A Middleware Architecture for Secure Service Discovery using Ontologies with Multiagent Approach

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ABSTRACT

Web is a place for information sharing as well as service providing. With the addition of Service Oriented Architecture ensures better reusability, maintainability and flexibility among the heterogeneous data sources. Possibility of a better interoperability within such a heterogeneous data sources is less without further assistance. For better service discovery, these issues must be cleared first. Besides this, security measures also play a key role. By developing a Multiagent based middleware system can resolve all these issues. Further it will add up better communication among the different modules of the system as well as the self learning capability. This paper’s approach is aimed to the development of Multiagent system based middleware architecture for better service discovery, selection and invocation through a secure way without replacing the existing services based on Web Service and Semantic Web Service technologies. The architecture will use ontologies heavily to introduce the rich semantics to the services to provide better meaning understandable by machines.

Keywords: Interoperability, Multiagent System, Ontology, Semantic Web Service, Service Oriented Architecture, Web Service

INTRODUCTION

Web Service and Semantic Web Service both are very familiar terms today to those who are involved into the web related research works. Sometimes both of these technologies are considered as the gateway to the next generation of web. Their Service Oriented Architecture (SOA) based nature ensures better reusability, maintainability and flexibility of information and resources. Besides these, maintaining the interoperability and integrity among the heterogeneous resources is also the very important task for SOA based system. Though the Web Service technologies are quite good to provide the required integrity and interoperability but this truth is valid only for the beginning stage of the heterogeneity. Web Service paradigm

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provides the feature richness, scalability and flexibility needed by the organization to manage the SOA challenges. But Web Service technology works well within the limited range of heterogeneity and provide only some limited number of rigid services. At this stage the researchers from different community turn their vision from Web Service technologies to the Semantic Web Service technologies, where semantics get added with the Web Service in the form of Ontologies. Basically Semantic Web Service technology is the combination of Web Service technology and Semantic Web technology.

There is another popular approach to solve the current state of the problem is Agent Oriented Programming (AOP). Developing software agents can resolve the problem of interoperability issue for a while. But, the question arises - “could it be the complete substitution for the existing Web Service and Semantic Web Service technologies?" This question needs more analysis. There is no doubt in certain stages, that the software agent can be proved as beneficial with their open communicative, reactive, proactive and goal oriented co-operative (Wooldridge, 2002) nature against existing technologies. Today use of the distributed Multiagent based system has become the favorite choice of the researchers, academicians and industry experts. But it is always difficult to replace the existing technology with a newer one. In lieu of that most of the time experts are remain busy to design such a framework where both the newer and the existing technology will work together co-operatively. This new framework would be more dynamic and communicative in nature and will work out successfully with better service discovery, selection and invocation mechanism within an extreme heterogeneous environment.

In this paper we have introduced a Multiagent based middleware architecture, which could be used to enrich the existing Web Services with semantics by developing ontologies. In this architecture two agents are completely dedicated for the ontology conversion, i.e., one agent will be used to prepare the compatible FIPA ontologies from the existing Web Service Modeling Language (WSML) (de Bruijin et al., 2005) based ontologies, and another agent will used to prepare the FIPA ontologies (FIPA, 2000, 2005) from existing OWL (McGuinness & Harmelen, 2004) ontologies. Two separate repositories are also used to store the different types of ontologies developed using different ontology languages.

The rest of the paper is organized as follows. A brief discussion on the related research work is given and the motivation behind the work is illustrated. After that the proposed architecture of the agent oriented middleware is depicted. In the next section the implementation issue and result is discussed. Finally, we conclude the paper and detail out the future work in this field.

RELATED RESEARCH WORKS

Automatic service discovery, selection, invocation all are the key requirements in an environment where resources are heterogeneous in nature, for example e-Governance. A number of successful efforts have been made to discover the services. Also a large number of initiatives and steps i.e., research works have been initiated by industries, academicians, and researchers for service discovery. Stojanovic et al. (2004) tried to show how semantic technology can be used to manage the services in the e-Governance domain by extending their previous works using Ontology specification to describe the e-Government Services, taking the e-Governance domain as an example.

Omair Shatiq et al. (2005) describes design and implementation of a middleware namely AgentWeb Gateway that facilitates two-way service discovery and description transformation and communication protocol conversion among FIPA compliant software agent and W3C compliant web service framework.

Another e-Governance specific project is ONTOGOV IST (Aposolou, Stojanovic, Lobo, & Thoenissen, 2005) project, which basically define its Ontologies, heavily depending on the OWL-S and the Web Service Modeling Ontology (WSMO).
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