Proposal of New Approach for Ontology Modularization

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Ontologies have established themselves as a powerful tool to enable knowledge sharing, and a growing number of applications have benefited from the use of ontologies as a means to achieve semantic interoperability among heterogeneous, distributed systems [1]. With the evolution of cooperative and distributed systems, and the emergence of the semantic Web, ontologies have become an indispensable resource. The number of ontologies available on the Web has also increased due to the appearance of several tools that assist users in creating their ontologies. This has posed problems of understanding and reuse of those resources already difficult to design. A solution was then proposed by the knowledge engineers namely *modularization*. Ontology modularization is crucial to support knowledge reuse on the ever increasing semantic Web [2]. However, modularization methods that serve the reuse goal are often intended for humans to assist them in building new ontologies, rather than for applications that need only a relevant part of an existing ontology. Moreover, modules obtained are always subject to verification and maintenance by humans to validate the semantic consistency of their contents. Unlike previous studies, we investigate in this paper how a modularization based on semantic comparison, may provide a module directly reusable by the application that requests it. Our contribution is twofold. On the one hand, it allows an application to extract and use a module that covers a subdomain from an ontology that covers a wider knowledge area, regardless of its structure and the formalism with which it is expressed. On the other hand, the user is relieved from manually estimating the meaning of the components of the ontology, after the modularization process.

The modularization approach we propose is part of the decomposition approaches of monolithic ontologies [3,4]. It is an *extraction method* since it aims to extract a relevant ontology module. The method should allow the user to express its needs by entering the concepts which interest him. The result is a fragment composed of concepts and relations that are relevant to the module i.e., which are *in strong semantic relationship* with the concepts submitted by the user. We define a *strong semantic relationship* between two concepts, as one of the six logic functions as follows:

- *Identity relationship*: it is a semantic relation between two concepts that have the same syntax, the same attributes and operations. Example: Identity (Person, Person).
- *Synonymy relationship*: it is a semantic relation between two concepts that express the same meaning. Example: Synonymy (Person, Individual).
- *Classification Is-a relationship*: two concepts where one is expressing a particular case of the other. Example: Is-a (Student, Person).
- *Homonymy relationship*: the same concept can have two different meanings. Example: Homonymy (Bug, Bug). The first one means an insect. The second one means a fault in a computer system.
- *Equivalence relationship*: a semantic relationship between two concepts that play the same role. Example: Equivalence (Teacher, Professor).
- *Antonymy relationship*: is used between two concepts totally disjoint. Example: Antonymy (Registered, Visitor).

For example, in an ontology that describes the human anatomy, the user is only interested in the anatomy of the foot. The method should extract a coherent module, semantically rich on the foot, from the ontology of departure.

Our approach is based on two basic steps:

- *1st step*: Identifying concepts that are in strong semantic relationship with external concepts.
- *2nd step*: composition of the module based on the concepts identified in Step 1. All concepts that appear in the definition of the concepts identified are considered part of the module.

The goal is to allow a program to extract automatically a single part of an ontology without human intervention and without restrictions on the ontology structure. This will help programs to satisfy their requirements by reusing directly ontology portions.

References

1. Chainbi, W.: An Ontology Based Multi-Agent System Conceptual Model, In Special Issue of the International Journal of Computer Applications in Technology, Inderscience Publishers, Vol. 31, Nos. 1/2, pp. 35-44, (2008)
2. Cuenca Grau,B., Horrocks, I., Kazakov, Y., Sattler, U.: Just the Right Amount: Extracting Modules from Ontologies. In International World Wide Web conference, (2007)
3. Seidenberg, J.: Web Ontology Segmentation: Extraction, Transformation, Evaluation. In Heiner Stuckenschmidt, Christine Parent, Stefano Spaccapietra (Eds.), Modular Ontologies concepts, Theories and Techniques for Knowledge Modularization, Springer-Verlag Berlin, Heidelberg, LNCS 5445, pages 211-243, (2009)
4. Stuckenschmidt, H., Klein, M.: Strutured-based Partitioning of large concept hierarchies. In Proceedings of the 3rd International Semantic Web Conference, (2004)