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A FRAMEWORK FOR DIRECT AND SEMANTICS BASED TRANSFORMATION FROM RELATIONAL DATABASE TO ONTOLOGY

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ABSTRACT

The Conventional Web matches the search index given by the user in the available document repository and retrieves those documents for information retrieval. The Semantic Web, the extension of conventional web retrieves not the documents by the mentioned method, instead finds the semantics of the given search index and retrieves the information from the knowledge repository. One such knowledge representation format is Ontology. Ontology is generated in two ways. One is through manual creation by Ontology language developers with the help of domain experts. The problem in this method is either the domain experts need to be familiar with the Ontology development language or the developers of Ontology should have domain expertise. The other method is converting the available structured data into Ontology. Since more than 70% of the Web retrieval is from Relational Data Base contents, conversion of Relational Data Base contents into Ontology documents is in need. This conversion is required for two reasons. One is to give solution to the first approach and the other is, Relational Data Base content is rich in data but the retrieval is not rich in semantics. Since the Ontology lacks rich data, the conversion from available data collection to a semantic data format needs focus. This paper proposes a framework for converting Relational Data Base contents into Ontology contents by following certain mapping rules. These rules give the direct or simple transformation from Relational Data Base components and data into the corresponding Ontology components. This paper also proposes the semantics based conversion rules which gives more reasoning support to the Ontology document to provide efficient information retrieval.

Keywords : *Semantic web, Schema, Mapping, Ontology, Resource Description Framework (RDF), RDF Schema (RDFS), Web Ontology Language (OWL), Description Language (DL), First Order Logic (FOL)*

1. INTRODUCTION

The rich information collection available in the structured data formats like Relational Data Base (RDB) can be used as historical data for various purposes. Because of the machine accessible nature of semantic data, Ontology is used as the efficient information retrieval base. Since the construction of new Ontology requires both domain experts and Ontology developers and also the need of making use of rich RDB data available in the Web initiates the conversion of RDB to Ontology. The various data repositories available are differentiated in terms of the data formats they store. RDB is the meaningful related information collection. The difference between RDB and Knowledge base is that, RDB stores only the information with attributes of objects with relations between objects in the form of tables, where as Knowledge base stores information in terms of the previously known facts that are derived from information. Ontology is one knowledge base content for any domain of discourse. The service provided by World Wide Web (WWW) is to make the scattered heterogeneous data available over the Internet to share among the Internet users world wide. The available information is in any form of structured data like databases, XML data, data warehouses,

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enterprise systems (CRM, ERP etc.) or unstructured data like Excel spreadsheets, Word documents, Email messages, RSS feeds, audio files, video files etc. In the web, these forms of data provides information retrieval to the web users by just displaying its content exactly as it contains.

This conventional web represents data in the form of HTML documents. Conventional web and semantic web is differentiated in terms of the data format it represents. That is, the way of presenting the data in the web and the outcome of the web search or information retrieval. In the Semantic web, the pattern of data is represented in terms of knowledge. The knowledge, however is derived information from given set of data. Ontology is one such document to define or represent knowledge. The semantic web not only contains Ontological documents, also the RDF documents, XML data etc. The different layers in Semantic Web shown in figure 1 gives the hierarchy of knowledge representation formats. Upper the layer, the more precise representation and the lower layers provide less preciseness. OWL (Web Ontology Language) document contains more expressive power, efficient reasoning support, well defined syntax, formal semantics and the convenience of expression than the lower layers of representation. Since WWW contains domain oriented database files in a large quantity, it does not suffer from lack of data, but lacks with efficient information retrieval. But Semantic web lacks such a huge repository of data. This means that Semantic web requires data either (1) in terms of manual creation or (2) through conversion from existing data. The tedious and boredom work of new Ontology creation and the necessity for domain experts to understand the syntax and semantics of Ontology development language leads a way to the mapping process of Relational Databases to the Ontology.

RDB and Ontology can be related with the following methods.

- The generation of domain specific Ontology is done by mapping the corresponding RDB domain
- RDB is created with existing Ontology to achieve semantics
- Creating correspondences between existing RDB constructs and existing ontology constructs.
- Maintaining the semantics of Ontology in RDB
- Discovering relationships between RDB and Ontology
- Semantic based Querying using Ontology in RDB
- Supporting Ontology based Semantic matching in RDB
  etc.,

The mapping between RDB and Ontology means that the RDB constructs like tables, attributes, data types, values etc., are converted or transformed into classes, properties, instances etc., in the Ontology. RDB mapped to Ontology means that the RDB constructs already exist and the new Ontology is developed based on the RDB constructs to provide rich set of data for the Ontology. In the vice versa, Ontology mapped to RDB means that Ontology already exist and the RDB is newly designed and data generated based on Ontology constructs to provide more reasoning and expressive power of Ontology. In creating correspondences between RDB and Ontology approach, if both RDB and Ontology exists for the same domain, the relations or correspondences are identified so that, the factors that RDB and Ontology lacks both are overcome.

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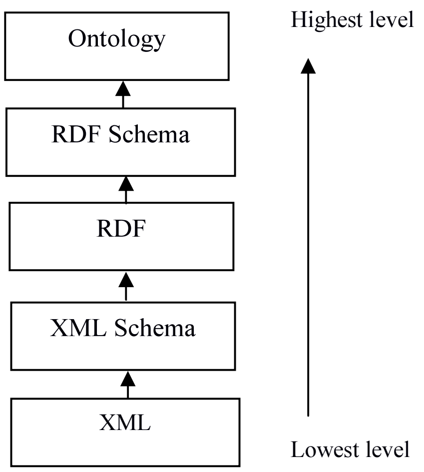

Figure 1: Layered Approach Of Semantic Web

If either one of the above two mappings is done then it is known as Forward direction of mapping. Both forward and backward direction of mapping is known as Reversible Mapping process. This reversible process means that if RDB mapped to Ontology and again the resultant Ontology is mapped to original RDB in order to check whether the Ontology has been generated purely based on all of the constructs of RDB. But this is a tedious task. This paper focuses on forward direction of mapping, ie., RDB to Ontology mapping alone. The paper is organised as follows. Section 1 gives introduction. Section 2 explains the Relational Data model and Ontology model. Section 3 describes about the RDB to Ontology mapping process. Section 4 deals with the framework for the implementation of this model. Section 5 gives the possible implementation details and section gives various works related to this paper. Section 7 gives conclusion and the future enhancements of this work.

2. DATA MODEL

A database model is a type of data model that determines the logical structure of a database and fundamentally determines the manner in which data is stored, organized, and manipulated in the database. The most popular example of a database model is the Relational model, which uses a table-based format. The Ontology model is also described in this section which uses the basic construct as class or concept.

2.1Relational Database Model

Relational database is formalised by First Order Logic (FOL). FOL is a formal system used in mathematics, philosophy and computer science etc. It models the world in terms of objects, properties, relations and functions. Objects are things with individual identities. Properties of objects that distinguish them from other objects. Relations that hold among sets of objects. Functions which are a subset of relations where there is only one value for any given input. Table 1 depicts the relation between FOL and RDB.

Table 1: Relation Between FOL and RDB

FOL	RDB
Objects	Table /relation
Properties	Attributes
Relations	Relationship among tables(Keys)
Functions	Subset of Relations

Each object terms a table or relation in relational database. The properties are the attributes of table and the relations indicate the relationship of table with other table. In relational model this kind of relationship is achieved through 'keys'. Here the tables use an attribute or part of the attributes as key. In our system, an airline system domain is provided and its constructs are mapped to Ontology constructs. Objects in airline system includes airport, airplantype, flight, airplane etc. The schema diagram of airline database system is depicted in figure 2. Schema diagram denotes various relations of the application domain and the attributes of each relation. Relations are the representations of objects. Also the relationship between the attributes among different relations with the unique key representation is also given. The directed lines denote the relationship of objects with other objects. Our generalized airline system has airport object denoting name of the airport and city and state where the airport is located.

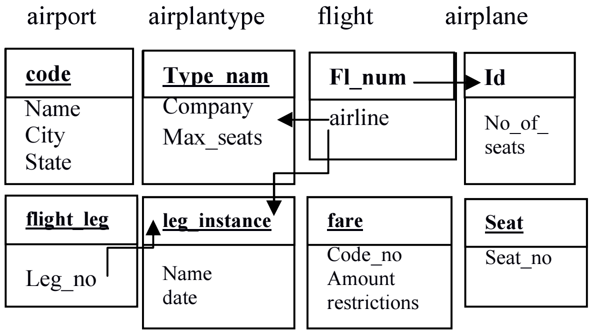

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Figure 2: Schema Diagram Of Generalised Airline System

The direction of line denotes for example, the Id attribute in airplane relation is related with fl_num attribute in flight and code is the primary key in airport relation and airline in the flight denotes the manufacturing company in airplantype relation. The system contains other relations as weak entities.

2.2Ontology Model

Ontology is formalised with Description Logic (DL) which is the subset of FOL. Ontology is more expressive and has more efficient decision problems than FOL. It provides logical formalism for Ontology. It models concepts, roles and individuals and their relationships. In spite of the implementation of DL in the Ontology or in OWL language the FOL terminology is mostly used in Ontology ie., in OWL language. Table II depicts the relation between DL and Ontology. Ontology is developed with Web Ontology Language (OWL). OWL is a richer vocabulary description language for describing properties and classes, such as relations between classes for e.g., disjointness, cardinality for e.g. “exactly one”, equality, richer typing of properties, characteristics of properties for OWL, for e.g., symmetry, and enumerated classes. OWL builds on RDF and RDF Schema and uses RDF’s XML-based syntax. Since this is the primary syntax we use it here, but RDF/XML does not provide a very readable syntax. Because of this, other syntactic forms for OWL have also been defined. Concept or class names, e.g., Cat, Animal, Doctor, Equivalent to FOL unary predicates Role or property names, e.g., sits-on, hasParent, loves, Equivalent to FOL binary predicates. Individual names, e.g., Raman, Coimbatore, Delhi, Equivalent to FOL constants
OWL DL provides various elements which describes the expressiveness of data in a more semantic manner.

Table 2: Relation Between DL And Ontology

DL	Ontology
Concept	Class / predicate
Role	Property
Individual	Instance / constant
Relationships	Subclass, disjointwith, equivalentclass etc.,

OWL is available in three flavours.

1) OWL Full - OWL Full allows free mixing of OWL with RDF Schema
2) OWL DL - puts constraints on the mixing with RDF and requires disjointness of classes, properties, individuals and data values.
3) OWL Lite - supports only a subset of the OWL language constructs.

3. RDB TO ONTOLOGY MAPPING PROCESS

Mapping the constructs of RDB to Ontology means that the RDB tables are mapped to Ontology classes, attributes are mapped to properties and data is mapped to instances or individuals directly. Table 3 shows the RDB constructs and the corresponding Ontology constructs to which the direct mapping can be done.

Table 3: Relation Between RDB And Ontology

RDB	Ontology
Table	Class
Attribute	Property
Data	Instance / constant

The RDB data to Ontology instance mapping is done in two ways. (1) Batch processing, the entire relational database content are dumped as Ontology instances.(2) Query-driven, the data based on the query posed by the user alone is mapped. This system follows batch process for data mapping. Apart from the simple mapping, the integrity constraints mapping is to be done which includes primary key, foreign key and domain related constraints. Up to this, the mapping process is known as Direct Mapping. That is, whatever constructs RDB possesses, they alone are constructed in Ontology. This paper proposes the mapping rules for both simple mapping and Integrity constraint mapping. Apart from this, additional OWL Description Logic elements are used to enhance the semantics of generated Ontology. The sample Entity Relationship (ER) diagrams for the airline system. (See figures 3, 4 and 5)

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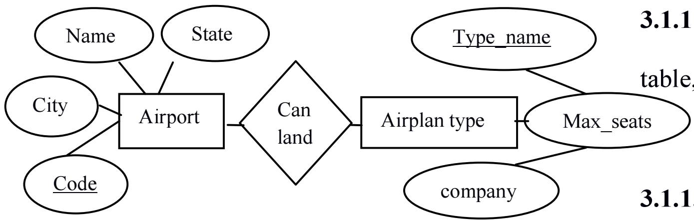

Figure 3: ER Diagram For Airport And Airplan Type Relationship

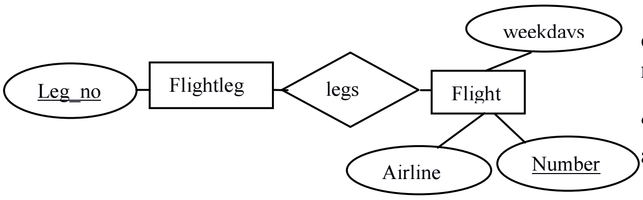

Figure 4: ER Diagram For Flight Leg And Flight Relationship

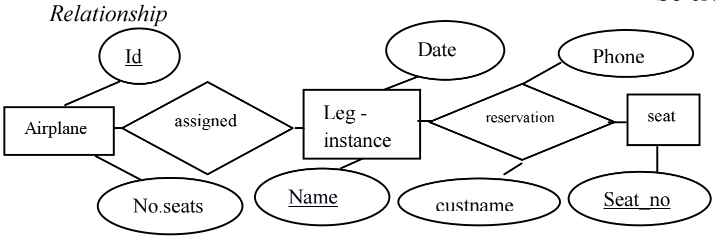

Figure 5: ER Diagram For Airplane And Leg-Instance (For Reservation) Relationship

ER diagram is the advanced data model. The relation between objects can be represented and based on this, the semantics of Ontology is generated.

3.1 Mapping Rules For RDB To Ontology Transformation

The direct or simple mapping is applied which translates table into class, column into data type property and RDB data to Ontology instance. As already mentioned direct mapping is whatever RDB constructs possess are directly mapped to Ontology constructs. In order to achieve the Ontology expressiveness and efficient reasoning power, the semantics based mapping is also applied in this system. Based on the schema diagram, the relations we provide set of mapping rules which denote how to generate Ontology or which OWL DL elements are used to generate Ontology. For each rule we have generated corresponding OWL DL for airline application. This generates our expected Ontology, and they are depicted inside the boxes.

3.1.1 Direct mapping rules

The simple mapping includes RDB table, attribute and data to be transformed into its corresponding Ontology constructs as follows:

3.1.1.1 RDB relation to Ontology class mapping

For all the tables of our airline system, classes are defined in OWL DL. Tables are mapped to classes based on the rule.

"Rule 1 : Create a class for the table which has at least one non-key attribute"

Thus in our case each table has non-key attribute. So creating class for each table is necessary.

Flight table in RDB

Create table airport (code integer primary key, name char(10), city char(10), state char(10))

Airport class in Ontology

```
<owl:class rdf:ID = "Airport"/>
```

3.1.1.2Primary key to InverseFunctionalProperty mapping

"Rule 2 : Map <owl:InverseFunctionalProperty> element to a column for which two different rows cannot have the same value and map <owl:minCardinality> for Not Null"

For example, two different airport code will not have same value. A column constraint primary key is mapped to both an inverse functional property axiom and a minimum cardinality constructor of 1.

The unique key representation in Ontology is as follows:

```
<owl:InverseFunctionalProperty    rdf:ID    =
"code"/>
<owl:class rdf:ID = "Airport">
        <rdfs:subClassOf>
                <owl:restriction>
        <owl:OnProperty
```

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```
    rdf:resource = "#code"/>
<owl:minCardinality rdf:datatype =
"&xsd:nonNegativeInter"1/>
            </owl:restriction>
        </rdfs:subClassOf>
</owl:class>
```

3.1.1.3 Attribute to DataTypeProperty mapping

Two types of property mapping in OWL DL are, 1) Object property which relates object with other object, 2) Data type property which defines the data type of attribute.

"Rule 3 : Create DatatypeProperty to create data types for each column and its corresponding data type."

```
<owl:DatatypeProperty rdf:ID = "code">
        <rdfs:domain rdf:resource = "Airport"/>
        <rdfs:range rdf:resource =
"&xsd;positiveInteger"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID = "#city">
        <rdfs:domain rdf:resource = "Airport"/>
        <rdfs:range rdf:resource =
"&xsd;string"/>
</owl:DatatypeProperty><owl:DatatypeProperty
rdf:ID = "#max_seats">
<rdfs:domain rdf:resource = "airplantype"/>
        <rdfs:range rdf:resource =
"&xsd;positiveinteger"/>
</owl:DatatypeProperty>
```

3.1.1.4 Foreign key to ObjectProperty mapping

"Rule 4 : Create ObjectProperty with domain and range properties to set a foreign key, if foreign key is not a primary key or part of a primary key "

```
<owl:ObjectProperty rdf:ID = "number">
<rdfs:domain rdf:resource = "#flight"/>
<rdfs:range rdf:resource = "#airplane"/>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID = "Id">
<rdfs:domain rdf:resource = "#flight"/>
<rdfs:range rdf:resource = "#airplane"/>
</owl:ObjectProperty>
```

3.1.1.5 Data to Instance mapping

"Rule 5 : Map each row of data with Ontology instances of classes as declared in RDF syntax."

RDB syntax

Insert into Airport (code, name, city, state) values ("A1010", "Coimbatore Airport","Coimbatore", "Tamil Nadu")

The Ontology instances are :

```
<Airport>
    <code
rdf:datatype="&xsd:string">A1010</code>
    <name
rdf:datatype="&xsd:string">Coimbatore
Airport</name>
   <city rdf:datatype
="&xsd:string">Coimbatore</city>
<state rdf:datatype ="&xsd:string">Tamil
Nadu</state>
</Airport>
```

3.1.2 Semantics based Rules

The direct mapping allows whatever RDB structure possesses, they are directly mapped to Ontology structures. This structure provides sufficient information retrieval as in the RDB. When special type of OWL DL elements are created for the provided RDB, the generated Ontology will give sufficient reasoning power. We provide some semantics based approach of OWL DL which can add more semantics to the developed Ontology.
The OWL DL Ontology given inside the boxes given below denote the new Ontology for providing more semantics.

3.1.2.1 <owl:equivalentClass>

"Rule 6 : Create equivalence class if two classes denote the same object"

Flight and airplane both terms denote flight object

```
<owl:Class rdf:ID="flight">
<owl:equivalentClass
rdf:resource="#airplane"/>
</owl:Class>
```

3.1.2.2 <owl:someValuesFrom>

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"Rule 7 : Create someValuesFrom property for the class which should have atleast one value in another class with the relevant relation"

Flightleg, Airport and Airplane exists in leginstance. The flightleg should have at least one data instance of leginstance object.

```
<owl:Class rdf:about="#Flightleg">
 <rdfs:subClassOf>
  <owl:Restriction>
   <owl:onProperty rdf:resource=#owns"/>
<owl:someValuesFrom
rdf:resource="#leginstance"/>
  </owl:Restriction>
<rdfs:subClassOf>
<owl:Class>
```

3.1.2.3<rdfs:subClassOf>

"Rule 8 : Create subClass element for two classes in which one is the sub class of the other"

Borrower has the subclass relation with depositor.

```
<owl:Class rdf:ID="borrower">
 <rdfs:subClassOf rdf:resource=#depositor/>
</owl:Class>
```

3.1.2.4 <owl:disjointWith>

"Rule 9 : Create disjointWith class element if two classes are disjoint with each other"
Flight is disjointWith Airport.

```
<owl:Class rdf:about="#Flight">
 <owl:disjointWith rdf:resource="#Airport"/>
</owl:Class>
```

3.1.2.5 <owl:AllValuesFrom>

"Rule 10 : Create AllValuesFrom property for any two classes which should depend on each other
All flights must land in airports.

```
<owl:Class rdf:about="#flight">
 <rdfs:subClassOf>
  <owl:Restriction>
   <owl:onProperty rdf:resource="#can_land"/>
   <owl:allValuesFrom
rdf:resource="#airport"/>
  </owl:Restriction>
 </rdfs:subClassOf>
</owl:Class>
```

3.1.2.6 <owl:inverseOf>

"Rule 11 : Create InverseOf property for any two object relations which are inversely related"
Fare is assigned by flights and flight assigns fare.

```
<owl:ObjectProperty rdf:ID="assigns">
 <rdfs:range rdf:resource="#fare"/>
 <rdfs:domain rdf:resource="#flight"/>
 <owl:inverseOf rdf:resource="#assignedby"/>
</owl:ObjectProperty>
```

3.1.2.7 <owl:hasValue>

"Rule 12 : Create hasValue property if any property has some specific value"

The leg number that flies from Coimbatore to Hyderabad is 1

```
<owl:Class rdf:about="#flightleg">
  <rdfs:subClassOf>
  <owl:Restriction>
  <owl:onProperty rdf:resource="#leg_no"/>
  <owl:hasValue rdf:resource="#1"/>
  </owl:Restriction> </rdfs:subClassOf>
</owl:Class>
```

3.1.2.8 <owl:minCardinality>

"Rule 13 : Create minCardinality if any property has a minimum value otherwise at least"

We can require every flight must run with at least one passenger.

```
<owl:Class rdf:about="#flight">
  <rdfs:subClassOf>
  <owl:Restriction>
  <owl:onProperty rdf:resource="#run_with"/>
  <owl:minCardinality
rdf:datatype="&xsd:nonNegativeInteger">1
</owl:minCardinality>
  </owl:Restriction> </rdfs:subClassOf>
</owl:Class>
```

3.1.2.9<owl:maxCardinality>

"Rule 14 : Create maxCardinality if any property has a maximum value otherwise at most"

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The flight fare from Coimbatore to Mumbai is at most Rs.5000.

```
<owl:Class rdf:about="#flight">
  <rdfs:subClassOf>
  <owl:Restriction>
  <owl:onProperty rdf:resource="#run_with"/>
  <owl:maxCardinality
rdf:datatype="&xsd:float">5000
</owl:minCardinality>
  </owl:Restriction> </rdfs:subClassOf>
</owl:Class>
```

4. RDB TO ONTOLOGY MAPPING SYSTEM FRAMEWORK

The system provides different modules. RDB components are extracted from the Data Dictionary. Simple Mapping rules are applied on the RDB. Jena API is used to extract the data dictionary contents from RDB. For each structure the appropriate mapping rule is applied by checking the condition. Then the Ontology is generated with OWL DL syntax. Until all the data dictionary contents are mapped to Ontology the Ontology generation is done. The mapping rules that we provide here generates Ontology with the components available as like RDB exactly. That is, RDB table, attribute, primary key, foreign key and data are converted in Ontology as Class, Data type property, Inverse

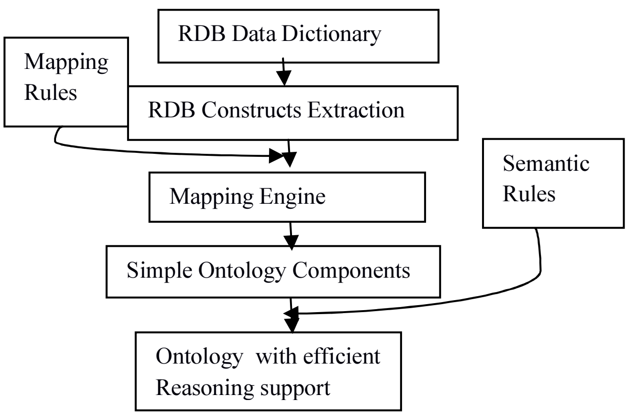

Figure 6: RDB To Ontology Transformation System

functional property, Object property and instances respectively. In order to achieve efficient reasoning support for the generated Ontology, the semantic rules are applied and the new Ontology is generated. Figure 6 describes the system.

Proposed algorithm for Transformation processs

Algorithm : Direct mapping and Semantics based approach for RDB to Ontology Transformation
Input : RDB & RDB Data Dictionary
Output : Ontology
Begin
    While (Data Dictionary is not empty)
    Begin
        Extract RDB Data Dictionary components one by one
        For each component
            Apply mapping rule
            Generate Ontology component
        End for
        Apply semantic rules on the generated Ontology
    End
End

5. IMPLEMENTATION DETAILS

The developed algorithm is implemented in JAVA. Various classes, data type properties, object properties related to the schema diagram depicted in figure 2 are generated for Airline system for the corresponding relational data base tables of airlines data base. This simple mapping is done by extracting the relational data base components from data dictionary. Semantic transformation for the generated ontology is achieved by creating ontology properties like equivalence class, sub class, disjointwith etc. The generated ontology is placed in an owl file and it is edited in PROTEGE tool. The information retrieval is done through SPARQL query language. Tables 4 and 5 denotes the space complexity for both relational database and ontology and the extracted information gives more precision than relational data base retrieval. The ontology or owl file occupies very less in size compared with relational data base size. The basic performance measures for information retrieval are precision and recall. Precision is retrieved instances that are relevant. Recall gives the fraction of relevant instances that are retrieved. The developed ontology produces

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more precision because the relationship between the airline classes like subclass, disjoint properties are generated for improving the expressiveness of knowledge about airlines, hence the retrieval is more precise than relational data base retrieval.

Table 4 : Space Complexity Between RDB And Ontology

Memory size (in KB)	Airline RDB	Airline Ontology
	1000	20

Table 5 : Precision And Recall Between RDB And Ontology

	Airline RDB	Airline Ontology
Precision (%)	25	70
Recall (%)	50	90

6. RELATED WORK

Several works have been done in Forward direction of mapping from RDB to Ontology. Irina Astrova et al.,[4] generates the Ontology based on the given SQL scripts of any RDBMS by providing SQL constructs and its corresponding Ontology constructs. Quang Trinh [5] describes a formal algorithm to use the relational database RS meta-data and structural constraints to construct its OWL Ontology while preserving the structural constraints of the underlying relational database system. Syed Hamid Tirmizi et al [6] defines a system for automatic transformation of SQL DDL Schemas into OWL DL Ontologies which represents the First Order Logic(FOL) based translation of SQL applications to the Semantic Web. The RDB constructs are based on FOL, this paper tries to provide a system which has the expressive and reasoning power of FOL into the Ontology. Zdenka Telnarova [7] focused on the principles of automatic conversion of constructs of Ontology and transfer of relational data model to constructs of OWL Ontology and transfer of relational data to Ontology instances. Shufeng Zhou et al [8] creates an Ontology generator from RDB by extracting metadata information from RDB with reverse-engineering and analyses corresponding relationship between RDB and Ontology, then presents Ontology generation. Xu Zhou el al. [9] proposes an approach for Ontology construction based on RDB with semi-automatic building and uses WordNet to extend the Ontology. Lei Zhang [10] provided an approach for automatic generation of Ontology based on database by analysing the Ontology and database by constructing rules of Ontology elements based on RDB and provides a system to generate Ontology automatically. Guntars Bumans [11] provides a simple and elaborate example of how mapping information stored in relational tables can be processed using SQL to generate RDF triples for OWL class and property instances. Noreddine GHERABI [12] presented an approach by capturing the semantic information contained in the structures of RDB, eliminates incorrect mappings by validating mapping consistency and providing an algorithm for constructing conceptual mappings and experimenting data sets with real world domains. Many Ontology to RDB mapping works are done. OUYANG Dan-tong [13] presents a set of constraint axioms called IC-mapping axioms, based on these a special Ontology with integrity constraint, which is adapted to map Ontology knowledge to data in relational databases. Ernestas Vysniauskas [14] proposed an algorithm and generates a tool for transformation of domain Ontology described in OWL to RDB. The methodology is illustrated with an example. Irina astrova [15] proposed an approach for automatic transformation of Ontologies to relational databases where the quality of transformation is also considered. Saurabh kejriwal [16] presents a schema aware approach for mapping OWL Ontologies to relational databases . Ernestas Vysniaskas [17] defines a reversible information preserving transformation from OWL2 Ontologies into relational databases using the proposed hybrid approach. Souripriya das et al. Addresses three issues by allowing OWL Lite and OWL DL based Ontologies to be stored in Oracle RDBMS and by providing a set of SQL operators for Ontology-based semantic matching.

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7. CONCLUSION AND FUTURE WORK

In this paper, a framework is proposed to generate an Ontology for a given Relational data base domain. The problem in the existing new Ontology construction is, the domain experts should be familiar with Ontology development languages or the Ontology developers should be domain experts. Also, the tedious and boredom work of constructing a new Ontology is overcome by this conversion. Still most of our web access is based on Relational data base, the semantically rich data can be achieved by constructing Ontology from the existing relational data base. Also, a better information retrieval is achieved by this. That is, Relational Data Base retrieves only information. Ontology retrieves Knowledge. This knowledge base is constructed by mapping the relational data base components into the corresponding Ontology components using certain mapping rules. This paper proposes the mapping rules and constructs an Airlines domain Ontology. The simple transformation of relational data base into Ontology does not give sufficient reasoning to the system. So, this paper also proposes the semantic rules to improve the constructed Ontology to give more expressive power and reasoning support to the system for efficient information retrieval. The resultant ontology gives very less space complexity compared with relational data base and also the efficient retrieval measurements precision and recall is more for ontology compared with relational data base. As the future enhancement, the Ontology is a knowledge base for any specific domain of discourse, any Relational Data Base domain can be taken to create the corresponding domain Ontology to give efficient web retrieval.

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