SEMANTIC QUERIES IN DISTRIBUTED RELATIONAL DATABASE USING GLOBAL ONTOLOGY CONSTRUCTION

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Abstract

Semantic web refers to the extension of the World Wide Web and it will provide a common framework which makes data available for reusing and sharing. Ontology is the backbone of Semantic web which is used to access relational database in Semantic web. This paper proposes a new approach which enables Semantic web application to access distributed relational databases. The method involves two main phases. In the first phase, have focus to construct one or more local ontologies. In the second phase, have focus to construct a global ontology to access distributed relational databases. Global ontology was constructed by merging one or more local ontologies. Global ontology supports a high level view of the database. This approach uses protégé 4.3 tools for constructing ontologies.

Keywords:

Semantic Web, Local Ontology, Global Ontology, Protégé Tool, Distributed Relational Database

1. INTRODUCTION

Ontologies are being used as the basis for communication for representing and storing data, for knowledge sharing, classification and organization of data resources and policy enforcement, etc. The term ontology has been defined in different ways. A number of ontologies have been developed for the purpose of managing and extracting semantic knowledge from online literature and databases.

Today, we are faced with the challenging problems of dealing with the distributed and heterogeneous data sources containing huge amounts of data in varieties of semantic structures. Designing a data integration system is a complex task which involves major issues that include the heterogeneity of the underlying data sources, the difference in accessing mechanisms, and the support of query languages with the aspects of semantic heterogeneity in relation to their data models. Currently ontologies are being widely used to overcome the problem of semantic heterogeneity.

1.1 LOCAL ONTOLOGY

Local Ontology is constructed from relational databases. The purpose of local ontologies is to cater for the heterogeneity of the source schemas and their respective data (Hafizullah Amin Hasim, 2013).

1.2 GLOBAL ONTOLOGY

Global Ontology extracts data from local ontologies, and it is constructed by merging one or more local ontologies. This Ontology construction achieved through protégé 4.3 tool.

2. ONTOLOGIES IN THE SEMANTIC WEB

The Semantic web is a universal medium for data, information and knowledge. It uses standard formats like RDF (Resource Description Framework [8] [9], RDFS (Resource Description Framework Schema) [6] and OWL (Web Ontology Language) [7] to enable integration and combination of data from different sources [3].

Ontology provides a shared data structure to exchange and reusable piece of information between agents and has been applied in many fields, such as semantic web, E-learning, E-commerce and information retrieval [4]. Ontology can be Used for annotations in websites and knowledge based services using other web resources. OWL (Web Ontology Language) is a Language for processing information in the semantic web. The Fig.1 shows the processes of the Semantic web.
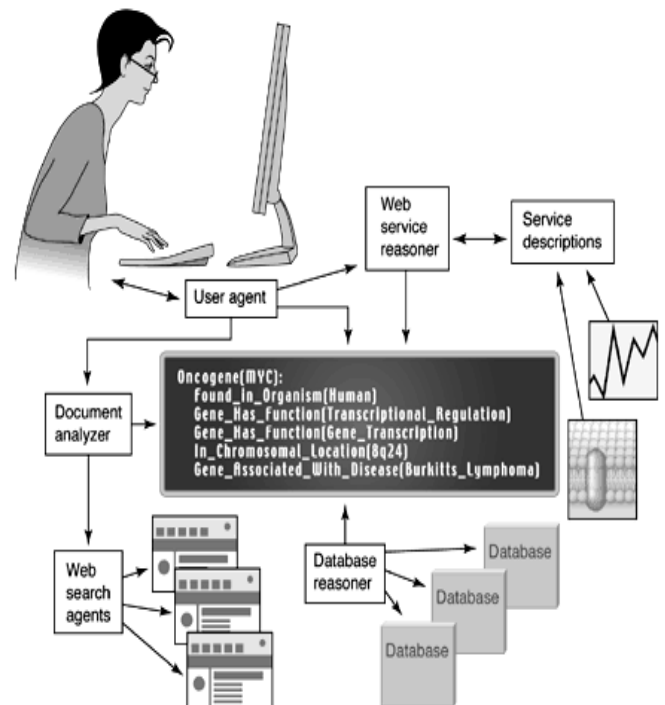

Fig.1. The Semantic web

2.1 WEB ONTOLOGY LANGUAGE (OWL)

The OWL language is the schema language or Knowledge Representation (KR) language, of the semantic web. OWL enables to define each concept carefully because it can be selected and assembled in various combinations with other concepts as needed for many different applications and purposes.

OWL has three sub languages:

- OWL Lite
- OWL DL (includes OWL Lite)
- OWL Full(includes OWL DL

2.2 PROTÉGÉ OWL PLUG-IN

In this approach we are using the protégé tool for constructing ontologies. Protégé is free, open source ontology editor. It's based on Java extensible, and provides a plug and play environment. It is supported by a strong community of developers, academic, government and corporate users because it is a GUI based tool to generate ontologies. It provides the capability of specifying the logical relationship between classes and relationships [15].

3. EXISTING METHOD

Local ontology is constructed from relational databases. In the existing system, the construction of a local ontology from a relational database includes the following steps [1]:

- Extraction of metadata from the relational database of Java Database Connectivity Components (JDBC)
- Transfer of the database model to the ontology model using transformation rule.
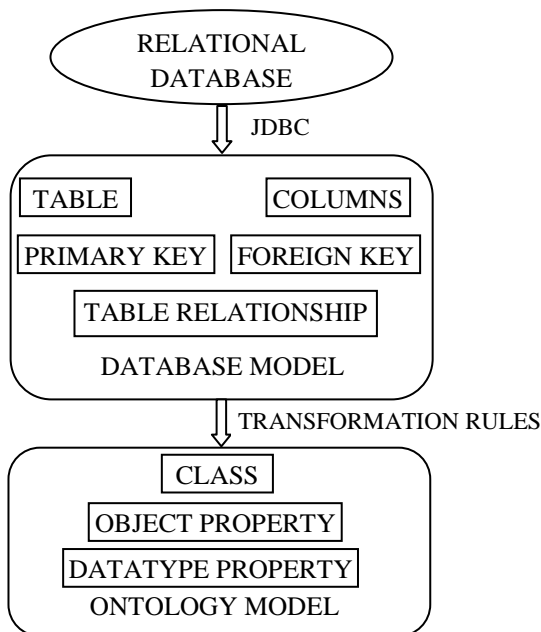- Transfer of the ontology model to the OWL ontology by Jena Framework

Fig.2. Local ontology construction

4. PROPOSED METHOD

- In existing approach, it uses transformation rules to build Ontology. To handle transformation rules are very tedious and error prone work.
- In the proposed method, we are using protégé 4.3 tools to construct Ontology.

- Protégé 4.3 tool is open source and Graphical User Interface (GUI) based tool.
- We are constructing local Ontologies using protégé 4.3 which is used to convert relational databases into Ontology.
- Global Ontology can be constructed by merging one or more Ontologies which are used to access distributed relational Ontology.

The following application are examples of Ontology:

- Semantic Web
- Semantic Web Service Discovery
- Artificial Intelligence
- Multi-Agent
- Search Engines
- Interoperability
- System Engineering

4.1 FIRST PHASE - CONSTRUCTING LOCAL ONTOLOGY

The OWL ontology contains:

- Classes/Class-hierarchy
- Properties (slot) value
- Relations between classes (inheritance, disjoints, equivalents)
- Restrictions on properties (type, cardinalities)
- Characteristics of properties (transitive)
- Individuals

Now, we are using protégé 4.3 tools to construct ontology. The main difference between a relational database and ontology is concepts can be stored using tables, but the system doesn't contain any information about what the concepts mean and how they relate to each other in relational database. Ontologies do provide the means to store such information, which allows for a much richer way to store information. The Fig.3 shows the difference between Relational database and Ontology.
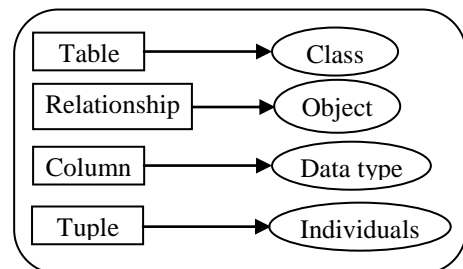

Fig.3. Relational Database and Ontology

For example, take Mphil details alone as one database. The following Table.1. Local_ontology1 shows the details of Classes, Object Property and Data Property.

Table.1. Local_ontology1

Things	Values
Classes	Professors, courses, mphilstudents

Subclasses	Mphil_computerScience, fulltimestudents, parttimestudents
Individuals	**Professors-** Dr.Ananthi sheshasaayee, Dr.Nirmala, Jasmine, Vidhya, Pugenzndhi, Sumathy, Pushpa,Velmayil, Jayanthi **Students-** Sakthidevi, Elavarsi, Jayasheree
Object property	Dr.Anathi sheshasaayee is Guide for Sakthidevi Inverse property-**isGuidedby, etc...**
Data property	MphilcomputerScience **hasFulltimestudents**=8. MphilcomputerScience **hasparttimestudents**=2.

The following Fig.4 shows the external design of Local_ontology1.
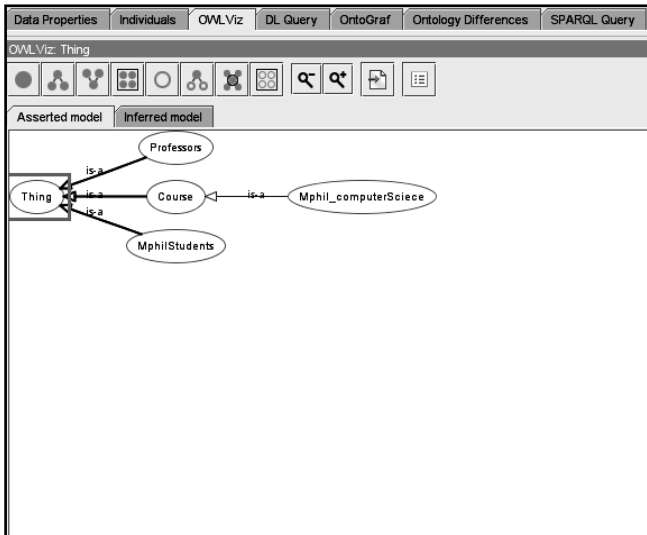

Fig.4. Local_Ontology1

The following Table.2. Local_ontology2 shows the details of Classes, Object Property and Data Property.

Table.2. Local_ontology2

Things	Values
Classes	TeachingSatffs, Classes
Subclasses	Nonteachingstaff, Postgraduate, Undergraduate
Individuals	**TeachingStaffs-** Dr.Ananthi sheshasaayee, Dr.Nirmala, Jasmine,Vidhya, Pugenzndhi, Sumathy,Pushpa,Velmayil, Jayanthi **Nonteachingstaff-** Hemamalini, Kalavani Postgraduate- MCA Undergraduate- BSC-I, II and III
Object property	Dr. Anathi sheshasaayee isHodOf Classes, Jasmine isInchargeOf MCA –I, etc.…
Data property	Undergraduate hasClassesOf=3 Postgraduate hasClassesOf=3

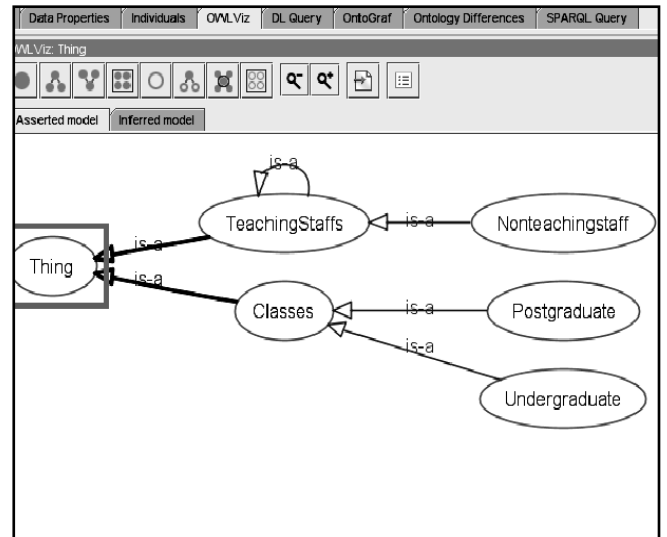The following Fig.5 shows the external design of Local_ontology2.

Fig.5. Local_Ontology2

4.2 SECOND PHASE - CONSTRUCTING GLOBAL ONTOLOGY

Global ontology extracts data from local ontolgies. It is based on matching and merging two or more local ontologies [2]. The following steps are used to create global ontology from local ontologies [5]:

i. Matching classes and properties between local ontologies and global ontology.

ii. Merging classes and properties from local ontology1

iii. Class generalization.

The identical classes, properties and values are combined to be one class, one property, and one value respectively in the global ontology.

In this approach, the following steps are used to construct global Ontology:

- Open existing local Ontology called Local_Ontology1 in one window.
- Directly import another Ontology called Local_Ontology2 in that same window.
- Now, merge two Ontologies into new Ontology name called merge_Ontology.

The following Fig.6 explains the merg_Ontology structure which is constructed from local Ontologies such as Local_Ontology1and Local_Ontology2.
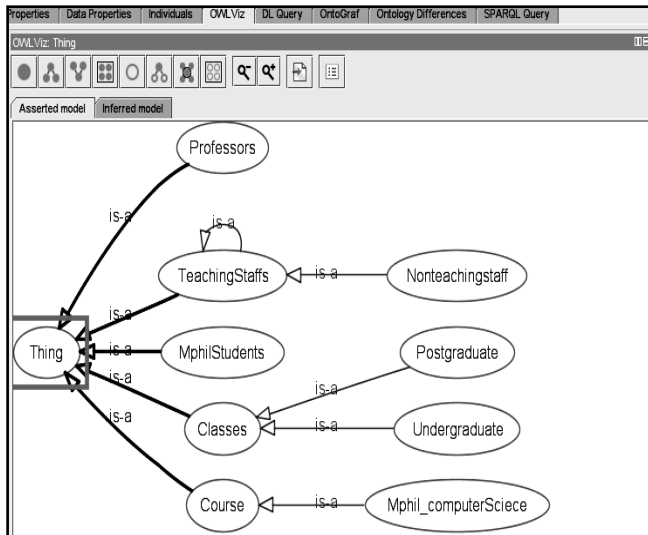
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Fig.6. merge_Ontology

Now, this global Ontology contains all the information of both local Ontologies. Using this one Ontology we can retrieve semantic information of each student and professors. Because of this purpose, we are using global Ontology on Semantic Web.

5. CONCLUSION

In this paper, we proposed a global ontology for performing semantic queries on distributed relational databases. The method proposed here evolves two main phases. In the first phase, constructing local ontologies from a relational database. In the second phase, merge two local ontologies to construct a global ontology. In our approach, Protégé 4.3 is used to construct ontologies. This is GUI based and frees open source tool, which is used to create and edit ontologies. Semantic web uses ontologies to retrieve web information which can be stored in ontology structure. The semantic queries can be achieved through global ontology which is used to querying distributed relational databases. Further research should focus on mapping global and local ontologies for heterogeneous databases. This can be achieved through WordNet.

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