Ontology Based Web Portal Designing

Manisha Kumari, Dr. Kanwal Garg

Abstract- Web is a growing source of information. Web users surf web for different purpose. Some users surf the web to work, some for fun, students surf it for study purpose and particular users for financial information. These users visit dozen to twenty websites where they can find interesting information. Web portal is a special kind of data- intensive website that collects information from different source and organizes in a hierarchical way. Web portal is easy to design and populate according to end user purpose, but it leaves back-end database lacking of subject domain semantics and user cannot retrieve relevant information. Ontology based web portal is the solution of this problem which adds a semantic 'layer' in web portal implementation. This paper gives an approach that uses power of semantics to create a new type of web portal that is fully ontology based. Idea is to allow a user to create a new website by extracting information from different website's sections selected by himself.

Keywords : Ontology, Web Portal, Semantic, Website, information.

1. INTRODUCTION

Web portal plays the role of an information aggregator and provides users with seamless service interface to access data in an integrated way [1]. Key features of web portal are personalization and knowledge management that differentiate it from ordinary website [2]. Examples of web portals are yahoo and company portals, which present resources inside and outside the company to their employees.

Searching information about a topic on different-2 websites takes a lot of time especially of those users having the working necessity to find particular information on these websites. To overcome this problem, idea of ontology based web portal, in which information is semantically integrated, is described in this paper. Authors used semantics to process the structure of a particular website and design of corresponding module to patch on the portal and to provide application of a set of features according to user preference specified in his profile. To provide high level and effective services (conceptual search, personalization and social interaction), there is need to build semantic integration functionality in web portal and ontology is the basis for such functionality [1].

In this paper first of all ontology is created from website. Website mapping over an ontology is done by top-down or bottom-up approach. In top-down approach a set of algorithms are used to generate ontology from the web pages of a particular website [3]. But in bottom- up approach, ontology creation starts from the website database and structure. In this paper author used bottom-up approach to design ontology from website. This ontology is used to add a website or part of website in web portal. Knowledge is extracted from all ontologies of mapped websites and these ontologies form a semantic sublayer. Websites are patched on web portal according to user preference which is mentioned in user profile. This paper mainly focuses on first, second and fourth layer. This idea of web portal designing allows to use semantic to refine collected information according to user preference and founds important section in a customized portal.

2. TECHNICAL ARCHITECTURE

Designed architecture of web portal contains four layers. Layer1 and layer 2 generate an ontology for every selected website, layer 3 extract knowledge from these ontologies and level 4 select websites or section of website to patch on web portal according to user preference collected during user profiling.

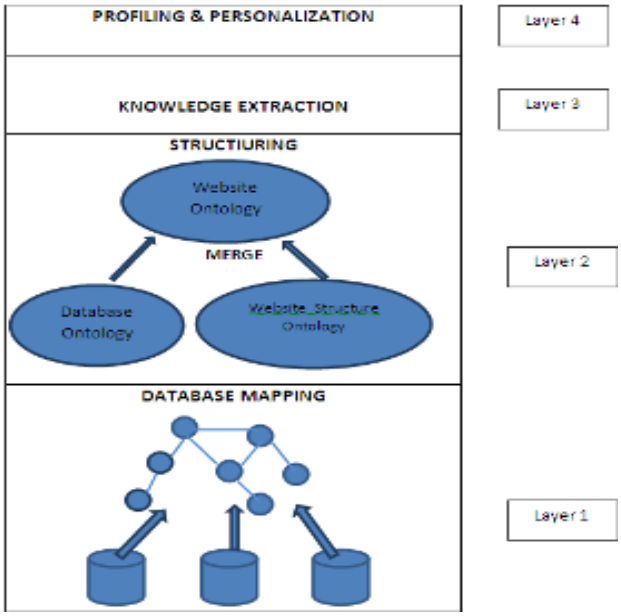

Figure1: Architecture

Database Mapping: - database of a website have many semantic information that may not be present in website structure. So it is necessary to create ontology based on database of a website to extract semantic information. First of all, websites that to be added in web portal must be selected. Mapping of a particular selected website over ontology is done by database mapping layer which is the first layer of architecture. This ontology is called *Database Ontology*. Database *ontology* for each selected websites must be generated in this layer. This ontology is used in structuring layer.

Structuring:- This layer generates ontology of a website in two steps. In first step, an ontology from the structure of a particular selected website is developed. This ontology is called *Website Structure ontology***.** In second step, *Website Structure Ontology* and *Database Ontology is merged* to develop *Website Ontology* as a result.

Knowledge Extraction: - from second layer *Site Ontologies* of all selected websites is generated. This layer extracts knowledge from all *Sites' Ontologies*. It sends module structure to profiling layer to attach on the web portal. It also extracts information from user profile according to his preference.

Profiling and Personalization: - it is the highest layer of architecture. Profiling of the user and personalization of web portal are done at this layer. Personalization stores the user preference in user profile. One can use software to automatically update module dynamically at this layer.

3. DATABASE MAPPING

Mapping rules are used to generate ontology from relational database. These rules depend upon relational database schema. Methodology explained in [4] maps only database schema into ontology not the instances or tuples .But this approach is different. It also maps tuples as instances of ontology. In [4] author compares all terms contained in database with those contained by WorldNet. If these terms are not found in WorldNet, then it is searched in domain ontology, if it is not found in domain ontology user must insert an equivalent name in the target ontology. There is corresponding relationships between relational database and OWL ontology: a database contains tables, a table contains several fields and records contain collection of field's values, OWL ontology contains several classes, a class contains several object and data properties and collection of property values are instances [7]. Figure 2 shows relationships between ontology and database components.

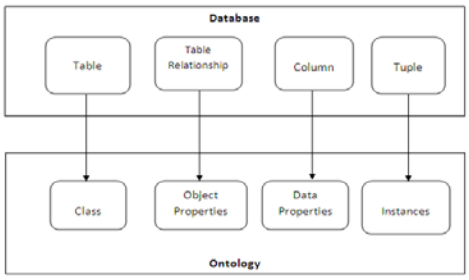

Figure 2: Relationship between Database and Ontology Components

Database Mapping Rules

First take an empty ontology and following steps are used to create ontology from database.

1. **Acquiring Classes**: - For each table in the database, a class must be generated into the ontology.

2. **Class Hierarchy:** - If two tables A and B in the database have primary-foreign key relationship then these two classes have parent child relationship and their corresponding classes A and B are organized in a hierarchy (Class A is subclass/superclass of Class B).

3 Learning object and Data properties: There are two types of properties in ontology i.e. object properties and data properties.

I. Foreign key indicates reference relationships between tables. For each foreign key there should be an object property. II. Each attribute/column (except foreign keys) must be converted to data properties having data type characteristics (string, int, date…….).

4. Cardinality: - Each property related to primary key of database has maxCardinality=1 and minCardinility =1**.** If a database attribute is NOT NULL in the ontology, then minCardinility of corresponding property is 1. If a database attribute is NULL in the ontology, then minCardinility of corresponding attribute is 0. If any attribute is Unique then maxCardinality of corresponding property is 1.

5. Instances: - tuples of a table in database are converted into the instances of corresponding class of a table and these tuples are linked according to foreign keys.

Database Mapping Example

A website of Living Things is chosen and some tables of that database are shown in figure3. From these tables and relationships between these tables author created an ontology shown in figure 4.

1. There are four main tables in figure 3; names of these are Living Things, Animal, Plant, and Body Part. So there are four classes of these four tables having same name.
2. Carnivore, Omnivore and Herbivore are subclasses of Animal Class. Fruit, Tree, and Grass are subclasses of Plant class.
3. Two foreign keys of Omnivore and Carnivore are not shown in Figure .But table of Omnivore and Carnivore is similar to Herbivore. So there are total six foreign keys in database. So six object properties are inserted in ontology.
4. Fifteen data properties are generated, six are related to primary keys (Category, Name, Plant Category, Name, Part-Name) and nine to the other attributes (Food, Living Gas, Activity, Animal, Type, Food –of, Stem, Function, Part type).
5. If an attribute in database is NOT NULL then minimum cardinality of corresponding data property should be set 1 otherwise set it to 0. For example we will have Living Things_Activity min 1. For each data property related to primary key will have restriction having cardinality 1.
6. Person, Loin, Cow, Leg, and Arm are some instances in ontology which are the values of tuples in database relations.

4 STRUCTURING LAYER

This layer creates *Website Ontology* and passes it to upper layer for information extraction .*Website Structure Ontologies* of Living Things website is shown in figure 5. These ontologies are created by analyzing structure of website. Protégé tool for ontology creation is used to `create these ontologies [8].

Database Ontology shown in figure 4 and *Website Structure Ontologies* in figure 5 are merged to form *Website Ontology* of Living Things website. Similarly *Website Ontologies* of all selected website are created. Ontology merging algorithm is used to merge ontologies or ontologies can be merged in protégé tool. PROMOT is an algorithm and tool for automated ontology merging and alignment [5].

5 PROFILING AND PERSONALIZATION

Profiling is the process of monitoring the user navigation, collecting user requests and storing these requests in user profile. After analyzing user profile, websites of user interest are patched on web portal. Personalization helps to find the websites of user interest. A personalization algorithm in [6] is explained for extracting personalized recommendations on ontological objects within web application. Personalization algorithm is described on an ontological model to rank object retrieved by a user with the help of figure 6.

Figure 6 shows an ontology part of a web portal about engineer, their production and work. In this figure rectangle shows concept, eclipse shows relation and properties are shown by lines. Rohan, Punit and Sunil are Indian Software Engineer, Haamid is a Pakistan software engineer, Vinod is an Indian Hardware Engineer. Punit has developed a "Shopping Place" website.

We assume that user reached to the page of Rohan and his developed websites by browsing Indian Software Engineer in a web portal described by ontology in figure 6. He has visited the page of Canada and has visited contact details from "Shopping Place" website. Now user profile contains registered interests Rohan, India, Canada, and "Shopping Place". Algorithm described in [6] has three steps.

Step1:- Author assigns weight to all properties which are used to extract object of user interest. (a) hasSuper property has weight 2 which extracts all concepts of Engineer and hasOrigin property has weight 2 which extracts all Indian Software Engineer (b) Contemporary Work (Relation) has weight 3 which extracts works produced on the same period with websites of Rohan ("Shoping Place" developed by Punit) and Production has weight 3 which extracts all websites developed by Rohan. (c) isMemberOf (instance) relationship has weight 4 which extracts all Hardware and Software Engineer (Punit, Harry, and Haamid, Vinod).

Step2:- This step discard all retrieved objects which are not included in user interest i.e. Haamid. Remaining objects are Punit, Harry, Vinod and "Shopping Place".

Step3:- In this step algorithm ranks all the retrieved objects by calculating the total weight of relation. Rank of retrieved object Punit is 9 this is calculated as following:

w(Punit) = w(Punit.hasOrigin(India)+ w(Punit.Production("Shopping Place")+

+ w (Punit.isMemberOf(Software Engineer) =2+3+4=9

Similarly weight of Harry and Vinod is 6 and rank of "Shopping Place" is 3. Thus, order of retrieved personalized content is Punit, Harry, Vinod and "Shopping Place".

6 CONCLUSIONS

In this paper author proposed an ontology-based architecture for designing web portal. It uses semantic power to collect information from websites by using ontology and attach these websites on web portal. The author described an idea toward a user-centric web that saves user surfing time. In this paper main focus is given on Database Mapping and Personalization layer. Important information stored in database part of website and in designing of web portal there is need to integrate or combine database of different related websites. This task is difficult, so authors

described idea of mapping database into ontology and combine it with website structure ontology or database ontology of other websites. Personalization helps to find websites of user interest by storing their request in user profile and ordering ontological concepts according to user preference. This web portal designing idea is beneficial for educational and business organization where pages of web portal can be designed according to information from combined ontology and personalized content.

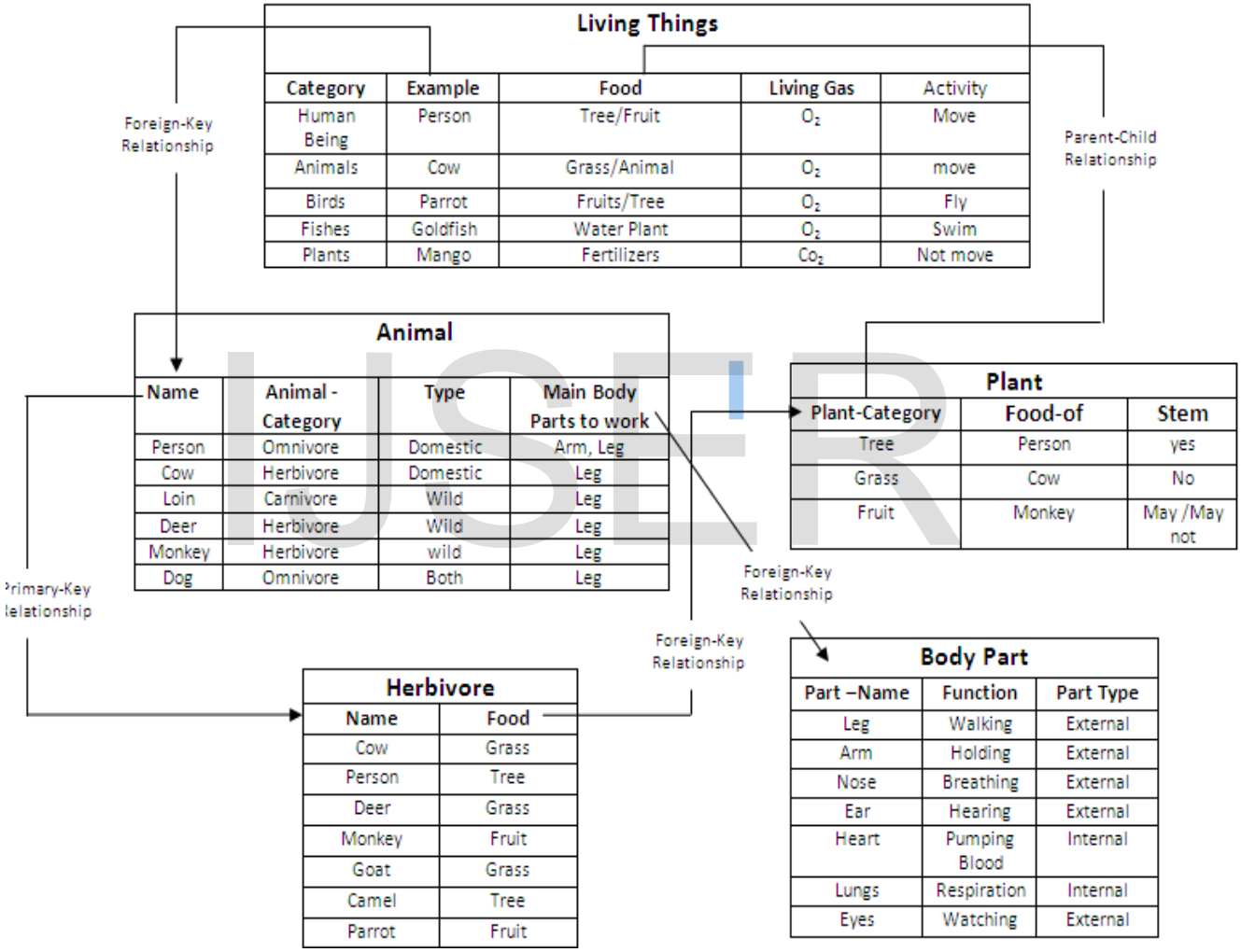

Figure3: Tables in Database and Relationships between Tables

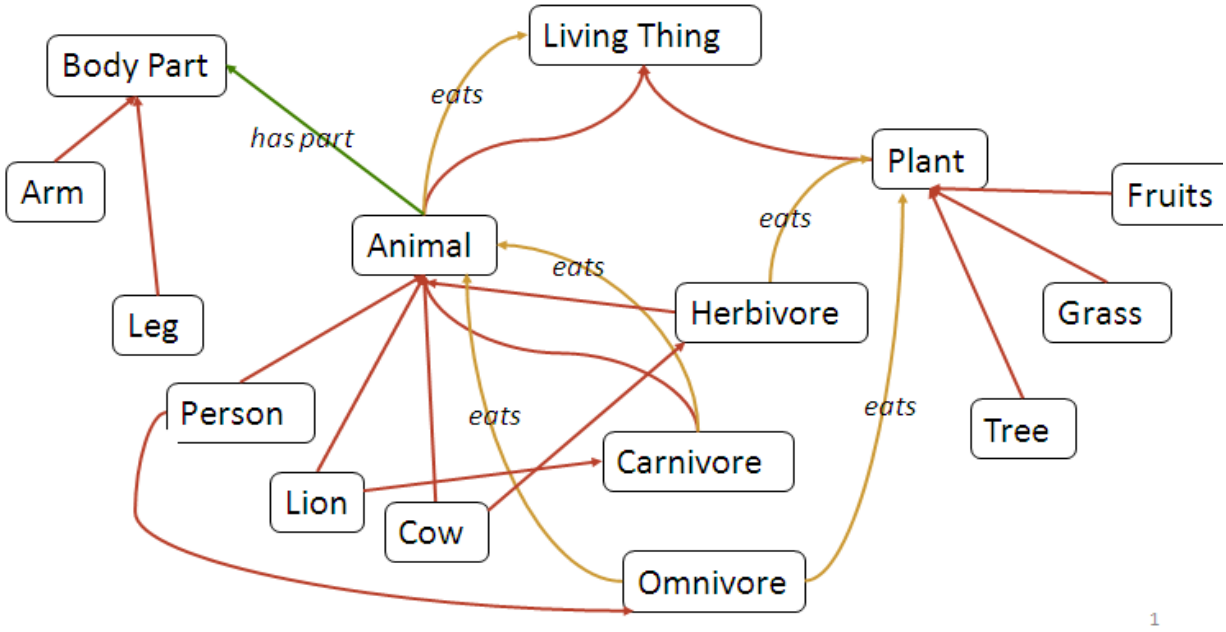

Figure 4: Database mapped into Ontology

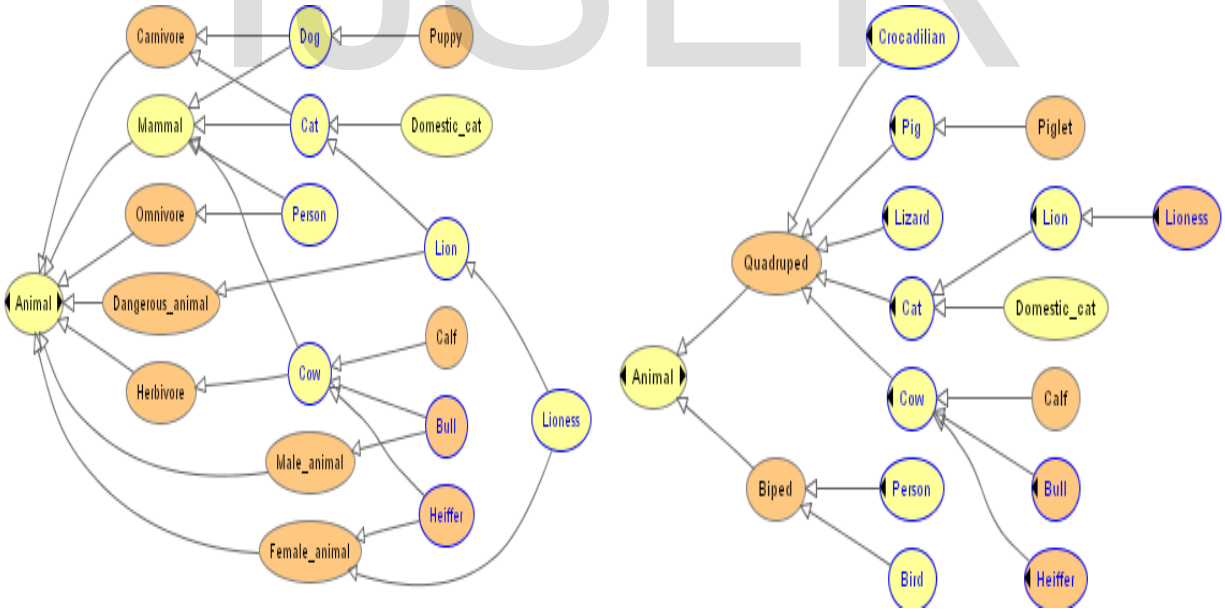

Figure 5: Website Structure Ontologies [8]

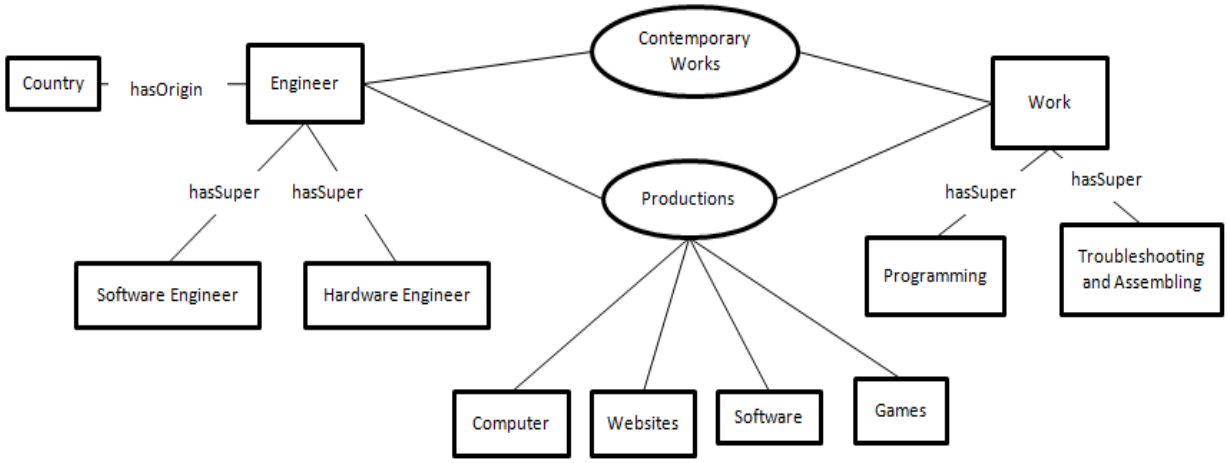

Figure 6.Ontological Data Model for a Web Portal

1 REFERENCES

[1]Ching-Long Yeh " Development of an Ontology-Based Portal for Digital Archive Services" http://www.iis.sinica.edu.tw/APEC02/Program/chingyeh.pdf, retrieved on 30 March, 2013.

[2] Yuhui Jin et.al. "OntoWebber: ModelDriven Ontology-Based Web Site Management", ftp://reports.stanford.edu/pub/gio/2001/Ontowebber01.pdf, Retrieved on 25 March 2013.

[3] Sidi Mohamed Benslimane et.al. "Extracting Personalized Ontology from Data-Intensive Web Application: an HTML Forms-Based Reverse Engineering Approach", International Journal of INFORMATICA,0868-495, pp. 511-534, December 2007.

[4] Robert paiano, Anna Lisa Guido " Semantic data integration: Overall Architecture" Communication of the IBIMA, 1943-7765, vol-8, pp.191-197,2009.

[5] Natalya Fridman Noy and Mark A. Musen, "PROMPT: Algorithm and Tool for Automated Ontology Merging and Alignment" American Association for Artificial Intelligence, 2000

[6] Christina Tziviskou, Macro Brambilla " Semantic Personalization Of Web Portal Contents" ACM 978-1-59593-654-7/07/0005, pp.1245-1246, 12 May 2007.

[7] Saeed M. Sedighi, Reza Javidan " Semantic query in relation database using a local ontology construction" AOSIS , pp.1-10, 31 October, 2012.

[8]Alan Rector et.al. "Ontology Design Patterns and Problems: Practical Ontology Engineering using Protégé-OWL" http://www.coode.org/resources/tutorials/iswc2005 , Retrieved on 22 March, 2013.