updated at runtime without interfering with the ongoing business. A SOA can be seen as a complex system with manifold services as well as *n:m* dependencies between services and applications:

- An application may need various service functionalities.
- Different applications may need the same service functionality.

Certain functionality may be provided by multiple services Semantic Web [3] is the crucial step for Web services composition. The functionality of a Web service needs to be described with further information, either by a semantic explanation of what it does or by a functional annotation of how it behaves [6]. The semantic Web is also an expansion of the current Web in which information is given well defined meaning, as a result better enabling computer and human to work in cooperation .Semantic Web aims to add machine-interpretable information to Web content in order to provide intelligent access.

Ontologies are used to capture knowledge about some domain of interest. Ontology describes the concepts in the domain and also the relationships that hold between those concepts. Different ontology languages provide different facilities. The most recent development in standard ontology languages is OWL from the World Wide Web Consortium (W3C) .It has a richer set of operators - e.g. intersection, union and negation. It is based on a different logical model which makes it possible for concepts to be defined as well as described. Complex concepts can therefore be built up in definitions out of simpler concepts. Furthermore, the logical model allows the use of a reasoner which can check whether or not all of the statements and definitions in the ontology are mutually consistent and can also recognize which concepts fit under which definitions. The reasoner can therefore help to maintain the hierarchy correctly. This is particularly useful when dealing with cases where classes can have more than one parent

II. RELATED WORK

In [6], an ontology based Web service composition method is proposed. Instead of a standard web ontology language such as OWL-S, they propose an ontology model for web service composition in order to define service attributes such as message, service, quality, operation and parameter. In METEOR-S [7], a web service composition framework with features such as dynamic failure handler and reconfiguration is proposed. To handle data mismatches between different suppliers, it includes an ontology mediator which handles the mapping between ontologies. Our work puts emphasis on semantic

In [8] and [9], in order to add semantic capabilities, a mapping is defined between OWL-S document and UDDI registry record. However they do not propose a complete mechanism for semantic queries. In this work, we propose a different approach for adding semantic capabilities. It is based on the proposed concept matching approach. In [9], a new semantic similarity algorithm is proposed. It defines various degrees on similarity on the basis of the inheritance relation in ontology model. The proposed semantic matching algorithms extend this approach with new features. COSS [10] is context aware web service composition system. For service discovery and matching, context information is utilized. Context input is provided by implemented context providers. However implementing or finding a previously developed context providers are difficult in real applications and thus not practical.

Word Net [11] is a semantic model that captures semantic relations in English words. It has similar features to the proposed semantic domain model. However proposed semantic domain model is for composition purpose and has many different features. service discovery, matching and modeling guidance in composition context.

To describe semantic meanings, various semantic Web service description models are proposed by researchers. One research trend in semantic Web services is to enhance WSDL with semantic descriptions. Semantic Annotations for WSDL and XML Schema (SAWSDL) [12] is a W3C recommendation to annotate semantics to WSDL and XML. SAWSDL provides mechanisms to associate semantic models (e.g., Ontologies) to WSDL and XML schema components. The semantic models are defined outside the WSDL document. SAWSDL does not denote any specific language for representing the semantic models. Sivashanmugam et al. [13] use the extensibility supported by WSDL specification to add semantic descriptions to WSDL. Miller et al. [14, 15] create a language called WSDL-S to extend WSDL with semantic descriptions. Miller et al. assume that the semantic models already exist. The semantic models are maintained outside of WSDL documents and referenced from the WSDL document through WSDL extensibility elements. Another research trends of semantic Web services is to create a full framework for semantic Web services. Ankolekar et al. [16] use a DAML+OIL based ontology, named DAML-S, to describe the semantic meanings of Web services. OWL-S is the successor of DAML-S. OWL-S provides an OWL-based framework for describing semantic Web services. The OWL-S ontology is written in Ontology Web Language (OWL). OWL-S uses the class “Service” to describe the knowledge about a Web service, such as what the service does, how to use the service, and how a service client can access the service. Each published Web service is mapped to an instance of “Service”. Instead of providing the concrete specification of how to access services, OWL-S uses a class named “Service Grounding” to construct the mapping between the semantic description of services and the concrete specification of how to access the services (e.g., WSDL). Except OWL-S, WSMO is another prominent semantic description model. WSMO defines four major components to describe semantic Web services: (1) Ontologies, which provides the terminology used by all other components; (2) Web Services, which describe the capabilities, interfaces and internal working of the Web services; (3) Goals, which represent the objectivities that a client can achieve by executing the Web service; and (4) mediators, which define elements to overcome interoperability problems between different WSMO components [17].

III. MOTIVATION

Present Approaches in web services composition facing so many difficulties. Some of them are

A. Selection of services

Since there may be many candidate web services for each task; it is difficult for the user to select suitable ones according to his requirements and constraints. In addition to this, user may not have the full information about the composite service that she/he requires and a guiding mechanism may be needed to handle this deficiency.

B. Interoperability

Each service of a composite service may be from multiple vendors that use different information system structures such as processes and models. This makes the interoperability of services an important problem. In order to resolve this problem, a common metadata in machine understandable form may be used. However, in some cases it is hard to use common Meta model in different organizations since each organization has different processes and its own legacy systems. In order to solve this kind of Meta model distinction, mappings are needed to define between different meta models.

C. Existing standards

Most of the established standards such as UDDI [14], WSDL [16] and SOAP [13] are not suitable for machine understanding. These technologies are based on XML [17] which is only machine readable and hence the semantics of a business model cannot be fully expressed.

Therefore, web service composition process requires the use of semantic languages like OWL [8] and OWL-S [9]. In addition to this, UDDI is not proper for full automation of composition process since it supports only keyword based search and it does not support defining relationships among services and identifying complementary services.

The basic reason for all these problems is the lack of semantics. So our work is mainly concentrates on the semantic web i.e., including semantic operations on every part of the work

IV. PROPOSED WORK

The proposed work focuses on to increase the service composition quality and automate service composition process by using semantic techniques. It is an automated and dynamic service composition, for this purpose we are going to construct one frame work, which makes use of semantic capabilities in order to provide automated composition under user's constraints.

The Basic Contributions of our work are:

A. *Enhancement of UDDI:*

- STEP 1: Generation of a set of semantically close keywords from a single keyword
- STEP 2:The similar concepts and original keyword are added to the keyword list
- STEP 3:UDDI Registry is queried with a set of keywords rather than a single keyword.

B. *Semantic Matching:*

- Semantic matching is used in service selection & composition operations and interoperability checking.
- For service Selection the procedure is as follows: S1 and S2 be given web services. S1 is a concrete service in a service registry and S2 is an abstract service requested by the user. Finding out the similarity degree of S2 to S1
  - (i) In the first step output parameters are compared if it is not similar then it can be considered as unmatched.
  - (ii) If the outputs are similar but only the some inputs are similar then the same services can be considered as intersect
  - (iii) If the outputs and the inputs are similar then it can be considered as exact match.
  - These similarity degree is used for determining the quality of composition
  - Generated compositions are arranged in a descending similarity degrees.
- For interoperability checking the procedure is as follows:
  - The procedure is about whether the two services are composable or not.
  - Let services say S1 and S2 if services S1 and S2 are composable iff S2's input parameters can be obtained from the requested parameters of abstract services and the output parameters of S1 and the other preceding services.

C. *Guiding the User*

- During the Construction of Service Composition, Constraints are taking from the user.
- According to the constraints given by the user, candidate services are obtained by selection process

V. EVALUATION

Recall 1 and precision 2 are the two basic quality parameters to evaluate the matching algorithms. In this section, the proposed algorithms are evaluated under recall and precision.

A. *Semantic Matching Evaluation*

Algorithms are evaluated with respect to how good they can find a requested item (concept or service) by taking similarities into consideration. Semantic matching is evaluated in two parts.

1) *Concept Matching Evaluation*

In this evaluation, the aim is to find similarities between some relevant and some irrelevant concepts in our ontology documents. It is expected from the concept matching algorithm to find similarities between relevant concepts and to find dissimilarities between irrelevant concepts.

where actual relevant similarity count is 30. Total sample data count is 40 but only 30 of them are really similar. In Table I, the results of three matching methods according to recall and precision quality parameters are given.

Actual relevance concept:30

TABLE I Concept Matching Results

	Syntactic Method	**Proposed Method**
Relevant concepts	5 relevant found, 25	27 relevant found, 3 irrelevant
Recall	16.7%	90 %
Precision	12.5 %	67.5%

Keyword based matching is not a semantic process. Therefore, it provides only syntactic checking. It gives no result or gives many irrelevant results. The recall ofthis method is low since it only does syntactic checking. The proposed matching algorithm finds 30 relevant similarities among 40 candidate similarities. But in fact 3 of them are irrelevant. . By adjusting threshold property, precision and recall values of the proposed algorithm can be increased. Precision and recall values of the proposed algorithm increased to 100% if intersections which have more than 80% hit ratios are accepted and intersections which have less than 80% hit ratios are considered as suggestions.

2) Service Matching Evaluation

In this evaluation, the aim is to find candidate services similar to the requested web services. Service matching degree is used as a quality measurement to indicate the similarity of the requested service template and discovered candidate service

For randomly selected 14 queries in the data set, we performed the service matching using the OWL-S services.Each query has its own relevance set containing 10 to 20 relevant services.So there is no possibility for zero matched results.For plotting the Precision vs Recall graph, some queries are randomly selected and the acquired results are listed in the table

The below table lists the recall and the precision of our approach and the syntactic approach. In the searches for relevant services, our approaches can find all the relevant
services with a recall of 81.3%. In the syntactic approach, a few relevant services are not returned using the provided keywords since the developer does not use the same words as the OWL-S description to search for

TABLE II Service Matching Results

Query	**Syntactic Method**		**Proposed Method**	
	Recall	***Precision***	***Recall***	***Precision***
Book price	0.58	0.40	0.75	0.66
University lecturer	0.74	0.64	0.63	0.93
Hospital Investigation	0.63	0.38	0.73	0.75
CityCountry_hotel	0.67	0.6	0.45	0.85
Car price	0.46	0.5	0.75	0.8
Geographical region	0.3	0.38	0.75	0.85
Novel author	0.5	0.52	0.64	0.74
Food price	0.43	0.43	0.6	0.78
Comedyfilmtitle	0.75	0.57	0.85	0.7
videomediatitle	0.56	0.78	0.69	0.89
Governmentdegree_Scholarship	0.44	0.78	0.52	1
Shoppingmall_cameraprice	0.5	0.44	0.77	0.65
DVDPlayerMP3Player	0.55	0.5	0.78	0.7
Surfing destination	0.5	0.57	0.88	0.78

Web services. In summary, our approach has a higher recall. The ideal approach should achieve high precision and high recall.

TABLE III Overall values of Precision and Recall

	Syntactic Method	**Proposed Method**
Recall	0.46	0.67
Precision	0.56	0.81

The above table shows the average of precision and recall values of both syntactic method and proposed method and the proposed method shows the better results compared to the syntactic method

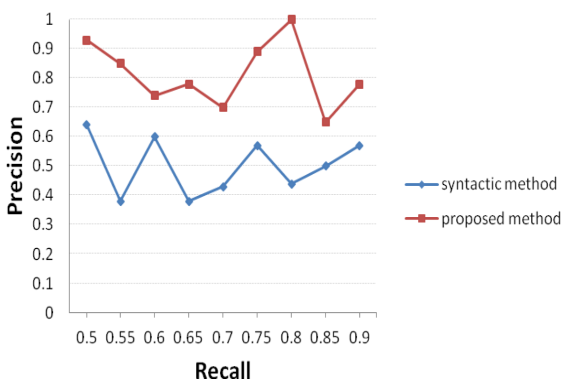

Fig. 1. Precision Vs Recall Graph

B. *Web Service Composition Evaluation*

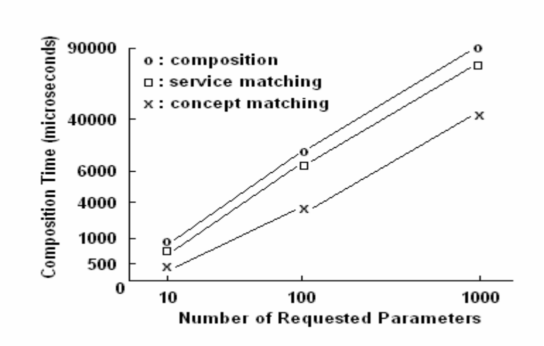

Fig. 2. Time required for Service Composition Process

In Fig. 2 , service composition execution time is displayed with respect to the number of requested parameters. As seen from the figure, most of the processing time is used for the matching. Service composition operation includes service matching and service matching operation includes concept matching task. Concept matching takes half of the total processing time. Service matching operation time includes concept matching operation time plus time passed for finding attributes of service and finding hit ratio of service matching. Composition operation time includes service matching time plus time passed for finding composition hit ratio time

As shown in the figure, composition time increases linearly with the increase in the number of requested parameters

VI. CONCLUSION

In this work, new semantic based techniques are proposed in order to facilitate the web service composition process. The first one includes new semantic matching methods for finding both concept similarity and service similarity. The second one is a new semantic domain model which can capture the relationships among the concepts and between the concepts and the actions (services). These new approaches are used in modeling the composite web service, service discovery and interoperability checking As a future work, improvement of proposed semantic domain model can be considered. This model is just in its early phase of development that is open to new extensions which will increase the amount and quality of semantic inferences.Another direction for future work is addition of new capabilities for semantic service registry.

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