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Framework for Domain Specific Software Agent Ontology Reuse

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Abstract: A software agent is a piece of software that is invoked for accomplishment of particular task. Reusing of software agents helps in the development of agent based applications. The heterogeneity of the development environments used by software agents creates a problem in its reusability. Ontology is the standardized representation of knowledge/ structure, irrespective of the development environment. So, by representing the agents as ontology helps in reusing such agents even if they are heterogeneous with respect to their environment. The present study depicts a framework to reuse existing software agents using ontological engineering approach.

Keywords: Software Agent, Reusability, ontology.

I. INTRODUCTION

A software agent is a piece of software that is invoked and is executed autonomously and continuously in a particular environment for accomplishment of a particular task. The use of collaboration of existing software agents rather than building a new agent to answer query that cannot otherwise, be answered by the existing agent individually, may lead to benefits related to development time and its cost as well. The application of reuse techniques on software agents may also lead to significant improvements in agent based application development [12]. The software agents belonging to same domain, that need to be reused in order to have new agent, may be heterogeneous in terms of their development environment. The reusability of such existing agents can be achieved by employing a mechanism that can ensure the exchange of information and data irrespective of their environment. The ontology is a means of knowledge/structure representation and it is independent of development environment. The ontological engineering approach helps in solving the problem of heterogeneity by using the common and standardized form of representation of the agents by an ontology . So, this ontology based approach provides the solution to the problem of heterogeneity when disjoint and diverse data sources are available.

In this study, a framework for the reuse of existing software agents to answer a query has been presented. Section 2 gives a brief review of literature and presents the proofs of knowledge sharing via ontological approach. In third section the proposed framework is presented and the last section consists of the conclusion and future direction of this approach.

II. LITERATURE REVIEW

Ghassan Beydoun et. al. argue that the ontologies should be used in the SDLC of MASs so that the already existing softwares can be reused.

An agent framework based on ontology has been presented in [15] that can retrieve data from distributed heterogeneous data sources such as XML and RDF. With this the user is able to retrieve data sources by simple query as an input and this query will be reformed and sent to remote data sources for information retrieval. But this system suffers from the problem of query translation.

In their research work, **Awny Alnusair and Tian Zhao** proposed an approach to identify the relevant components from the existing ontologies. A well defined ontology model has been proposed to ensure component reuse.

The work[10] proposed ontology merging mechanism. This ontology can promise the reformulation of user queries in accordance with the user requirements. The researchers have outlined the methodology for semantic data retrieval based on distributed heterogeneous data sources and the challenging problem of query reformulation on the basis of merged ontology and data source descriptions has been identified.

A study to evaluate various existing ontology based query systems has been presented by **Hoang and Tjoa**. The authors also presented the research directions in ontology based query research. Search strategies, query formulation, query refinement and user interaction techniques has been analyzed and compared.[8]

The usage of ontologies for information retrieval can overcome the problems associated with syntactic search. **J. Uma Maheswari** suggests a conceptual framework that goes through five phases for information retrieval. To improve the relevancy of retrieval an improved matching algorithm is used. [12]

A framework namely OBSERVER represents a highly independent system which has no concern with the diversity of data repositories/ontologies and it can deal with many types of heterogeneity at the structural, functional or semantic level [3].

III. PROPOSED FRAMEWORK

In this section a framework to facilitate the reuse at ontological level is proposed. As per the figure 1, the architecture of the proposed framework consists of following components:-

- **User/ Interface Agent:** The user/ interface agent is an entity who generates a query in the agent environment. The query comprises of the terms required by the user. The query is then parsed to the query processor.
- **Query Processor:** The query processor is composed of following components:
 - **Processing Agent:-** The query processor is responsible for the reformation of query entered by the user. The QP can employ many techniques such as reformation, query stemming.
 - **Mapping Agent:-** Mapping Agent looks for the suitable ontologies in the domain of ontologies. The outcome will be the list of ontological data sources that satisfy the requirements of the user/interface agent fully or partially.
 - **Transfer Agent:** The transfer agent is responsible for transferring the reformulated query to the remote agents.

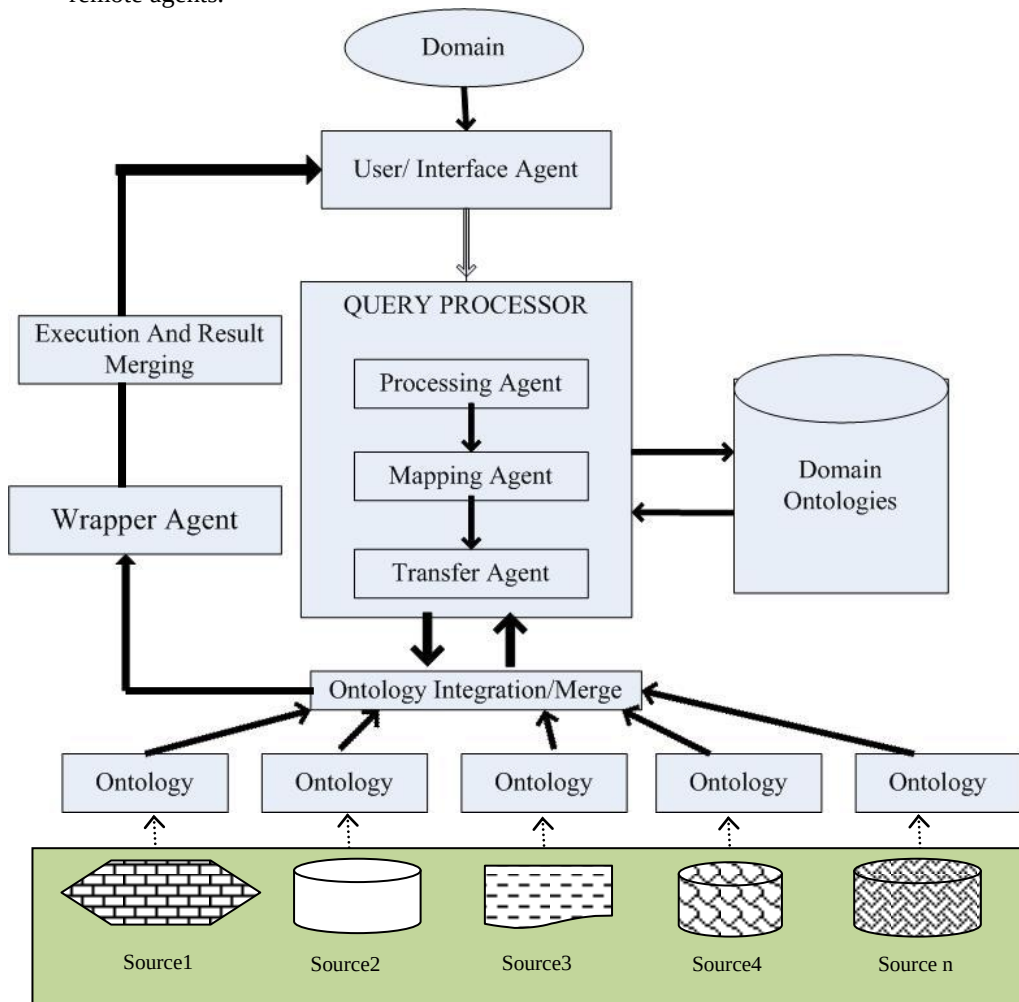


Figure1. Mechanism for ontological reuse of software agents

- **Wrapper Agent:** The wrappers come into picture when the remote agents exhibit their ontologies to be reused by user/interface agent. They simply serve as the mediators between the remote agent and the user/interface agent.
- **Remote Agent:** The remote agents are the actual data sources which fall in the domain of the requirements of the user/interface agent. These can share their ontologies for satisfying the needs of user/interface agents.

A. FUNCTIONAL SCENARIO

Figure 2 depicts the functional scenario of the framework. The step by step processing of the query is as follows:

1. The user/interface agent will make a query using suitable keywords or terms. The query then be parsed to Query Processor.

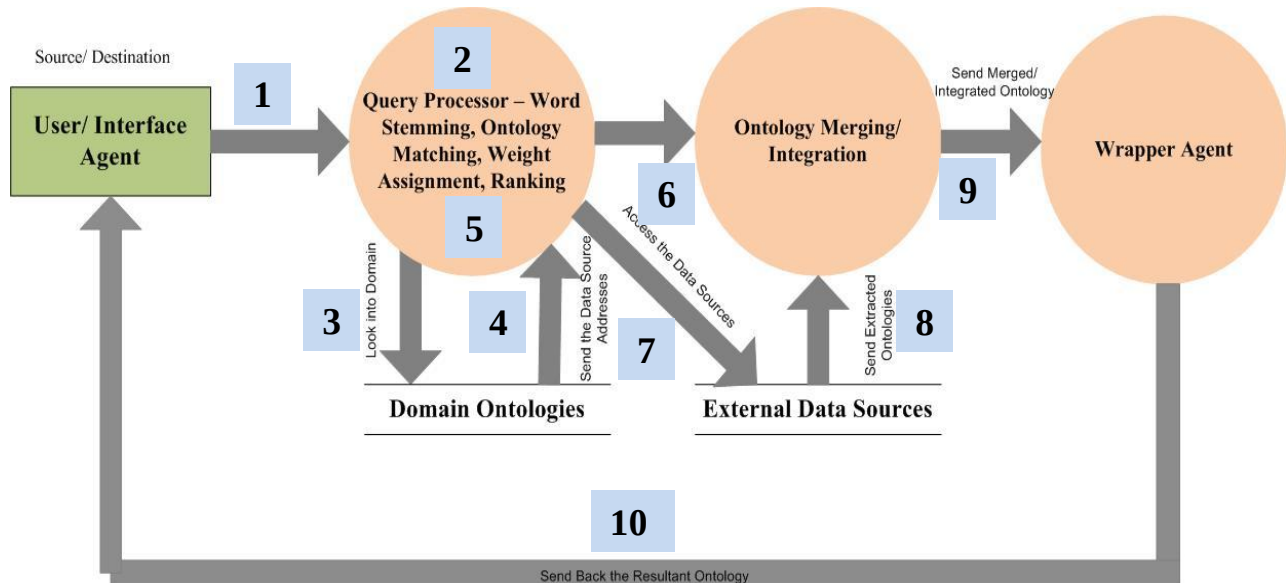


Figure 2: Functional Flow of the Proposed Framework

2. Query Processor will reformulate the query by using query parsing and word stemming techniques. Query parsing phase results in the meaningful words. In this, the terms/keywords entered by the user are split into meaningful words and then Word Stemming process is applied to them. Stemming deduces the stem from the fully suffixed word according to its morphological rules. The unwanted words such as a, the, an etc. are also removed. For example if the user enters the keyword interesting or interested, then the system will stem it to interest.
3. Now the mapping agent will look into its domain ontologies for the same keywords obtained after stemming. All the combination of words is taken for processing. Specific domain ontology is taken to verify whether the word is present in that ontology. If yes then the relationship of the words are taken into the consideration. This phase is called as Ontology Matching.
4. The Ontology Matching may present more than one data sources as a result. For considering the best, Weight Assignment and Rank Calculation is done. The weight is assigned to each word with respect to other word according to the relationship in ontology like superclass, immediate subclass, subclass etc based on improved matching [6] algorithm.
5. After the weights are assigned, the next step is to calculate the rank. The cumulative weight is calculated for each combination of words based on the improved matching algorithm. The best document gets the minimum score. Documents are arranged in ascending order according to their cumulative weight.

6. Now the mapping agent will pass the query to the mobile agent called as Transfer Agent. The passed query will hold a module that holds the necessary mapping and merging instances, tables of mapping and common vocabulary.
7. The transfer agent accesses the remote agent sites. The local processing agents of remote agent sites will perform the necessary mapping of the information obtained from remote agents to its local data and then provide the required information.
8. The output of Step 7 will be the complete or partial ontologies extracted from remote sites. Then after this, the necessary ontology integration and/or merging, if required, will be performed. For the ontologies on the same subject, merge technique is used. A globally accepted framework for the merging of ontologies is available. But if the ontologies are exhibited on different subject, then Ontology Integration is performed. For this three operations namely assemble, include or extend are used depending upon the level of integration required.
9. The outputs of ontology integration and/or merging are passed to Wrapper Agent. It will present the data in the language understandable to the user/interface agent.
10. The results are then passed to User/interface agent via Wrapper Agent.

IV. CONCLUSION AND FUTURE SCOPE

The proposed model is under study. It is based on the observations from the papers quoted in the literature. The description of the model using a modeling/description language is the future scope of the study.

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