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Automatically Generating Interfaces for Personalized Interaction with Digital Libraries

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ABSTRACT

We present an approach to automatically generate interfaces supporting personalized interaction with digital libraries; these interfaces augment the user-DL dialog by empowering the user to (optionally) supply out-of-turn information during an interaction, flatten or restructure the dialog, and enquire about dialog options. Interfaces generated using this approach for CITIDEL are described.

Categories and Subject Descriptors

H.3.7 [Digital Libraries]: User Issues; H.5.2 [User Interfaces]: Graphical user interfaces, Interaction styles; H.5.4 [Hypertext/Hypermedia]: Navigation

Keywords

out-of-turn interaction, personalized interaction, browser toolbars

1. INTRODUCTION

There have been many tools proposed recently to assist librarians, who might have little or no experience in building computer systems, in constructing digital libraries (e.g., Greenstone [4] and 5SGraph [5]). We present here a system for automatic generation of *interfaces* to digital libraries, especially those that support personalized interaction. We model our system after the ‘staging transformations’ framework [1] that supports functional specification and realization of user-DL dialogs.

Our view of personalized DL interaction is where the user and DL take turns exchanging initiative and where the user is empowered to supply partial information in as expressive a manner as possible. Today’s DL interfaces are predominantly hyperlink driven; to reconcile the mismatch between the hardwired hyperlink structure and user’s information seeking goals, we provide the capability to have an *out-of-turn interaction*, where the user can supply some unsolicited, but relevant, information to the DL. When such an out-of-

turn input is made, the user momentarily takes the initiative and the site restructures itself before reclaiming the initiative. Since out-of-turn interaction is optional and unintrusive, it can be introduced at multiple times, at the user’s discretion. Out-of-turn interaction is targeted at focused dialogs where the user has a specific information-seeking goal in mind but the DL’s current hyperlink structure does not accommodate it (e.g., a user interested in papers by ‘Belkin’ but is unsure what categories Belkin has published in).

We have built two interfaces to support out-of-turn interaction in DLs: a toolbar embedded into a web browser for out-of-turn textual input, and voice-enabled content pages for out-of-turn speech input. Studies using these techniques have revealed that users are adept at recognizing when out-of-turn interaction is necessary but have also highlighted the need for supplemental operators to enhance the personalized experience [3]. While some of the operators are always applicable, others are only defined under certain conditions (see below), hence the need to develop customized interaction interfaces for specific DLs.

2. GENERATING PERSONALIZED DL INTERFACES

Our generator presumes a DL modeling such as in the OAI-augmented 5S framework or an XML-based representation. We currently target DL pages indexed according to some classification scheme inherent in the representation; the classification terms are available for out-of-turn input as well as additional terms modeled in the leaf documents (and not explicitly used in the classification). The generator currently supports the following personalized interactions:

- **Basic out-of-turn interaction:** This interaction technique prunes all paths through the classification scheme that do not contain the out-of-turn input. A combination of program slicing transformations is utilized to identify the paths which must be retained. This technique only allows partial input included in the classification scheme.
- **Generalized out-of-turn interaction:** If the user’s input does not correspond to a label in the classification scheme, this interaction technique is more appropriate as it can accommodate partial information modeled at the leaves, in addition to the tree labels.
- **Meta-enquiry: what may I say?:** Keeping users abreast of what information is available to communicate is a feature all DLs must address. This technique



Figure 1: An example of a personalized interaction with CITIDEL.

permits the user to enquire about the partial information that remains unspecified in the user-DL dialog.

- **Collect results:** This is a dialog termination technique and allows the user to request that the classification be flattened and re-presented as a flat list of relevant pages.
- **Restructure classification:** For DLs with categorical facets, this interaction technique enables the creation of a personalized browsing hierarchy, which can be further navigated in a dialog, e.g., a DL organized along a author-journal-title motif could be restructured into a journal-author-title motif, supporting interactive aggregation scenarios.

3. EXAMPLE

Fig. 1 illustrates a personalized DL interaction with CITIDEL (Computing and Information Technology Interactive Digital Educational Library; citidel.org) [2] using out-of-turn

speech input; the user is initially unable to respond to the solicitation of literature category and instead says ‘Belkin’ out-of-turn (screen i). This causes many leaf pages to be removed (notice reduced frequency purviews annotating each hyperlink label) and some categories (e.g., ‘Hardware’) to be completely pruned out, since Belkin’s papers are not indexed under such categories (screen ii). The user then responds to the initiative by following the ‘Information Systems’ hyperlink (screen iii). After this point, the user decides to terminate the dialog and request a flat list of Belkin’s papers (screen iv).

Our approach to automatic interface generation produces either a browser toolbar in XUL (XML User interface Language) for use in the cross-platform Mozilla web browser or a SALT (Speech Language Application Tags) voice interface for use in Internet Explorer. Currently, the toolbar captures out-of-turn input as a bag of words (hence supporting phrases) whereas the voice-enabled pages do not accommodate lengthy constructs (for ease of speech recognition).

The generator is built in Java; a graphical interface (not shown here) supports configuration of DL interfaces by allowing designers to choose the interaction techniques they desire to support. For librarians who are more computer-literate, we defined a small markup language (OTML–Out-of-Turn Markup Language) using XSchema and employed the translation capabilities of XSLT to compile it into a XUL toolbar or SALT voice interface. Use of OTML supports a level of customization finer than that of the generator (e.g., designers can customize tooltips for each widget in the generated toolbar).

CITIDEL interfaces generated by our tool enable multimodal personalized interaction and have had qualified success [2]. We expect approaches to generating interfaces for DLs such as ours to become more popular with the rise in end-user programming.

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