Practical experiences towards generic resource navigation and visualization

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Abstract. The Star Resource Navigator is an ontology based tool to visualize, navigate and search web distributed RDF resources. Resources and their connections are graphically represented as a star connected graph with labels indicating the existing relations. The Navigator has been tested in different application domains, coded by means of different ontologies. Because of its intuitive and easy to use interface, the system is oriented to end-users who are not Semantic Web experts. After a brief analysis of existing tools and techniques to visualize RDF structures, the paper describes the Star Resource Navigator, as an example of intuitive environment for resource navigation and visualization.

1 Introduction

In the Semantic Web context, a number of specifications to express content semantics, including RDF, OWL, Topic Maps, etc has been defined. While the process of marking content with metadata can be accomplished by using these formal languages, a remaining important issue is how to visualize this information. The crucial point is to transform abstract information structures into a visual form enabling the viewer to observe, navigate, understand and interact with the information. A solution to this problem is the application of information visualization techniques to the Semantic Web. Since the Semantic Web architecture is a complex and multi-layered building, its visualization may vary according to the type and nature of information to be graphically represented [3]. Different strategies have to be applied to visualize topic maps, ontologies, RDF schemas, RDF resources, XML or SVG documents. The interest of this research work is mainly on RDF resource visualization, navigation, and retrieval.

This paper starts with a brief analysis of existing tools and techniques to visualize RDF structures. It then describes the Star Resource Navigator, as an example of intuitive and easy to use environment for resource navigation and visualization. In the conclusions it remarks the strong points of the system and provides directions for future developments.

2 The issue of visualizing RDF resources

Semantic Web resources can be rigorously described thanks to a number of formal languages; this allows a network of information and meta-information to be defined and used for inference by automatic tools. However the human user cannot rely only on these formal definitions; he/she needs a graphical representation to understand resources and their relations. In order to meet this need different solutions have been proposed for ontology and RDF data visualization. Some of them are provided within RDF or ontology editing tools. Here is a list of the most relevant:

- RDFSViz, a visualization service for ontologies represented in RDF schema (http://www.dfki.uni-kl.de/frodo/RDFSViz/);
- OntoViz, a highly configurable ontology visualization tool integrated in Protégé (http://protege.stanford.edu/plugins/ontoviz/ontoviz.html);
- IsaViz, a flexible tool for RDF graph visualization, with a number of functions for zooming, editing, searching and browsing the graph structure (http://www.w3.org/2001/11/IsaViz/);
- RDF Gravity (http://semweb.salzburgresearch.at/apps/rdf-gravity/user_doc.html), a tool for visualizing and navigating directed graphs built in RDF and OWL, with the possibility to zoom, search, filter out and visualize specific parts of RDF graphs;
- GVis [2], a general purpose, flexible and highly customizable graph visualization tool is, used in the context of the Hera project for visualizing large RDF graphs;
- Cluster Map [3], a key component of the Spectacle system, used for the visualization of ontological data, with a very expressive and configurable interface.

The previously listed tools propose interesting solutions to represent ontologies and RDF data; although some of them have a very intuitive graphical interface (e.g. RDF Gravity) they require knowledge of the main Semantic Web concepts: ontology, class, properties, instance, literal, etc.

Another group of visualization techniques aims to visualize RDF instances or resources to end-users who are not Semantic Web experts. RDF resources are based on formal structures like ontologies or schemas, which are part of the system, but made transparent to the user.

The FOAFNAUT system, for instance, (http://www.foafnaut.org/) belongs to this group. The system shows a graphically navigable network of persons who know each other. If a person is selected, the node is expanded and the connected resources are shown around, without erasing the details of the already visited resources. This system is based on the FOAF (Friend-of-a-friend) vocabulary that allows the expression of personal information and relationships creating a social network of persons (http://www.foaf-project.org).

The Star Resource Navigator, presented hereafter, is another example of system in this category; it is an ontology based system for navigating and retrieving RDF resources oriented to end-users who are not Semantic Web experts.

3 The Star Resource Navigator

The Star Resource Navigator project was undertaken at the Department of Innovative Technology of the Applied Sciences University of Southern Switzerland (SUPSI-DTI), with the objective of providing a generic tool for RDF resource visualization, navigation and retrieval. The resources are usually spatially distributed and identified by URI. The system is based on the PeC Navigator [4], developed to provide a graphic visualization of people, groups and competencies within the SUPSI domain.

The Star Resource Navigator main distinctive feature with respect to the PeC Navigator, is to be not constrained to a specific application domain. Different domains have been used to test its capabilities: the initial SUPSI domain, the e-learning domain for the description of competencies and learning content [1], the pet domain for the description of people and animals. In addition, experiments in the cultural heritage domain are currently in progress. Each domain structure is coded in a specific ontology:

- the PeC ontology for the SUPSI application domain,
- the competence ontology used in the learning domain.
- the pet ontology adapted from [http://ideagraph.net/xmlns/pets/hedwig.xml] for the pet domain.

The Star Resource Navigator three-tier architecture guarantees independence among content, logic and presentation. This separation allows independence from the application domain.

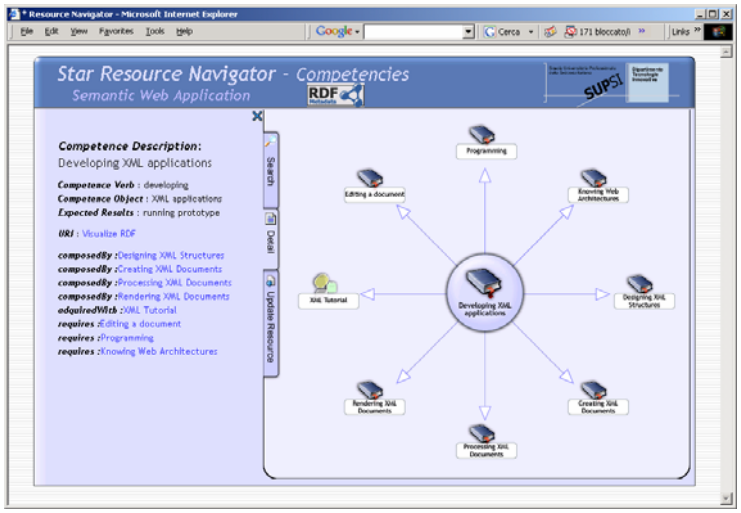

Fig. 1. The Star Resource Navigator graph for the learning domain. This figure shows a competence, its related competencies and didactic material

As in the original PeC Navigator, the Star Resource Navigator approach for presenting resources and their connections takes inspiration from the FOAFNAUT interface model. However, the Star Navigator is not limited to a specific vocabulary. Resources and their connections are graphically represented as a star connected graph whose centre is the currently selected node, surrounded by the related resources (see Fig. 1 for the learning domain and Fig. 2 for the pet domain). In the graphical representation different resource types, as identified by ontology classes, are shown using different icons.

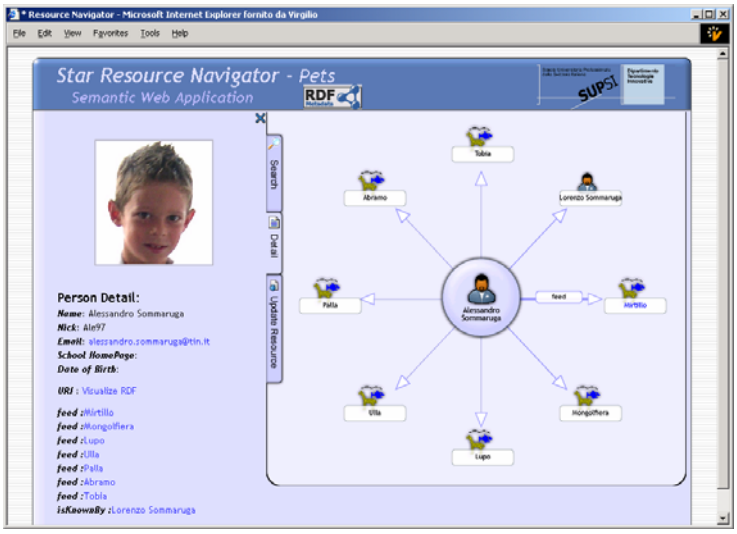

Fig. 2. The Star Resource Navigator graph for the pet domain. This figure shows a person resource in the centre of the graph, surrounded by another person resource, that he knows, and several pet resources that he feeds

If the user selects a new resource, the selected node smoothly moves to the centre of the graph and its details are shown in the left panel of the window. For instance by selecting the cat resource in Fig. 2, the chosen node moves to the centre of the graph (see Fig. 3).

Another interesting feature is the search capability (see Fig. 4). The search is activated by specifying a search string in the input textbox “search”, and indicating which resource type to retrieve. All resources matching the search string are listed. The user may select a specific resource and see the resource details by using the “Expand” button. This simple search mechanism could be enriched with a more sophisticated mechanism that allows inferences to be made on the RDF resources.

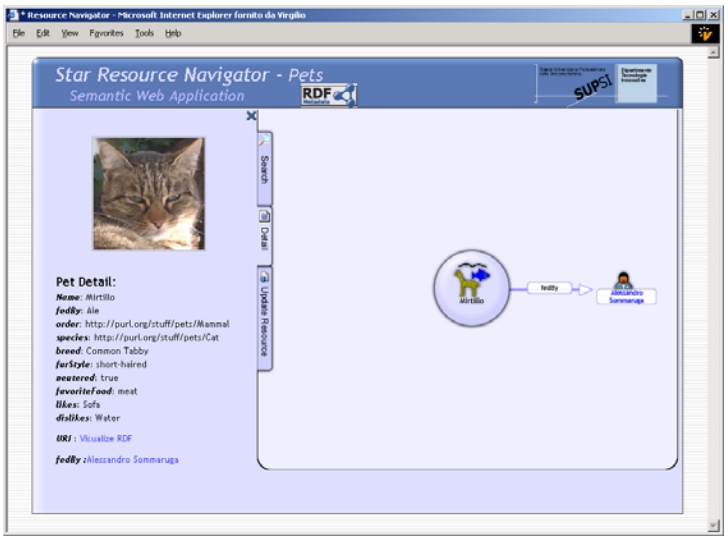

Fig. 3. Resource detail in the pet domain. This figure shows a pet resource and the related person who feeds it

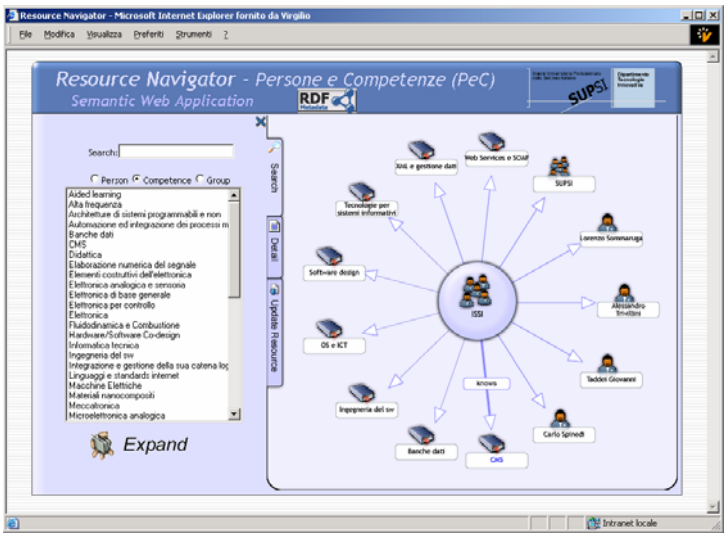

Fig. 4. Searching in the Star Resource Navigator. The figure shows in the search panel all the resource instances in the SUPSI domain corresponding to the selected type (Competence)

4 Conclusion

The Star Resource Navigator is an ontology based tool to visualize, navigate and search web distributed RDF resources. It is a tool for visualizing RDF instances and how they are interconnected, and not a tool for ontology visualization. Thanks to its intuitive interface, it is intended for end-users who are not experts of Semantic Web concepts.

A first conclusion that is emerged from these experiments is that reaching a complete generality is a very complex task; in fact it requires that the system is able to interpret any ontology, any resource description, and the graphical interface adapts itself to the domain features (for instance different icons are used for different resource types). An initial configuration phase is required to specify domain dependent features.

Another topic, which is currently under consideration, deals with the graph design. The choice of showing only one resource and the directly connected resources avoids information overload, and is effective to visualize graphs where the number of resources connected to the central node is low. When this number increases, it could be useful to apply a filter to show only nodes connected by specified relations, as tested in the ongoing cultural heritage domain prototype.

The conclusion drawn from this experience is that the choice of how Web resources should be visualized and navigated depends on different parameters: the amount of data to present, which information is interesting to visualize, the end-user profile, the task to be accomplished, etc. Different approaches may be appropriate for different purposes. For users who are Semantic Web experts a tool for ontology and RDF data visualization could be the best choice; for a person who is not Semantic Web aware the Star Navigation approach could be simpler and more intuitive.

References

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