F-023

Discovering And Composing Semantic Web Services Using Agents

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Abstract

This work presents a multi-agent architecture, which can discovery and compose semantic web services dynamically and automatically. The proposed system mediates between user requirements and semantic web services using ontology technology, combines appropriate web services to provide better user experiences. The intelligent agents with knowledge make it possible to appreciate semantic ontologies and to support users with accessing the integrated services. A simple experiment validates the applicability and the flexibility of this approach.

I.Introduction

In recent years, the Internet is evolving from an aggregation of information to a service oriented platform. With the rapid development of Web Service technologies, the problems about how to find appropriate services and how to use them effectively has become more and more important. As an approach to those problems, semantic web service (SWS)[1] has been introduced. The aim of SWS is to make web service machine-understandable and more accessible. By appending semantic markups to web services, intelligent software agents should be able to discover, invoke, compose and monitor semantic web services automatically. The integration of agent technologies and SWS gives a brand new possibility of improving the user experience.

In this context, there have been a number of researches. They can be divided mainly into two types; discovering and composing. The research concerning discovering, aims to find appropriate web services to meet user requirements. Loia, Fenza and Senatore[2] proposed a multi-agent architecture, which integrates fuzzy technologies and semantic web methodologies for improving the semantic discovery of web services. Neiat, Mohsenzadeh, Forsati and Rahmani[3] presented a agent-based framework to fulfill the communication gap between the FIPA[4] agent system and the web service discovering system. The proposed framework translates the service description between the two systems to enable agents invoking desired web services and vice versa.

On the other hand, the research about the composition of web services have the intention of composing multiple web services where single web services cannot individually satisfy the user requirements. Tran, Tan and Goh[5] introduced an approach based on AI planning, which can compose web services with suitable output and input. Grag and Mishra[6] presented multi-agent based semantic web composition process with a novel selection model based on quality of service (QoS) rating of the service provider.

As we noticed, the two types of research lack support from each other side. The discovering without composition cannot find ideal services when there are no services to satisfy the requirements and the composition process without effective discovering cannot give a useful result. Addressing that issue, we will introduce a new multi-agent architecture in next section which combines the two process and makes them work together through the specific domain ontology to support each other.

II. Proposal

We propose a hybrid architecture as shown in Figure. 1 which combines discovering process and composing process of the semantic web service. The components of the architecture will be explained below with a translation situation. In this example the system attempts to find suitable services from a morphological analysis service, a bilingual dictionary service and a translation service for different languages and tries to compose them to provide the translation service combined with the specific bilingual dictionary.

Domain Ontology: The ontology holds the common concepts and predicates of the specific domain in which the system will be applied. In the example, the concepts

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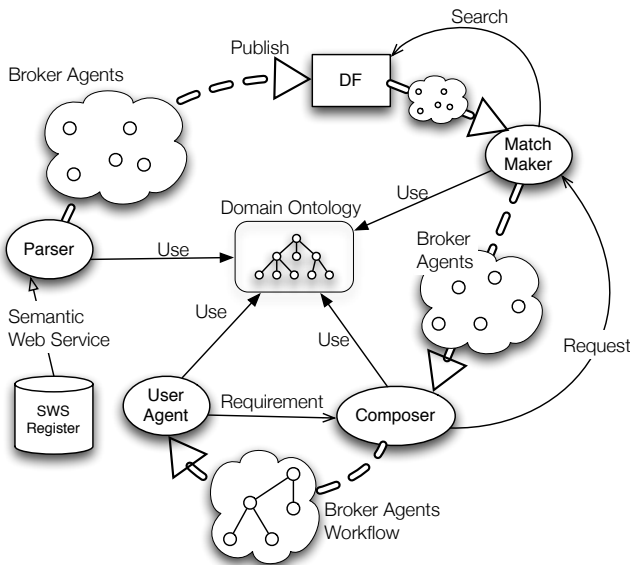2. CyberScience Center, Tohoku University, Sendai, Japan

Figure. 1

III. Experiment

We developed a prototype experimental system for the translation example with JADE[8] and Langrid[9]. The system discovered and composed suitable web services form 11 language web services for 3 languages to provide a specific dictionary-integrated translation service and showed the flexibility of being able to satisfy different requirements. In the perspective view of performance, the response time, t in seconds, for the requests with different word number n are shown in the table below.

n	15	25	44	73	119	188	296	735
t	6	6	10	28	34	46	68	170

As we see in the table, the response time increased linearly with the word number's growth. The time complexity of the proposed approach could be seen as $T = O(n)$, which is an acceptable performance.

IV.Conclusion

We proposed a multi-agent architecture to discovery and compose semantic web services into integrated services dynamically and automatically. The architecture combines discovering and composition together using ontology technology. The experiment showed the applicability and flexibility of this approach. From that we see there is a new possibility in using semantic web services effectively in the future.

will be "Document", "Morpheme", "Phrase" etc and the predicate would be "Document can BeAnalyzed into a MorphemeList", "Document can BePreTranslatedBy Phrase" etc.

Parser: The agent generates the Broker Agents for the semantic web services using Domain Ontology. The service description and semantic markups will be translated into an agent service description.

Broker Agent: The agent with the knowledge and ability to invoke the specific web service. Broker Agent also has the knowledge about the action, input, output, precondition and effect (IOPE)[7] of the web service. For example, the morphological service's Broker Agent should has the action of "Analysis", input of "Document" and output of "MorphemeList".

Directory Facilitator (DF): The 'yellow page' service of a FIPA[4] Multi-Agent System which provides publishing and search service for agents.

User Agent: The user interface of the system which gets user requirement and passes it to the Composer.

Composer: The agent with the knowledge about the specific business process to compose appropriate Broker Agents into a Broker Agent Workflow. In the translation example, the Composer should know about "Document should be Analyzed into MorphemeList", "Morpheme should Generate PhraseList", "Document should be PreTranslatedBy Phrase" and "Document should be TranslatedBy Translator".

MatchMaker: The agent searches in the DF for Broker Agents which meet the request received from Composer using the actions and IOPEs of Broker Agents.

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