AN ONTOLOGY IN ORTHOPEDIC MEDICAL FIELD

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Abstract: At present time, Ontology is a powerful Knowledge Representation tool for Web Information Retrieval and Mining. In particular, lots of medical applications in the field of diagnosis and tele-health would take advantage of information sharing and publication on the Web with the use of Ontology. We are especially interested in the field of orthopedic pathologies of human march. There are several laboratories in the world working in this topic but they are not exploiting potential of the Web in theirs works, they are almost isolate in information management. We have already carried out mining in database from the Venezuelan *Hospital Ortopédico Infantil*, nevertheless, it is necessary to build an ontology in order to query and mine information from different laboratories in the world. We would like in the near future to apply fuzzy logic techniques and fuzzy querying over such information. In this paper, we present the building of an orthopedic medical ontology, to the best of our knowledge, has not been reported other in this specific field that we are interested on.

1 INTRODUCTION

Several investigations aiming at optimizing the handling of medical information so that it becomes both useful and agreeing with the user requirements, in the sense of extracting significant knowledge to be used in the detection and cure of diseases, have been reported.

In the sense of allowing both manipulation and access to medical information with the purpose of satisfying exigent user requirements, it is important to have computational tools to perform this. Currently, the relational database querying has answered to some extent these needs.

Queries could be improved using ontologies, since they are very useful to represent knowledge within a specific domain. This representation tool has desirable features, such us: re-usability, interoperability and formality. Therefore, there are many current researches in the area of knowledge representation and manipulation based on ontologies.

Ontologies have demonstrated to be very advantageous tools to formalize, maintain, reuse, share, generalize and communicate knowledge in a specific dominion. The ontologies provide a common vocabulary, in relation with an area of knowledge and define, at different formal levels, the meaning of the terms and relations among them (Valencia, 2005).

We are interested in querying medical information, in particular for orthopedics, employing SQLf, a fuzzy querying language (Goncalves & Tineo, 2006), (Bosc & Pivert, 1995). It obeys to the fact that fuzzy sets are powerful manners to represent user preferences, imperfect data and weak relationships. We would like our project to be not limited to a single database but capable of accessing information from diverse health centers.

We would like to build a fuzzy Ontology, based on knowledge, in the medical database of the March Laboratory at *Hospital Ortopédico Infantil* (HOI) in Caracas, Venezuela.

Nevertheless, before to obtaining this Fuzzy Ontology, it is necessary to build a classic ontology and subsequently convert it with fuzziness. There are a lot of mechanism to get this done but not all them it are useful to our proposal, so we need to

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study and apply some of these strategies that accord fit to our necessity.

This paper shows the process of making this (up to our knowledge very first) Ontology of knowledge about medical studies over patients with Orthopedic diseases in pathological walking.

2 SOURCE DATA BASE

Venezuelan March Laboratory at *Hospital Ortopédico Infantil* (HOI) is one of the biggest and most advanced laboratory for diagnostics, research and treatment of march pathologies in Latin America. HOI uses an advanced mediation system for both diagnostic and treatment of the illness related with the locomotive and neuromuscular system. This system allows to collect simultaneously both data and images in three dimensions, and after an adequate treatment. HOI also has a database that keeps tracks of all its patients' cases since 1997. For the purpose of this research work, HOI has provided a copy of this database with registers until December 2006 (Vasamon & León, 2007).

HOI database was developed in Ms.Access™. This database has the logic scheme show in Figure 1. Names in he scheme are in Spanish, because this is the Venezuelan current language. Semantics of tables is as follows:

Paciente. This table has basic information of patients. – *ID_paciente*, primary key code. – *Nombre*, given name. – *Apellido*, family name. – Sexo, gender. – *Fecha_Nac*, date of birth, – *Historia_HOI_I*, medical history identification number. – *ID-DIAGNOSTICO*, foreign key to the main diagnostics disease for the patient. – *Fundational/Privado*, indicates whereas the patients comes from a beneficial foundation or a private consultation. – *Lado, Tono, Lado 1, Tono 1*, indicators for the side leg (left/right) and a measure of muscular tone of this side. – *Nivel*, regarding to the level of the main disease in the patient.

Estudio. this contains information about studies performed to patients, some of the main columns are the following. – *Estudio_ID*, primary key code. – *Paciente_ID*, foreign key to the patient. – *Pre_Post*, indicates whereas the study is made as a requisite previous or posterior to a surgical intervention. – *Fecha_estudio*, date of the study, – *Master_Video*, number of the video register for the exam. – *Tipo_Estudio_ID*, foreign key to the study kind register. – *ID-DIAGNOSTICO*, foreign key to study's analysis resulting diagnostics disease.

Tipo_estudio. This part of the database gives identification and name of different kinds of studies.

Interpretador. This table gives identification and name of physicians that interpret studies.

Referente. Here give identification and name of physicians that reference patients and ordain studies for patients.

Referente 1. As the previous one, it gives identification and name of physicians that reference patients and ordain studies.

Diagnostico. This table gives identification and name of different diseases or pathologies diagnostics.

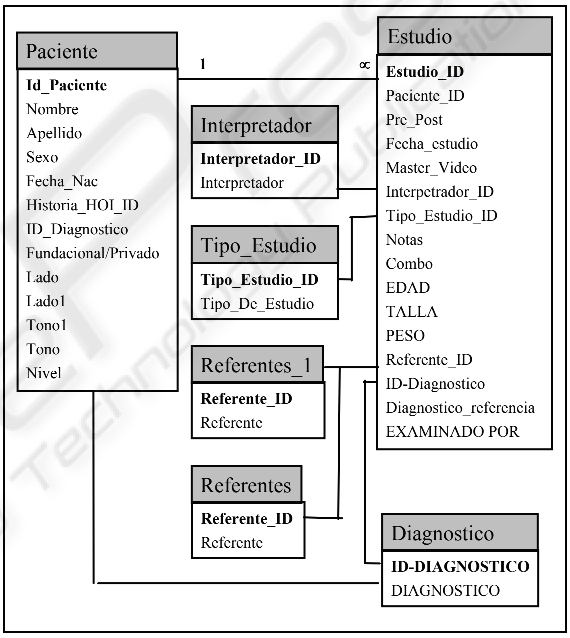

Figure 1: Logical schema of HOI Data Base.

3 BULDING THE ONTOLOGY

There are many definitions of ontologies, but the most accepted is the one given (Gruber, 1993) that states: "an ontology is an explicit, formal specification of a shared conceptualization of a domain of interest". However, since we are going to use the method described in (Men *et al*, 2005), we adopt the following definition:

An Ontological Structure O is a 5-tuple

$$O = \{C, R, H^c, rel, A^o\}$$

where C is a finite set of concepts; R is a finite set of relations; H^c is called concept hierarchy or taxonomy, which is a directed relation $H^c \subseteq C \times C$, for example, $H^c(C_1, C_2)$ specifies that C_1 is a subconcept of C_2; rel relates concepts non-taxonomically, for example, rel (R) = (C_1, C_2) specifies that C_1 and C_2 have relation R.; A^o is a set of axioms, which is expressed in an appropriate logical language, e.g. First Order Logic (FOL).

3.1 Language of Representation

Typically, an ontology can be generated from various data types such as textual data, dictionaries, knowledge-based semi structured schemata and relational schemata (Quan *et al*, 2006). However, in all those cases, the ontology can be represented with different languages, but the most commonly used today are XML, OWL and RDF. Because OWL is one of the most used languages in the field of ontologies and it is standardized by the W3C, it is going to be used to model the medical ontology that will use in this investigation. The following figure presents the evolution of the different languages employed to represent Ontologies.

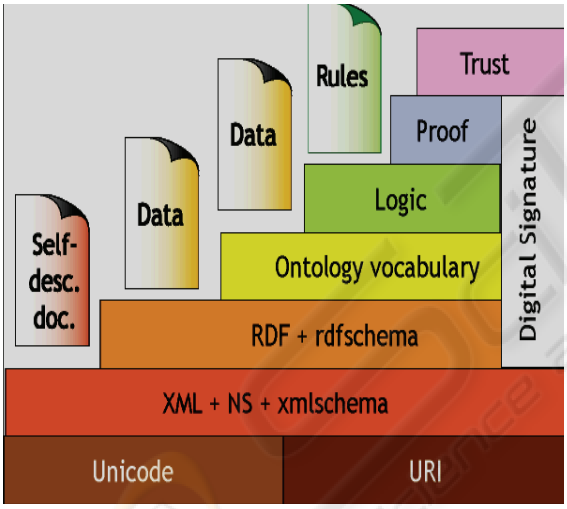

Figure 2: The architecture of Levels of T. Berners Lee.

3.2 Methodologies Building

In (Men *et al*, 2005), they propose an approach of learning an OWL ontology from data in a relational database. Compared with existing methods, the approach can acquire ontologies from relational databases automatically by using a group of learning rules instead of using a middle model. However, this proposal has the inconvenient that an ontology is created in OWL directly without an intermediate model, so if the database is poor in knowledge, then Ontology is poor too. Furthermore, it's important this intermediate model, that makes rich the learning produced, is important.

There are so many methodologies for learning ontologies (Garcia, 2005), but only few are helpful for our purpose. Among them, it is the so-called Methontology (Fernández *et al*, 1997 and Gómez-Pérez, 1998). This methodology guides the ontology building by specifying a set of intermediate representations (IRs) at the knowledge level. These IRs bridge the gap between how people think about a domain and the languages in which ontologies are formalized, that it allows us both to extend and enrich our ontology, previously generated with the HOI database. We sketch this methodology, followed by our study case, in Figure 3.

At the end, we will evaluate our ontology, generated by using quality assuring metrics, according to pervious work what is proposed in (Lozano, 2002).

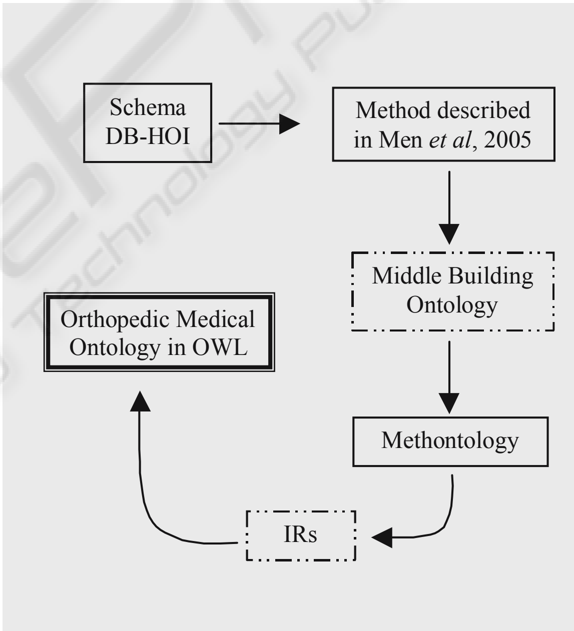

Figure 3: Model to building the Orthopedic Medical Ontology.

3.3 Editing and Browsing Tool

Instead of using the Methontology tool which supports the ontology maker during the entire life cycle of the ontology development process, called ODE (Ontology Design Environment); we prefered to use another environment to carried out this. The reason to do that was the fact that ODE has the inconvenient that it does not work with the OWL.

Because these reason of that, we are experimenting using Protege or OntoWeb with those two mechanisms to build our ontology instead. These tools are well known, free and with a profuse support.

4 CONCLUSIONS AND FUTURE WORKS

In this work we combine several methodologies in order to build an Ontology of knowledge regarding medical studies that have been performed over patients with Orthopedic diseases in pathological walking or march. The work has been undertaken on the basis of the Venezuelan *Hospital Ortopédico Infantil* (HOI) March Laboratory database. The result of this work would be an original contribution to the research for this kind of laboratories, because there is no precedent ontology in this field. Several institutions could take advantage of this as a support tool for the diagnosis and treatment of these diseases. This work would allow the publication and sharing of this kind of information for querying and mining purposes. In future works we will apply fuzzy logic tools for mining and querying medical information from march laboratories. In order to do so, we will extend such techniques with the use of Ontology. We hope to reach a benefit for humanity.

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