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Review on Medical Care Ontologies

Parminder Kaur[1], Aditya Khamparia[2]

[1]Student, Department of Computer Science, Lovely Professional University, Phagwara, Punjab (India) -144806

[2]Assistant Professor, Department of Computer Science, Lovely Professional University, Phagwara, Punjab (India) -144806

Abstract: ***Ontology is the philosophical study of the nature of being, becoming, existence, or reality, as well as the basic categories of being and their relations. Ontology is the study about what kinds of things exist, what entities are there in the universe .It is a shared and common understanding of some domain that can be communicated between people and application systems. Ontologies help us to build more powerful and interoperable information systems in health care. Ontologies help us to transmit, reuse, and share patient data. In this paper different Ontologies by different authors have been compared with respect to their tools, approaches used and features.***

Keywords: Ontology, protégé, medical ontology, OWL, tools

1. Introduction

An ontology formalizing organizational interrelations is a key component for building effective distributed knowledge-driven e-health systems in a real medical scenario. Medical errors are common, costly and preventable. They appear to occur in the setting of three major forces: Human/systems errors, information-seeking behavior, and clinical communication. It is possible to model this domain with an ontology that extends the concepts already contained in the UMLS. The ontology may provide a means of resolving coding disagreements, clarifying the role of communication in medical errors, development of a project database, targeting interventions, and promoting hypothesis-generation.

There is no common definition of the term "ontology" itself. The definitions can be categorized into roughly three groups: Ontology is a term in philosophy and its meaning is ``theory of existence" or Ontology is an explicit specification of conceptualization or Ontology is a body of knowledge describing some domain, typically common sense knowledge domain.[21] From definitions we are concluded that an ontology is for the AI community. Ontology is an inner body of knowledge, not as the way to describe the knowledge.

The paper has been structured as, apart from introduction in Section I, Section II covers a brief view of various ontologies, Section III covers the literature survey, Section IV is our observation and discussions on each of these medical ontologies, including various applicability features with different languages and tools on different platforms and finally paper has been concluded with Section V.

2. Overview On Ontologies

Ontology, is an analytic philosophy, concerns the determination whether some categories of being are fundamental and asks in what sense the items in those categories can be said to "be". [22] It is the inquiry into being in so much as it is being ("being qua being"), or into beings insofar as they exist—and not insofar as (for instance) particular facts can be obtained about them or particular properties belong to them.

Some philosophers, notably of the Platonic school, contend that all nouns (including abstract nouns) refer to existent entities. Other philosophers contend that nouns do not always name entities, but that some provide a kind of shorthand for reference to a collection of either objects or events. In this latter view, mind, instead of referring to an entity, refers to a collection of mental events experienced by a person; society refers to a collection of persons with some shared characteristics, and geometry refers to a collection of a specific kind of intellectual activity. Between these poles of realism and nominalism, stand a variety of other positions; but any ontology must give an account of which words refer to entities, which do not, why, and what categories result. As per the Principal questions of ontology include: "What can be said to exist?" "Into what categories, if any, can we sort existing things?" "What are the meanings of being?" "What are the various modes of being of entities?"

One common approach involves dividing the extant subjects and predicates into groups called categories. Such lists of categories differ widely from one another, and it is through the co-ordination of different categorical schemes that ontology relates to such fields as library science and artificial intelligence.

3. Types of Ontologies

- Domain Ontologies: Captures the knowledge for particular domain (e.g. medical)
- Metadata Ontologies: Provides a vocabulary for describing the content of on-line information.
- Generic ontologies: Captures general knowledge about time, space and event
- Representational Ontologies: Provide representational entities without stating what is represented
- Method Ontologies: Provide terms specific for particular tasks.

3.1 Protégé

Protégé is a free, open source ontology editor and a knowledge acquisition system. It also includes deductive classifiers to validate that models are consistent and to infer new information based on the analysis of ontology. Protégé

is an extensible, platform-independent environment for creating and editing ontologies and knowledge bases.

Features

a) Intuitive and easy-to-use graphical user interface.
b) Scalability: Protégé's database back-end loads frames only on demand and uses caching to free up memory when needed.
c) Extensible plug-in architecture: You can easily extend Protégé with plug-ins tailored for your domain and task. Some ideas for plug-ins are:

- Small user-interface components those are particularly well suited to displaying and acquiring values in your domain.
- Custom back-end plug-ins that use your own storage mechanisms.
- New applications intricately linked with a knowledge base as a Protégé tab.

4. Literature Review

Table 1: Comparative View of Medical Ontologies

Table 1 reveals different medical ontologies with their tools, languages, method name, model, and approach used, features, author name, reference and year.

Author Name [Reference]	*Ontology Name*	*Tools/ Languages*	*Method Name /Model/ Approach used*	*Features*
Jensen.et.al [2013][1]	The Neurological disease ontology	OWL2 and protégé 4.x	Foundational Model of Anatomy	• Disease caused by genetic or environmental reasons. • More than one drug treatment is possible for particular disease.
Bodenreider .et.al [2013][2]	Disease ontologies	UMLS (Unified Medical Language System)	based on a study of desiderata	• Providing coverage for the domain of diseases, disorders, illness etc. • As being a deviation from a healthy status and less frequently diagnostic criteria. • Cover the manifestations of conditions.
Satria.et.al [2012][3]	Building and reusing medical ontology for Tropical disease	Protégé 4.1 and OWL DLS	Ontology based approach	• Facilities the sharing and reuse of biomedical knowledge across heterogenous platforms. • New terminological, taxonomical hierarchy and medical data interrelationship were formulated. • Used in semantic based stastistical analysis of medical data.
Moawad.et.al [2012][4]	Viral Hepatitis	Protégé -OWL (Web ontology language)	OBR based (Biomedical Reality)	• Includes a variety of different viruses: hepatitis a, b, c and d viruses. • OBR is a recent framework for building biomedical ontologies to facilitate inference across the boundaries of anatomy ontology, pathology ontology etc.
Herdiani.et.al [2012][5]	Dengue Hemorrhagic Fever Ontology	OWL (Web Ontology language)	Development of life cycle method	• Interoperable platform for accessing information on the epidemiology of DHF on the website. • Information support on DHF control research and formulation of DHF control policy initiatives.
Alfonse.et.al [2012][6]	Liver Cancer Ontology	Protégé-OWL	Web based	• Find and locate information about liver cancer needed for interested users and domain experts. • Semantic representation of liver cancer information over the web. • Medical intervention – contains the staging, diagnosis and treatment classes.
Adams.et.al [2011][7]	The Primary Immunodeficiency Disease ontology	OWL and protégé	Foundational model of Anatomy	• Mendelian disease of low incidence, development maintenance and regulation of immune system. • Extensive hierarchy of biomarkers for the further classification of phenotypes. • Immunological knowledge across resources within a common framework.
Almeida.et.al [2011][8]	The Blood Ontology	Protégé-OWL	Based on the components of blood	• Well consolidated initiatives like gene ontology, cell type ontology pertaining to the OBO foundry framework. • Focuses on physiological aspects of blood. • Covering the issues related to the official documentation of interest to blood banks.
Mungall.et.al [2011][9]	Cross Product extensions of the Gene Ontology	OWL	Relational graph	• Results derived from gene ontology can be used to make cross ontology queries. • Providing structured annotations for genes and genes products, in terms of molecular function. • Automated reasoner tool to classify a kind of germ cell differentiation based on cl classification.
Schneider & Brochhausen [2011][10]	The Chronious ontology	OWL	Based on basic formal ontology	• Develop the integrated telemedical platform for monitoring the general health status of patients with chronic health conditions. • Provides decision support for the clinicians in treating patients.

Topalis.et.al [2011] [11]	A set of ontologies to drive tools for the control of vector –borne diseases	OBO foundry	Based on basic formal ontology	• The micro forms the core of the related database on insecticide resistance which was adopted for immediate use by the world health organization. • Micro is a pure application ontology that is being used to drive a dedicated database. • Cover all aspects of insecticide resistance with an emphasis on field work and monitoring.
Wennerberg.et.al[2009] [12]	Towards Context –Driven Modularization of Large Biomedical Ontologies	UMLs	Very large and complex models	• Support clinical applications such as medical image search. • Domain corpora helps in identifying the most relevant ontology that potentially yields the ontology modules that provide sufficient knowledge for the purposes for the software application. • Level of detail and the complexity of the medical knowledge determines the way how the modules should be identified.
Mizoguchi.et.al[2009][13]	An advanced clinical ontology	Hozo	Based on EAV triple	• Semantic interoperability of medical information. • Build a medical ontology which is ontologically sound. • P operator was introduced in the ontology building tool hozo. • More articulate generic structural/disorder components are introduced.
Daramola & Fatumo [2009] [14]	Developing ontology support for human control iniatitives	OWL protégé 3.4	Semantic based statistical analysis	• Provides interoperability support for the knowledge management. • Sharing and reuse of knowledge. • Readable by both man and machine as an ontology contains semantic description. • Researchers to stay abreast of current biomedical knowledge.
Denney.et.al [2009] [15]	Creating a translational medicine ontology	Biomarker	Data integration application based	• Provides a framework for the modeling of patient centric information, essential for tailoring drugs. • A patient centric application ontology developed between collaborative effort of industry and academic to highlight methodology and work to date. • Require traditionally separate datasets from early drug discovery through to patients in clinical setting be integrated, presented queried and analysed collectively data integration from diverse areas such as discovery research, track of, medications, track of doctors.
Bonevich.et.al[16]	Discovery of novel cancer genes through application of clinical metadata ontology	OWL (web ontology language)	Knowledge base framework	• Routine properties were collected like cancer type mutation status and tumor stage. • Controlled vocabulary was organized into a hierarchy called the compendia ontology. • Rule engine was created to iteratively apply analysis definitions to partition samples into distinct classes.
Mokkarala.et.al[2008][17]	Development of a comprehensive medical error ontology	Protégé-OWL	Integration based development	• Cause of MI (Myo Cardial) in farction was the wrong dosage of medicine due to verbal direction given by ICU cello. • Languages level heterogeneity i.e. avoiding translating in different languages. • Error occur while searching literature and identification of candidate ontology.
Wang.et.al [2005][18]	An ontology of Blood Pressure	Protégé OWL Plugin	Based on partition	• Designed for the architecture of world wide web especially for the semantic web. • OWL builds on rdf and rdf schema and adds more vocabulary to describe properties and classes. • User friendly interface which makes editing less confusing, time sufficient and energy savings.
Jovic.et.al [19]	Heart Failure	OWL (Web Ontology language) protégé	Based on the knowledge	• Precise, volominious, portable and Upgrade representation of heart failure domain. • Building knowledge based systems in the heart failure domain as well as unambiguous communication between professionals.
Pikatza.et.al [2004] [20]	Asthma	Protégé 2000	Profatn method	• CIG reduces ambiguities, assures the quality of medical care and improves patients education. • Provides recommendations for the physicians that helps them in the decision making process.

5. Observation & Discussion

Ontology design and its exploitation brought several benefits with regards to flexibility, adaptability and work efficiency from the end-user point of view; for the maintenance stage, two software tools are presented, aimed to address the incorporation and modification of healthcare units and the personalization of ontological profiles. A direct benefit of developing ontology is that the project members can now speak with one another about the concepts with “common

ground". Defining the concepts in the ontology also promotes the discovery of targets for interventions with informatics techniques. Since potential targets have formal definitions, hypotheses about how the targets might respond to intervention can be viewed in light of the target's relationships with other concepts in the ontology. The ontology also provides for careful inspection of the Clinical Communication Task's potential contribution to medical errors. It will allow the project members to resolve differences with regard to categorizing and coding data into a logical schema. None of the author till now has done review on medical ontologies on this topic.

Figure 1 shows percentage usage of different medical ontologies are disease ontologies is of 5% (Neurological, disease, tropical, primary immunodeficiency ,vector borne diseases), ontologies is of 7% (Gene Chronious, Large Biomedical ,Clinical ,Human Control, Medicine ,Medical Error Ontology), cancer is of 2% (Liver ,Novel Cancer), blood is of 2% (Blood, Blood Pressure), fever is of 2% (Dengue, Viral Hepattis), asthma is of 1%,heart failure is of 1%.

From detailed study of comparative view it has been observed that semantic based statistical analysis suggested by Daramola [14] facilities the reuse and sharing of information, whereas hybrid approach from Mokkarala [17] worked on protégé - OWL platform . Wang [18] based on partition; OWL builds rdf and rdf schema. Bonewich[16] Knowledge base framework method in which rule engine was created to iteratively apply analysis definitions to partition samples into distinct classes.

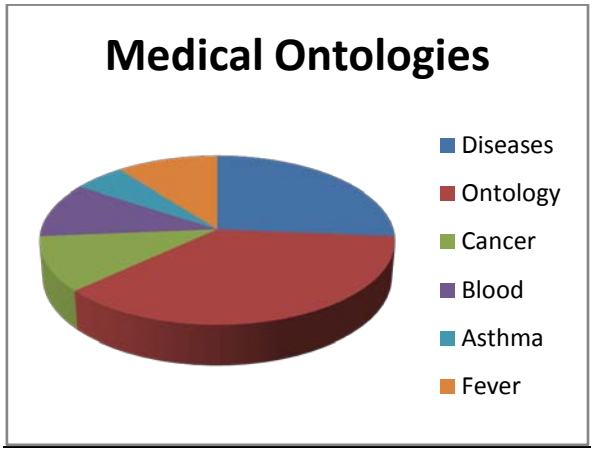

Figure 1: Comparison of medical ontologies

6. Conclusions

In this paper comparative study has been discussed keeping an overview of recent progress in different medical ontologies with their tools, languages, methods, models and their different features. Ontologies facilitates the adaptation in front of changes in the healthcare organization or Care Units, supports the creation of profile-based interaction models in a transparent and seamless way, and increases the reusability and generality of the developed software components.

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