Personalised Navigation System with Multidimensional Linkbases

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Abstract. Adaptive hypermedia techniques provide users with personalisation of contents and links. Some of the criticisms of adaptive systems are that users do not always understand why the system is adapting the content and links [14], and that the adaptation process can lead to prolific or out of place linking. This paper introduces the concept of a multi-dimensional linkbase to describe a single linkbase containing links annotated with metadata that places them in several different contextual dimensions at once. We also allow users to have control over personalisation by enabling direct manipulation of the linkbase. We argue that this approach answer some of the criticisms of adaptive hypermedia.

1 Introduction

Adaptive hypermedia (AH) techniques [3] enhance how information can be presented online: the same information adapted in the forms of contents and/or navigational hyperlinks based on individual users. Many frameworks and systems to date have been proposed [4,7,10].

The link augmentation technique, which originated from the open hypermedia community, is defined as *the process of inserting additional links dynamically into an existing web page* [1]. The links are separated from the body of a hypermedia document and stored independently in a link database (linkbase). A link service is required to insert dynamically additional links from a linkbase or a variety of linkbases into a web page. These links can be filtered so that they correspond to a user model. At the University of Southampton, open hypermedia (OH) research was commenced in the late 1980's with the creation of Microcosm [8], the Distributed Link Service (DLS) [5] and the Fundamental Open Hypermedia Model (FOHM) [12]. The link augmentation process is not a new technique and can be found in several other systems [1,15], and although it is not present in Brusilovsky's AH methods and techniques, there have been attempts to bringing the concept of OH to the field of AH [2,10].

FOHM, is a model of open hypermedia with contextual structures used to describe the structure of hypertext objects and their associations between data. It has a notion of n-dimensional context which can be attached to the hyperstructure, and defines the contexts in which that structure is visible. FOHM has also been used to implement AH by encoding adaptive rules in the context mechanism. Auld Linky (formerly Auld Leaky), is a contextual link server designed to store and serve FOHM structures [13]. Auld Linky can be used to respond to requests for link matching dynamically and to provide flexibility in modelling hypermedia structures such as navigational links, tours, level of detail and concept structures and as such is particularly useful for the implementation of adaptive hypermedia.

In this paper we introduce the concept of a multi-dimensional linkbases to represent different dimensions of expertise in a single linkbase. This concept builds on and extends the contextual structures of FOHM and is implemented using Auld Linky.

2 A Multi-Dimensional Linkbase (MDL)

The motivation for this research stemmed from our hypothesis that in a domain where there are many different categories of users such as novice, beginners, and advanced learners (and some stages in between) within a given context, or where there are many expertise dimensions required in the subject domain, the concept of a multi-dimensional linkbase can be beneficial. For instance, a user who is a skilled English historian but has no expertise in Asian history requires a different links presentation from a user who might be an Asian historian but has limited knowledge about English history. Within this context, we believe that it is essential to take into account the representations of links from different dimensions of expertise. We regarded this as the concept of multi-dimensional linkbases. It is defined as a concept that different sets of links or linkbases are treated as different dimensions of expertise. So for example one Link could be annotated as a member of the expert group while another in the same linkbase could be annotated as a member of the novice group. At the same time users are provided with control over the presentation and personalisation of links.

3 Personalised Navigation System with MDL(s)

The concept of a MDL has been put into practice by the development of a web-based personalised navigation system, called an inquiry-led personalised navigation system (IPNS). Users are provided with navigational tools that map properties about their expertise onto contextual dimensions, each of which can be enabled or disabled, facilitating flexibility and reducing the problem of link overload. In IPNS the links are classified by types of information and their relationships [11] and by the functions of links. In addition to the *Expertise MDL*, we have introduced two more linkbases; namely *Inquiry* and *Glossary*. Although these are implemented using the same FOHM

structures they are not multidimensional in our current implementation. Both provide the user with more navigational functions.

- *An Expertise MDL* comprises referential links that relate a keyword in a context to its additional explanation. The Expertise MDL comprises three dimensions of expertise – Subject links (sub classified into raw materials, operations and output, which the user has the option of having 'beginner', 'advanced', 'no links', and 'all links'), Language links (allow users to observe some of the keywords in a chosen language, English, Latin or Spanish), and Learning Style (simply implemented to provide users with a selection between inter-active and non-interactive versions). These Expertise links are augmented into existing pages based on user's levels of expertise and individual user model.

- *An Inquiry linkbase* consists of structural and/or associative links depending on a keyword it is representing in the author's own defined ontology. Based on the 'keyword-based retrieval system', these links are to help users find what they want to know through searching.

- *A Glossary linkbase* embodies another set of referential links. Based on Microcosm philosophy, the user can highlight a word/phrase and request matching links.

The links in the IPNS application are all held in one of the three linkbases. If no links are chosen by using the provided tools users will only notice the ordinary structural links to navigate between pages. Links within the document are dynamically added depending on their selection in the MDL and other linkbases. A single MDL contains the source and destination information for all links in its group. Individual links within MDL can have one or many sources and/or destination. The Context object in FOHM determines the visibility of links. Auld Linky performs the context culling process and returns the remaining links in a given context for a particular user. Figure 1 describes an overall picture of how different arrays of MDLs are provided in the system.

4   Discussion

The benefits of the link augmentation technique are that the separation of links from documents enables the links to be created, added, or modified without any effect on the original document, and that despite the text being modified or moved around, the links still function [1]. However, its conventional process centres the link insertion on known or visited keywords, which can inevitably result in common problems such as too many links inserted into an existing hyperdocument – 'prolific linking' [6], a situation when every keyword becomes a generic link [1], and irrelevant or out of place links where the links fail to support the document's context [9]. Furthermore, despite AH techniques offering personalisation of contents and links to users, one of the criticisms of adaptive systems is that users are prevented from having the control of the system's action [14]. With these issues in mind, we hypothesise that representing the different dimensions of expertise and allowing users to have direct control of the visi-

bility of links can rectify the traditional problems with link augmentation and AH systems. In addition, this concept provides users with greater flexibility as the links displayed are chosen by the users and not automatically detected and generated by the system. We believe that presenting links based on the users' own selection allows them to perceive the behaviour of the working system and empower them by letting them decide whether or not to make use of the functionality offered.

5   Conclusions and Future Work

This paper presents an inquiry-led personalised navigation system based on a concept of a multi-dimensional linkbase. It is a concept where arrays of links signify dimensions of expertise and each of these offers links presentation based on the user profile. IPNS is an attempt to offer navigational links according to users dimensions and levels of expertise. We have developed three linkbases based on our link classification, namely an Expertise MDL and Inquiry and Glossary linkbase, and consider that representation of links from different dimensions of expertise will resolve the problems with prolific and out of place links and facilitate the flexibility. Users are also provided with the inquiry-led tools which enable them to personalise links presentation, each of which can be enabled or disabled; hence facilitating flexibility and reducing user's 'too-many-irrelevant-additional links' syndrome. It was implemented in a specific domain as a personalised web-based system; however, it can also be enhanced to facilitate shareability and reusability issues when it is further developed in a web services environment. FOHM and Auld Linky are the main technologies of our implementation. Future work will be looking at a more formal evaluation of the prototype to confirm whether our concept is applicable and meaningful to users and to establish what is the extent and limit of this understanding.
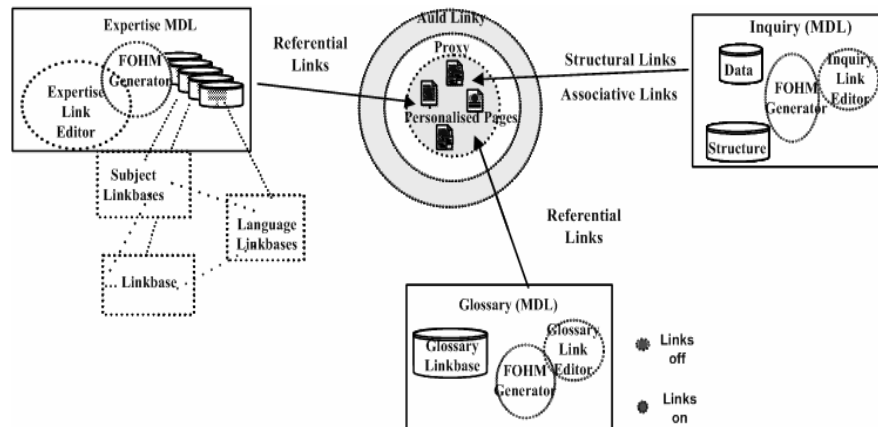

Figure 1 Multi-Dimensional Linkbases (MDLs)

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