SEMPort – A Personalized Semantic Portal

Melike Şah, Wendy Hall, Nicholas M Gibbins, David C De Roure
School of Electronics and Computer Science, University of Southampton, Southampton, SO17 1BJ, UK
{ms305r,wh,nmg,dder}@ecs.soton.ac.uk

ABSTRACT
This paper presents an ontology-based semantic portal, SEMPort, which aims to support both content providers and the users of the portal during providing information, browsing and searching. The content is enriched with context-based semantic hyperlinks and personalized views. Distributed content editing/provision is supplied for the maintenance of the contents in real-time. As a case study, SEMPort is tested on the school's Course Modules Web Page (CMWP) and evaluated using this domain.

Categories and Subject Descriptors
H.5.4 **[Information Systems]**: Hypertext/Hypermedia – *architectures, navigation and user issues.*

General Terms
Design, Experimentation, Human Factors

Keywords
Personalization, reusability, semantic hyperlinks, semantic portals

1. INTRODUCTION
Ontologies are the backbone of semantic portals that are used for structuring, accessing, sharing and the presentation of knowledge. For the maintenance of semantic portals, content editing interfaces are used. For example, in KAON portal [2] newly added data can not be seen without restarting. In addition, semantic portals generally contain huge amount of data and the navigation is not very effective. Hyperlinks to similar pages are often not presented and user based adaptation is not provided. For example, the Rewerse portal [3] provides limited adaptation for end-users.

To address these problems, we propose an ontology-based semantic portal, SEMPort. In this paper, we extend the work we undertook in [1]. An adaptive engine is added for implicitly updating the user model. Parts of the personalization, semantic hyperlinks and content editing are extended. We evaluated SEMPort using the CMWP and this paper also presents the evaluation results.

2. A Case Study of SEMPort on CMWP

2.1 System Overview
The system architecture of SEMPort has been reported in [1]. We have extended this architecture with an adaptive engine. The adaptive engine is used to query and update user models explicitly and implicitly by tracking their browsing and using inferencing.

2.2 Adding Semantics to the CMWP
We annotated the CMWP using two ontologies; a part of the ECS ontology [4] which we call ECS_COURSE and ACM Computer Classification System (CCS) [5]. ECS_COURSE was used to annotate the CMWP. We extended ECS_COURSE with SKOS ontology [6]; ACM CCS was converted into RDF using SKOS ontology and used to annotate topics covered by the modules.

2.3 Ontology-based User Modeling
To provide personalization, we have developed a user ontology, which is named USER. USER is used to represent the background and the interests of the users as a set of concepts that have relationships to the domain model concepts. Personalization starts when the user is login to the portal; the explicitly obtained information from the user is added to the user model using USER. The users can explicitly update their profiles from the developed web interface (users can add/delete/change data). In addition, SEMPort allows addition of semantic bookmarks to the ACM CCS topics. During the browsing, users can add more interests into their profiles by adding bookmarks. Users can also associate different weights to the interested ACM CCS topics (low, medium, high). In addition, SEMPort can implicitly add interested ACM CSS topics into user profiles by tracking their browsing. Also, user profiles can be implicitly updated by using inferencing.

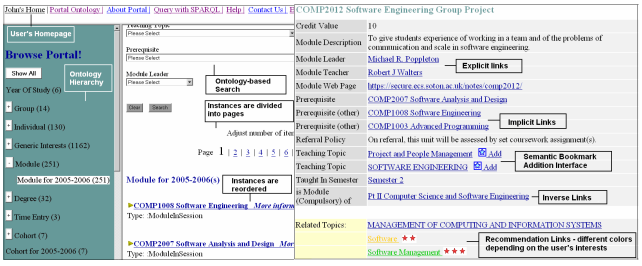

Figure 1. Semantic navigation. Left- A general view. Right - A detailed view

2.4 Functionalities of SEMPort

2.4.1 Semantic Navigation & Ontology-based Search
In SEMPort, the ontology hierarchy is used to supply browsing; users can access to instances of concepts from the ontology hierarchy as a general view (Figure 1, left). If the user is logged on to the SEMPort, the general view is personalized; instances are sorted. When a user clicks onto an instance, a detailed view is opened (Figure 1, right). The detailed view shows all information about a particular instance (all attributes and values), as well as displaying semantic hyperlinks. If the user is logged on to the SEMPort, the detailed view is personalized: related hyperlinks are annotated with visual cues. To facilitate information access, ontology-based search is integrated with the semantic navigation. Users can perform concept-specific searches during browsing.

2.4.2 Context-based Semantic Hyperlink Addition
To improve the navigation of the user, in SEMPort, semantic hyperlinks such as explicit, inverse, implicit and recommendation links are generated (Figure 1, right). Explicit links reveal relationships to directly associated resources defined by the ontology. Inverse links creates bi-directional links to the

HT'07, September 10–12, 2007, Manchester, United Kingdom.
ACM 978-1-59593-820-6/07/0009.

connected page. Implicit links uses rules to deduce new relations between concepts. Recommendation links provides links to related pages based on the covered ACM CCS topics. Semantic links are generated in combination of rules and SPARQL queries.

2.4.3 Personalization

In SEMPort to help users to locate related information, personalized views are provided. First, during the semantic navigation links are weighted ranked and sorted based on the interests of the user and the semantics between ACM CCS topics (Figure 1, left). Second, hyperlinks are annotated with different visual cues using the similarity of a link to the user profile (Figure 1, right). Third, personalized homepages are generated based on the background and interests of the users.

2.4.4 Content Editing/Provision Interface for CMWP

A distributed web interface is developed for the maintenance of the contents on the CMWP, which can be used by module leaders and the administrator (admin). Module leaders can update the contents of the modules; they can add/delete/change attributes (including inherited) and their values. To ease entering values to relationship attributes, valid instances are provided automatically, thus users are guided during the update. Multiple values can be added to the same attribute and multiple attributes can be deleted at the same time. All changes are saved to the KB; changes can be seen in run-time and consistency checking is presented. Admin can add/delete/change attributes on *any instance* in the same way. Also, admin can permanently delete instances from the KB.

3. EVALUATION

We carried out a two-phased experiment: First, we tested the navigation of CMWP and SEMPort. Second, the features of SEMPort were tested. In the tests, ten subjects were used who were PhD students of different research groups. None of the subjects had used SEMPort before and nine of them used CMWP before.

3.1 Experiment – Phase 1

In this phase, our aim is to compare the CMWP and SEMPort in terms of navigation. In the experiment, ten subjects were asked to carry out three different tasks using the CMWP and SEMPort. We randomly divided subjects into two groups; first group performed tasks firstly on the CMWP and the other on SEMPort. Then, groups were swapped. During the experiment, users were asked to write down correct answers and we measured the task completion times (no time limit was placed). Also, a questionnaire was used to identify thoughts to the navigation of CMWP and SEMPort.

The Results of Phase 1: For each subject, the total number of individual correct answers to each group of tasks was calculated and a score was generated. The results are illustrated in Figure 2, left. The results show that participants performed tasks better using SEMPort (98% correct) comparing to the CMWP (41% correct). Subjects found less number of answers using the CMWP. The main reason was the structure of the information on the CMWP; most of the subjects were either quit or used their background knowledge. In SEMPort, ontology hierarchy provided a good structure for accessing data. Also, subjects liked semantic links; they enabled them to complete tasks easily. Because most of the subjects were quit, task completion times were faster on the CMWP (Figure 2, right), despite the fact that the found correct answers using the CMWP was lower compared to SEMPort.

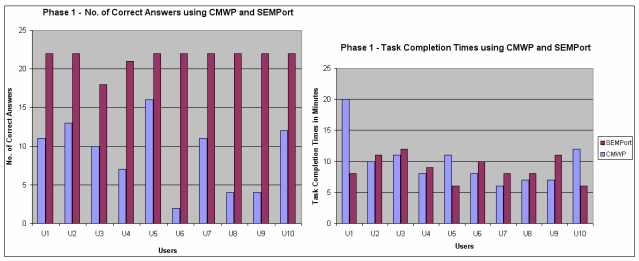

Figure 2. left - The total number of correct answers. Right - The task completion times on the CMWP and SEMPort

Questionnaire Results for Phase 1: In the questionnaire, likert-scale questions were used (5 point-scale). The results show that participants were easily able to use navigation (4.2) and find information (4.4) using SEMPort, in contrast to 2.9 and 1.9 of the CMWP. Subjects rated "How well were you able to complete tasks" 1.7 for the CMWP and 4.5 for SEMPort. The correct answers of the subjects also proved this. Users found presented hyperlinks useful (4.5) on SEMPort and fair (2.7) on the CMWP. Participants also believed that their navigation was improved with SEMPort (4.4) comparing to 2.5 of the CMWP. Overall, subjects satisfied with navigation 4.4 on the SEMPort and 1.9 on CMWP.

3.2 Experiment – Phase 2

In this phase, the same ten subjects performed six more tasks using SEMPort's interface and likert-scale questionnaires were used (5 point-scale). The results show that users were satisfied with ontology-based search (4.4), personalization (4.5) and content edition/provision (4.4). Among the personalization features, subjects rated personalized homepages 4.5, hyperlinks with visual cues 4.1 and link sorting 4.0. We also asked subjects "*Which feature did they like most"*. As a result, personalization (38%) and semantic hyperlinks (31%) were the mostly preferred features of SEMPort. In addition, 100% of the subjects preferred to continue to use SEMPort, comparing to 10% of the CMWP.

4. CONCLUSIONS AND FUTURE WORK

SEMPort is a reusable personalized semantic portal. Semantic navigation, ontology-based search and content editing can be used in different domains without adaptation. Semantic links can be adapted to different domains by changing rules. In conclusion, this paper presented SEMPort's features and our evaluation. The results show that participants performed tasks better using SEMPort and their navigation was improved compared to CMWP. In the questionnaires, subjects were satisfied with all of the features of SEMPort (4.4 or greater). For future work, we plan to generate a framework for providing personalized data on the web.

5. REFERENCES

[1] Şah, M., and Hall, W.: Building and Managing Personalized Semantic Portals. WWW2007, 1127-1228, 2007

[2] Maedche, A., et al.: SEAL – Typing Up Information Integration and Web Site Management by Ontologies. IEEE-CS Data Engineering Bulletin, 2002

[3] Abel, F., and Henze, N.: User Awareness and Personalization in Semantic Portals. ISWC, 2005

[4] ECS Ontology, http://rdf.ecs.soton.ac.uk/ontology/ecs

[5] The ACM CCS, http://www.acm.org/class/1998/ccs98.txt

[6] SKOS Core Guide, http://www.w3.org/TR/2005/WD-swbp-skos-core-guide-20051102