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Ontology Modelling of Industry Standards for Large Model Visualization and Design Review using Protégé

Jorge Posada, Carlos Toro – VICOMTECH –Spain {jposada,ctoro @vicomtech.es}
Stefan Wundrak, André Stork – Fraunhofer IGD – Germany {stefan.wundrak, andre.stork @igd.fhg.de}

Extended Abstract

Keywords: ontology-driven software development, Large Model Visualization, STEP Standard

1. Introduction.

A 3D model of an Industrial Plant typically has representations of pre-defined engineering parts. These elements are described by an ISO standard (STEP-10303-227 **[STEP01]**) in the domain of Plant Design. The Application protocol 227 describes the specifics for plant spatial configuration. We integrated a module to explicitly associate this semantics to the geometric parts from a CAD reconstruction. Our design review walkthrough system for Plant Design uses semantic compression added to simplification techniques of the geometrical data to increase the efficiency and complement the traditional Computer Graphics methods in the field. The architecture of our system can be seen in figure 1.

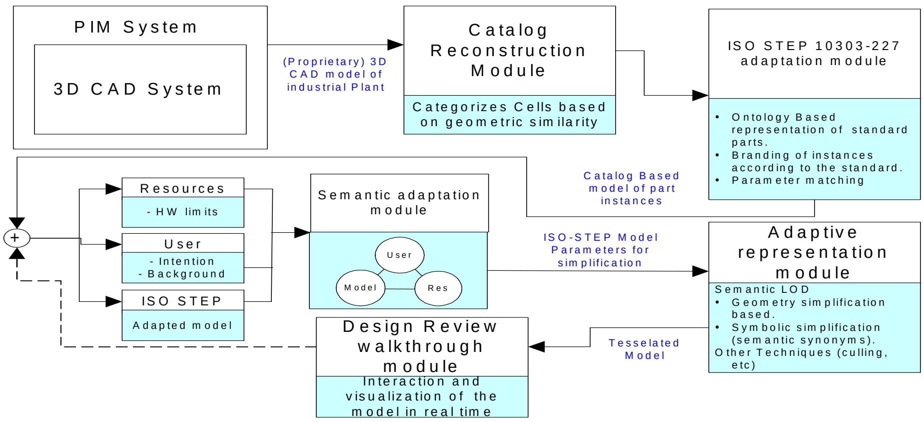

Figure 1: Our semantic walkthrough architecture

2. Motivation for an Ontology Support.

We have modeled a full ontology related to the ISO-STEP standard because our ultimate objective is to have a system where the concepts and relationships of the domain could be modeled and queried using semantic criteria **[BOR97]**, beyond the mere data modeling structures of the norm. This ontology modeling also allows a more transparent interrogation of the user task/profile, which can also be modeled as ontologies. The main reason to use this approach is related to the fact that STEP is only a data exchange format, but our requirements for semantic simplification required higher capabilities to express relationships and concepts.

3. Construction of the Ontologies

The ontologies are modelled using Protégé 2000, adapting the tags and relationships (to be more suitable for a knowledge representation model) presented in the ISO STEP-10303-227 standard**.** This serves as an important contribution to the model part of the semantic triangle described in **[POS04]**. The current ontology of the domain model has a total of 298 classes, 143 slots and 451 frames, and currently represents the 60% of the ISO application protocol 227. For the User and Task parts of the semantic triangle, we based our implementation in similar concepts implemented by our group in the European Project WIDE (IST-2001-34417).

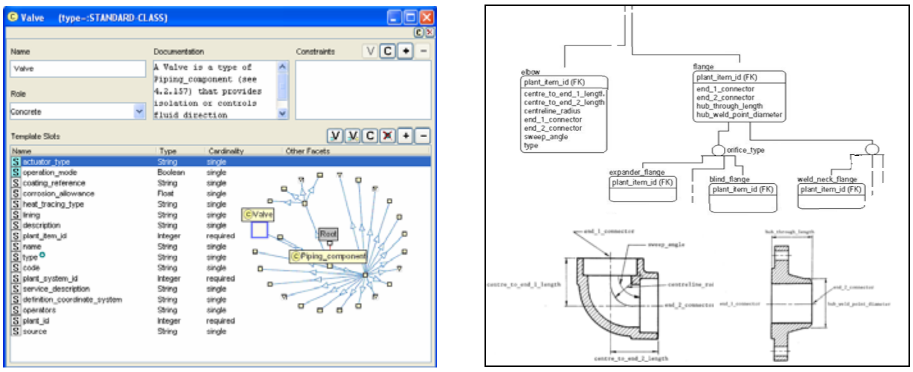

Figure 2: (Left) Model STEP Compliant Ontology modelled in protégé (Right) STEP excerpt

By giving a user task/profile (manager, engineer, etc) the available computer resources and the model (three ontologies) we query them in order to select an adaptive representation of the model. The model ontology is filled with the real parameters of the CAD model (this is an automatic process using an OWL/RDF API), and then a semantic association followed by a semantic adaptation allows the visualization enhancement by producing an output that has embedded juts the needed information for each user/task profile and available computer resources.

3. Results.

Using an ontology driven approach, the categorization of the instances of engineering elements described by the STEP Standard is more intuitive. The representation via an ontology allows the visualization of parts with a simplified approach. This approach depends on the user task/intention, the resources and the model itself. In figure 3 a valve can be seen in both representations (complete and semantically simplified for a trained engineer user). In table 1, the effect of the semantic compression for some parts in a Chemical Plant Model is presented.

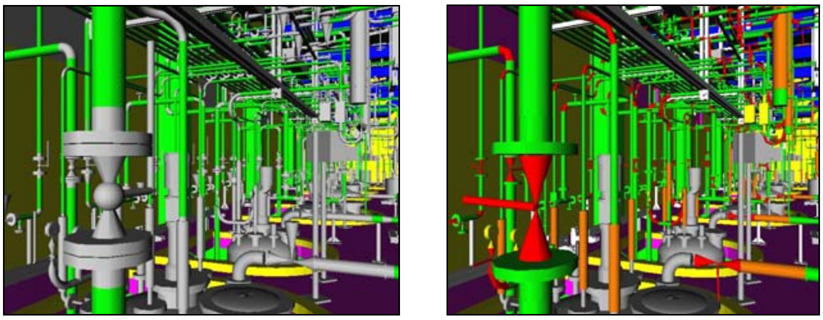

Figure 3: (Left) A view with geometric LODs (Right) The same view with semantic compression representations (in red).

Component / # tris	**ISO –STEP Valve**	**ISO –STEP Elbow**	**ISO -STEP Flange**	**Piping Clamp**
# of tris (pure geometric, high quality tess complex = 1.0)	48710	6080	5888	19378
Pure Geometric LOD. # of tris (not semantically compressed).Complexity = 0.3	1302	204	121	594
Semantic compression representation # of tris. *Engineer, Pentium IV, GForce4 , 512MB RAM*	100	32	80	0
Ratio semantic rep. vs. geometric LOD	7.68 %	15.6 %	66.1 %	0

Table 1. Effect of semantic compression for some parts in a Chemical Plant model.

References

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[STEP01] International Standard ISO 10303, Industrial Application Systems and Integration – Product Data Representation, Application protocol 227, Plant Spatial Configuration., First edition, Geneva, Switzerland 2001.

Authors Information and Affiliations.

Jorge Posada[1], Carlos Toro[1],
Stefan Wundrak[2], André Stork[2]

[1] VICOMtech Research Centre, Mikeletegi Pasealekua 57
20009 Donostia, Spain ,{jposada, ctoro} @vicomtech.es
http://www.vicomtech.es

[2] Fraunhofer Institute for Computer Graphics, Franhofer Strasse 5
20009 Darmstadt, Germany, {andre.stork, stefan.wundrak} @igd.fhg.de
http://www.igd.fhg.de/igd-a2

Contact Author:
Carlos Toro
ctoro@vicomtech.es