Adaptive Faceted Browser for Navigation in Open Information Spaces

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ABSTRACT

Open information spaces have several unique characteristics such as their changeability, large size, complexity and diverse user base. These result in novel challenges during user navigation, information retrieval and data visualization in open information spaces. We propose a method of navigation in open information spaces based on an enhanced faceted browser with support for dynamic facet generation and adaptation based on user characteristics.

Categories and Subject Descriptors: H.3.3 [Information Systems]: Information Search and Retrieval; H.5.4 [Information Systems]: Hypertext/ Hypermedia—*Navigation*

General Terms: Algorithms, Design, Experimentation

Keywords: Open information space, navigation, adaptive faceted browser

1. INTRODUCTION

Present information systems increasingly need to work with open information spaces which have several distinguishing properties. These include:

- *Changeability* – open information spaces change much more often than closed information spaces by their very nature.
- *Size* – while differently sized open information spaces can be found, they usually tend to grow fast and thus usually are relatively large.
- *Complexity* – varying degrees of complexity are common ranging from relatively simple to very complex information spaces.
- *User diversity* – open information spaces can often have very diverse user bases.

One of the proposed approaches for dealing with large complex information spaces originated in library sciences and is based on the use of a faceted classification scheme and its use in faceted browsers. These employ a faceted navigation model by means of an active user interface that allows users to select the desired subspace of the original space by selecting restrictions in one or more facets [2].

WWW 2007, May 8–12, 2007, Banff, Alberta, Canada.
ACM 978-1-59593-654-7/07/0005.

Semantic web technologies such as ontologies and semantic search appear to be promising directions of further research. In [1] the authors describe two semantic search systems and outline how the semantics of search terms can be used for improving search results. Furthermore, in [3] the authors assume an ontological representation of domain model and employ automated user modeling. They propose user adaptation of faceted browsers as a solution for some of the disadvantages of using faceted classifications as well as to improve user orientation in large information spaces.

While all the aforementioned approaches can be used with open information spaces they do not provide satisfactory support for their changeability as they rely on static application domain and/or configuration data.

2. ADAPTIVE FACETED NAVIGATION

We propose the enhancement of (adaptive) faceted browsers with support for dynamic facet generation based on data stored in the domain and user ontologies. Thus we extend the existing adaptation stage of the facets in a faceted browser with an additional stage for facet generation at runtime on a per user basis.

2.1 Dynamic facet generation

During facet generation we examine the attributes of the desired instances within the information space as defined by the respective domain ontology. For example, in the domain of job offers, we examine attributes of the domain concept *JobOffer* and its associate concepts, e.g. *Organization* denoting organizations offering positions. Next, we select eligible candidates from the relevant attributes of instances and construct facet descriptions based on metadata from the domain ontology. Lastly, we determine a suitable presentation method for each new facet and forward the resulting set of new facets to the following facet adaptation stage.

The selection of suitable candidate attributes for facet generation first evaluates the attributes of the target instance type (i.e. direct attributes), e.g. *JobOffer* and next the attributes of associated types (i.e. indirect attributes), e.g. *Organization*. Since it is not desirable to generate all possible facets due to the their large number, efficient attribute selection is crucial in order to select the most suitable attributes. We evaluate the aggregate suitability of individual attributes based on:

- *Current user behavior* – the user's navigation and current selection of facets. Thus e.g. if a restriction on the industry sector is selected, additional facets associated with *Organization* are likely to be generated in order to allow the user to further refine her query.

- *Attribute relevance* – if the relevance of an attribute in the user model is high it is likely to be used for facet generation.
- *Global attribute relevance and facet usage data* – the overall "popularity" of facets and attributes for users increases the likelihood of a facet being generated for a specific user. Based on identified user groups/clusters, the preferences of similar users have higher weights.

Since dynamically generated facets are created from either direct or indirect attributes of instances, they are presented differently. Figure 1 illustrates proposed types of facets.

- *Direct facets* – top-level facets based on direct attributes of the target instances (job offers), e.g. the organization that is offering a position.
- *Indirect facets* – top-level facets based on indirect attributes of the target instances, e.g. the size of the organization associated with a job offer.
- *Nested facets* – facets that in addition to (or instead of) a set of individual restrictions contain a set of *child* facets, e.g. a facet that contains facets for the size, industry sector and employee rating of an organization offering a position.

Direct attributes of target instances are always presented by means of direct facets. If only one indirect attribute of an associated instance type is presented an indirect facet is used. If multiple indirect attributes of the same type are presented a nested facet can be used so that each nesting level corresponds to one level of attribute indirection.

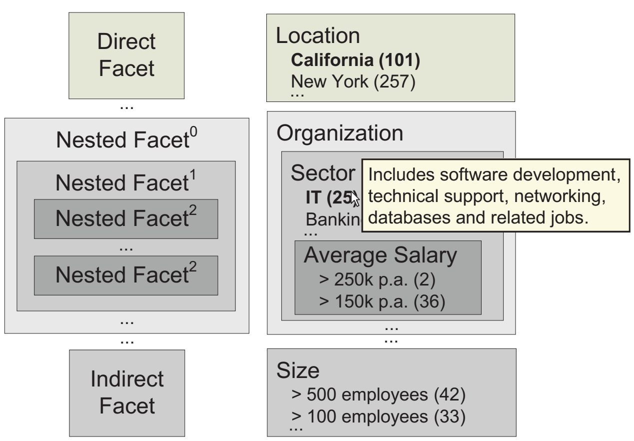

Figure 1: Facet types (left) and adaptation examples (right). Bold text is used for recommendation, tooltips and instance counts for annotation.

2.2 Facet adaptation

The facet adaptation stage processes all existing facets and adapts them at run-time to the specific needs of individual users. The primary goal is to reduce the information overload of the user, to provide guidance towards the user's goal and to improve user orientation in the information space. The adaptation process itself is based on the same type of source data as the facet generation process – on current user behavior, on the user model and on global statistics. The adaptation of facets consists of these steps:

1. *Active facet selection* – the total number of available facets is reduced to a reasonable number since many facets are potentially available. Inactive facets are still available per user request. E.g., the organization size and industry sector facets would be active while the driving license required facet would be inactive.
2. *Facet ordering* – all facets are ordered in descending order based on their estimated relevance for the user.
3. *Facet and restriction annotation* – active facets and their respective restrictions and child facets are annotated to provide better user orientation. E.g., tooltips describing the facet or the number of instances satisfying each restriction would be displayed (see Figure 1).
4. *Facet restriction recommendation* – the restrictions in each facet are evaluated and if applicable, suitable restrictions are marked as recommended. E.g., IT companies would be recommended if the user works as an IT consultant (stored in the user model).

3. CONCLUSIONS

We presented a novel method of dynamic facet generation with successive facet adaptation as an enhancement for generic faceted browsers. Our approach is suitable for open information spaces as it not very susceptible to changes which are a distinguishing characteristic of open information spaces. We evaluated our method in the domain of job offers (`nazou.fiit.stuba.sk`) and in the domain of scientific publications (`mapekus.fiit.stuba.sk`). Our experiments indicated that adaptive selection of active facets can significantly improve total processing time, which depends linearly on the number of displayed facets and restrictions.

Furthermore, our approach reduces the reliance of existing approaches on static data and increases the overall usability of the faceted browser due to the availability of additional facets that can be used for navigation. The proposed adaptation of facets alleviates some of the disadvantages of faceted classification, such as difficult access to popular items, and improves overall efficiency by reducing information overload.

Acknowledgments. This work was partially supported by the Slovak Research and Development Agency under the contract No. APVT-20-007104, the State programme of research and development under the contract No. 1025/04 and the Scientific Grant Agency of Slovak Republic, grant No. VG1/3102/06.

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