도메인 온톨로지 구축에 관한 연구

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A Study on Comprehensive Domain Ontology Methodology

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Abstract

Ontology developing process has aroused a lot of controversy among knowledge engineers and knowledge users. The recent surges on ontology building methodologies and practical ontology applications have explored a broad spectrum of knowledge management challenges. On the one hand, the abundant methodology theories provide us with a set of useful heuristic rules, from which we get the overview of ontology building process. But on the other hand, every research groups would like to justify their theories by listing their specific characteristics and unique method when approaching the right way. However, there is still no one "correct" way or methodology for developing ontologies. In this case, the methods used to evaluate only a subset of specific domain do not make any sense to the commonsense users. As a result, a comprehensive understanding of domain ontology is urgent and necessary.

1. Introduction

Ontologies are a core element in the knowledge management architecture, its explicit specification of the terms in the domain and relations among them has been widely used for a computer understandable architecture----enable the people and the computer working together to achieve a more meaningful World-Wide Web.

Sharing common understanding of the structure of information among people or software agents is one of the driving forces for the development of ontologies. Often ontology is not a goal in itself, it defined a common vocabulary for researchers who need to share information in a domain, allows a common understanding which will contribute a lot to the reuse of certain knowledge.

The recent surge on ontology research, ranges from large taxonomy of categorized Web sites (such as on Yahoo!) to the classifications of individuals and their features in a certain domain (such as Wine ontology, food ontology).at the same time, ontology web languages and web applications for ontology standardization have been promoted and complemented in the last few years.

Many methodologies which guide the building process of ontologies have been proposed independently by different research groups. However, Most of them have in common that they start from the identification of the purpose of ontology and the need for domain knowledge acquisition, differ in their following steps to be taken. Each has its own characteristics but evaluates only a subset of the specific domain.

Ontology design is a creative process, not only for the rules: "There is no single correct ontology for any domain" [1], but also for no two

ontologies by different people would be the same. The potential methodology for guiding the building process and the designer's understanding and view of the domain will lead the design road and change the result. To this extent, the best solution for the variable alternatives when modeling a domain always depends on the application you use and the outcomes that the end users are expecting to get from the knowledge base.

Concerning different methodology-based ontology development, there is a great need for combining ontology development with capabilities for collaboration and getting a comprehensive sight of the entire work.

2. Related Works

Due to the fact that ontology engineering is still a relatively immature field, each research group suggests its own methodology to guide the building process of ontologies, each has its own characteristic and supported by certain applications.

In the following, we will give a brief overview of the mainstream methodologies.

2.1 Methodology Comparability

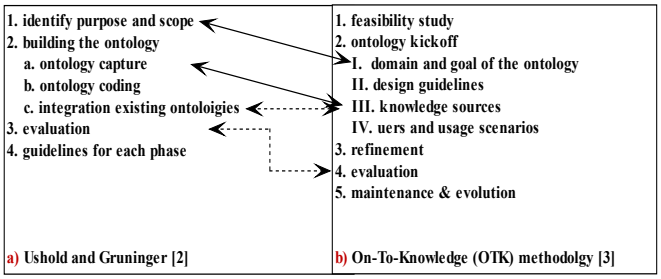

Figure 1. Relationships between phases of two methodologies

As a related work, we listed phases of two current prevailing methodologies, and compared some of the phases, which actually describe the same functionalities. Meanwhile, the variable alternatives in each process of these two methodologies verified the chaotic situation to be the most terrifying obstacle to ontology engineers.

"What type of methodology is uses to develop an ontology?"

"How can we avoid the chaos of choosing a methodology among so much candidates?"

"Why we need a methodology at all?"

We would like to emphasize the necessary of using a methodology by first look at some puzzles almost everyone might face up to. To get a reply, one might suggest you to look up the paper: Ontology Development 101--- the first standardized document with listed rules and descriptions. You might look it as a methodology and immediately doing your work according to the procedures as described. (In fact, it would better be classified as a set of useful heuristics rather than as a methodology. But in any case, it's a valuable resource especially for beginners). The theories in this paper enlighten on the importance of methodology in ontology field, make is easier for the reader to get on the right way to the iterative process.

2.2 On-To-Knowledge (OTK) Methodology [2]

It describes a methodology for application driven ontology development, covering the whole project lifecycle from the kick off phase to the maintenance phase. They put ontology development into a wider organizational context by performing a priori feasibility study, which is based on CommonKADS (cf.Schreiber et al., 1999). They modified certain aspect of CommonKADS for a tight integration of the feasibility study into their methodology.

The feasibility study offers a full analysis on the users and use cases scenarios; with a scoping and problem analysis study, comprised of two parts:

a. identifying problem/opportunity areas and potential solutions, and putting them into a wider organizational perspective;

b. deciding about economic, technical and project feasibility, in order to select the most promising focus area and target solution.

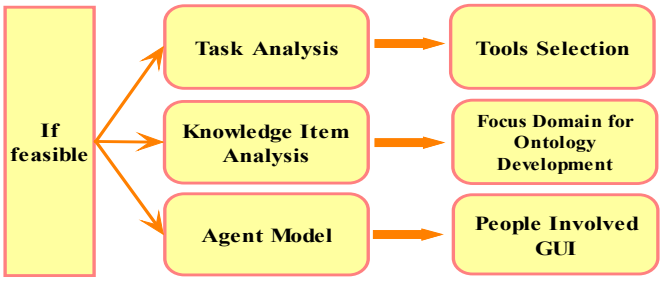

Figure 2. Feasibility Study Results

After these modified CommonKADS steps, the domain scope which goes through the feasibility study is supposed to be falling into 3 aspects of functions dealing with three levels of tasks, lead to the modified result as indicated in the shading in Figure 2.

The results as described above serve as input f

or the kick off phase, and begin the first stage of ontology development.

3. Towards the ontology development process

3.1 Preliminary Study

This paper are supposed to serve as a rough plan for the people who want to take advantage of ontology to integrate a more convenient, more comprehensible structure of widely spread information into a framework, in which all information will be organized, given well-defined meanings, even allow computers to understand, corporate and process the embedded knowledge. On the other hand, a meaningful output for end users.

Before entering into our endeavored work, we should have a distinctive idea in mind, that is, who is benefit from the methodology? Let us put forward our understanding by given out some case studies. Suppose a local museum want to classify and rebuild the catalogs in a more convenient way, so the task has been distributed, but who will be responsible for this job? In what aspect will the chosen domain suppose to facilitate specific end users? Here we give out a primitive description, which referred to as a model of our methodology.

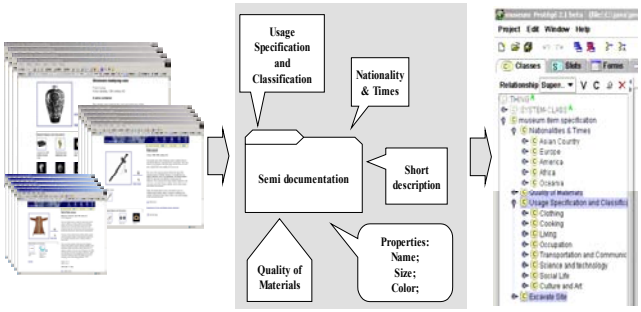

Figure 3. proposed methodology model in the case study

The definition of our proposed methodology is analogous to methods of Knowledge Based System. It does not begin from scratch, but it is a refinement cycle, adding the new aspects and perspectives of the systems and integrating the successful ingredients of previous methodologies.

We focus the preliminary study on two aspects:

Step1: Conceptualization. Elicitation task to obtain a first description of the problem and determination of user cases.

Step2: Analysis. The result will be the requirements specification of the intended domain field.

Figure 3 shows an initial information process model, through this case study model, we would like to explain the use of &Step 1 Conceptualization, and put forward the Analysis stage smoothly and sufficiently. The semi documentation in Figure 3 is something like retrieving the necessary information from media, and collecting a first description of the ontology domain, although it is far more completed. Other works to fulfill the specific usage of the intended ontology is left to &Step 2 to take responsibility of an overall analysis before ontology engineers begin to think about the hierarchy of ontologies like described in the latter half of Figure 3.

The use and user cases study has been introduced in most of the application driven methodologies, especially in the earliest stages of ontology development. The method of use case modeling determines the requirements of ontology, leave the results to be filled into three aspects of systematical analysis: task analysis, knowledge domain analysis and agent analysis.

The CommonKADS methodology [4] which serves for the development of Knowledge based system offers three models have the same function as described above, here only the extensions to CommonKADS are given.

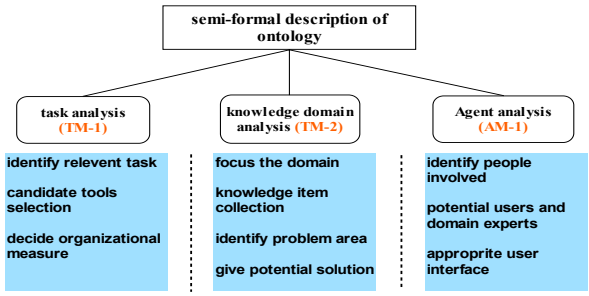

Figure 4. Modified CommonKADS steps

According to CommonKADS, task assignment should be performed in a fixed way, however, we take good use of the result from conceptualization stage to carry out a flexible task analysis, in the meanwhile, remains the restrict forms of the task model; we also enjoyed accepting the agent model as an executor of a task as well as integrating other two CommonKADS2. 2 On-To-Knowledge (OTK) Methodology [2]

3.2 Architecture Design

With the semi-formal description of ontology, knowledge engineers are about to provider a structure, which is suitable for both the developing process and the maintenance afterwards. Here, the general architecture design is

subdivided into two levels.

1) Knowledge level: Several design decisions should be taken regarding the management of ontologies:

a) Domain of the ontology. The ontology engineer may use the outcomes of the task analysis to describe the domain of the ontology, specify the particular domain in use.

b) Guidelines for Design. We must make clear how the key concepts and relationships should be acquired, it should not only involving brainstorming techniques, but also containing capture vocabularies from competency questions, reuse of existing ontology to collect a first hand script of class hierarchies.

c) Supported Application. The domain expert may take advantage of outcomes from the candidate tools study, which is part of the TM-1, to get a clear picture about which applications fit the proposed domain and give the proper interface to the potential users.

2) Coordination level: on this level, we will focus on the precious agent analysis (AM-1) in order to clarify the user and user case study.

Lists of potential users and description of each usage scenario should be reported from the real experience: In what situation did they wish such an ontology? How did they proceed without it? Each individual user gets a point of view of his scenario, which will finally be reflected on the building process of ontology.

As for human agents, who are likely to be potential domain experts and might be a valuable resource at the stage of refinement phase of ontology development. Human agents might also be users of the system, and therefore might indicate a need for appropriate user interface.

The result of our case study covered in this architecture design integrating the semi document of Step 1 with all the analysis result and form a formalized domain ontology specification.

Domain Ontology requirements specification
Domain: Museum Collections Made-by: Haitao Liu Purpose: Ontology about museum collections to be used as a deposited metadata to facilitate certain searches on the museum website, provide users with meaningful result, share the local information, e.g. Ontology Scope: a list of 209 elements, containing 5 direct subclasses: *Properties, Nationalities & Times, Qualities of Materials, Usage Specification and Classification, Excavate Site; properties of elements, such as possession-by, has-color, excavate-year, special-symbols;* Source of Knowledge that being reused: the current hierarchical catalogues used by *South Korea Central Museum.*

Table 1. Requirements Specification

3.3 Evaluation and Refinements

Evaluation means to carry out a technical judgment of the ontologies: Check out the gaps among existing class elements, detect misconceptions and gather user's satisfaction, the outcome of these efforts might be necessary to help the knowledge engineer to correct his previous work, and begin the update/insert/delete circle.

According to the case study, some of the instances can be presented to justify our methodology. Suppose there are some new items should be added to the knowledge base, a matching between the fundamental information and ontology is described as the following:

Ontology Slot / *Item Description*	*Slot Name*	*Type*
Name	**Name**	**String**
size	**Size**	**Symbol**={small, medium, large}
shape	**Shape**	**Symbol**={round, ellipse,…,}
Earthenware	**MadeOf**	Instance of **Quality of Materials**
Belongs to Tang Dynasty	**Times**	Instance of **Time & Period**
Excavation Site: China, ShangDong Province	**Nationality & Times**	Instance of **Country**
Short Description	**Description**	**String**

Matching with Ontology metadata

Through this table, we classified original item into the ontology scope by identifying typical description, and then matching with ontology slot. This process seems easy to achieve due to varieties of ontology edit tools, however, the satisfactory of the proposed ontology structure to fulfill the user requirement is depending on the original structure set by ontology engineer. So the instance here plays a role in evaluating the feasibility of ontology structure.

4. Conclusion

Through our proposed methodology, we have suggested some improvement derived from our delicate work on existing methodologies studies. We hope to find out a right way for our future research, especially on the integration and evolution of ontologies.

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