A Semantic Navigation Framework for automatic presentation of ExpertFinder information

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1 Introduction

The Web, but also for example a digital library, has an intricate topology that makes navigation through resources a tricky task. The mere introduction of Semantic Web technologies won't automatically solve this task, because the Semantic Web only promotes machine understandability of Web resources by explicitly providing a thick bunch of annotations, thus leaving their interpretation and use to the application.

We therefore propose a Navigation Conceptual Model and Semantic Navigation Engine that aim at helping Web surfers in traversing such an intricate hyper-environments, by giving them proper tools that can help them in getting oriented and fulfilling their aims. Our approach makes joint use of Web navigation studies and knowledge management methods. The result is an ontological model of navigation through and presentation of resources and an engine that is able to exploit the model's semantics.

Different and heterogeneous content sources can be mapped at the ontological level to our conceptual model and reach a seamless integration and a better presentation of contents. This approach also lets the Web designers make lever on the resources' semantics to more easily design navigational paths, by employing the meaning of the visualized resources to improve the effectiveness of the users' navigation.

Our approach therefore can be suitable to navigate through the resources described with metadata defined by the ExpertFinder ontological framework.

2 The SOIP-F approach

Today, one of the big challenges in the Knowledge Management field is the seamless integration of and access to resources coming from multiple and heterogeneous content sources. A solution must consider two kinds of problem: the integration problem, dealing with the merging, alignment and connection of information, and the navigation problem, regarding the proper presentation of resources in a hypertextual environment where users may get lost.

The *integration problem* can be solved by means of ontology-based integration approaches [1, 2], which employ the resources' semantics, expressed in the machine-readable form of ontologies, to drive the merging. We believe that the ExpertFinder initiative is aimed, among other things, at building an ontological framework to enable this kind of integration above the information and metadata already available about people, institutions, expertise and so on.

Our approach focuses on *the navigation problem* and makes joint use of Web navigation studies and knowledge management methods. In particular, we make use of the metaphor of the Web as a physical world [3,4], so surfing the web can be compared to a journey with a well defined destination. According to this metaphor, users traversing the Hyperspace need the sort of information which is normally required to traverse the physical space: this information is provided by presentation and navigational elements called *travel objects* [5]. Drawing our inspiration from the concept of travel objects, we designed an ontological model for surfing through resources, by collecting and formalizing the main aspects of users'

navigation. This ontological model captures the semantics of the way the contents should be organized and displayed; it is divided into three different parts:

- The *navigation model* regards the semantically-related links which provide hints about how to proceed when visualizing the information about a resource. We identified some primitives that should be considered and included in the model, such as the related, broader/narrower and part-of relations. In order to include those primitives, we decided to reuse shared ontologies such as the SKOS model [6].
- The *access model* conceptualizes the travel objects which help Web surfers to find their way through resource and contains building blocks to design guided tours, ordered lists of resources (such as "recently added" pages) and so on. The access model can be organized as an ordered tree where resources are connected with relations such as up/down and previous/next.
- The *presentation model* takes into account the composition, the order and the layout of different parts of information on the page. It comprises the travel objects blocks that can be used to visualize information.

Following the travel metaphor, we introduce the idea that Web users need vehicles to travel across resources. A *vehicle* is a navigation means that gives the Web traveler access to a specific view on the available knowledge. This view presents a subset of all the available information regarding the resource: if we divide all the knowledge about a particular item in travel objects, the atomic bunches of information, we can build a view by composing together these elementary "bricks". A view enables also the navigation from that resource to another one following hyperlinks and can suggest different paths to cross information.

In order to build a vehicle, we employ the semantics of the contents that we assumed conceptualized in a domain-specific ontology, such as the ExpertFinder framework. Then, our approach is to identify in the domain ontology the classes and properties that are relevant to be comprised and displayed in the navigational path and we *map* them to the primitives of our navigation, access and presentation ontologies. This can be performed by any ontology mapping approach [7]; a minimalist approach can be the employment of CONSTRUCT queries from SPARQL [8] to express simple (or even complex) mappings. The vehicle is therefore defined and described by any suitable set of mappings between the domain ontology and our proposed model.

Our approach is able produce different views on the same content, in order to consider different information needs and different navigation paths that lead the user to meet with that content. In fact, in different navigations, users follow different paths, either because they are looking for different information or because the task they need to achieve through navigation is more specific or more generic, so the granularity of the required information is narrower or broader. This can be easily achieved by defining multiple vehicles with different mapping between the two models.

The approach described above has been made concrete for several years by its reference implementation called SOIP-F (Semantic Organizational Information Portal Framework) [9][10]. SOIP-F is a framework that helps Web designers to build domain-specific portals on the basis of a domain knowledge base described by an ontology. It follows a MDA (Model-Driven Architecture) approach, in that it takes the navigation, access and presentation models as application ontology.

The SOIP-F approach aims at providing portal users with the most suitable information to fulfill their needs and to answer their questions. This can be accomplished because all resources are semantically annotated with machine-processable descriptions that can be exploited to design the portal pages.

To prove our approach we built some test-portals (see *http://seip.cefriel.it*) on top of our SOIP framework exploiting the navigation and presentation semantics we described.

A significant test-portal has been developed within the COCOON FP6 project [11,12], in order to help General Practitioners (GP) in accessing healthcare open access content. The COCOON infrastructure contains a Semantic Information Retrieval (SIR) service which supports GPs in searching and navigating medical contents in a semantic way. A SIR infrastructure has been set up in three European regions: Lombardy in Italy, Brussels in Belgium and Epirus in Greece and serves around 250 GP testers. SIR is made up by an instance of SOIP and by a commercial conceptual indexing engine. The documents are crawled from 59 open access journal, they are indexed using TeSSI ontology[5] and Dublin Core metadata

(i.e., title, authors, abstract, publication date, source, etc.) becoming available for semantic navigation through SOIP. A demonstrative version of SIR is available at *http://seip.cefriel.it/soip4cocoon/*.

3 Applications

Our approach supports the presentation and navigation of information described by an arbitrary ontology, without any assumption regarding the particular domain. In the context of ExpertFinder, this method can be used as a tool for interfacing the user with the data and the services described by the ExpertFinder ontological framework.

In particular, with regards to the ExpertFinder use cases, our approach and our reference implementation SOIP-F can be successfully employed in:

- The implementation of a Semantic CORDIS portal, because SOIP-F can be used to define different views on the information about projects, institutions, and so on
- The automatic generation of personal and institutional web pages, because SOIP-F can provide the user interface and the navigational paths to access this kind of data.

Since in the context of the ExpertFinder initiative, the integrated ontological framework represents the "domain ontology", we can also think about the possibility to enrich our reference conceptual model to include the ExpertFinder framework. For example, we could try to define some default vehicles that can be used across different use cases.

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