Combining Cognitive and System-Oriented Approaches for Designing IR User Interfaces

Norbert Fuhr, Matthias Jordan, and Ingo Frommholz
University of Duisburg-Essen, Duisburg, Germany
{norfert.fuhr|matthias.jordan|ingo.frommholz}@uni-due.de

Abstract. In this paper, we present a new framework for designing user interfaces for interactive IR. Based on the distinction between the logical, layout and content view on documents, we regard IR as a combination of selection, projection, organization and visualization on these aspects. These transformations should be configured according to the information seeking strategy currently chosen by the user.

1 Introduction

Although interactive information retrieval (IIR) is a commodity nowadays, there has been little research on the systematic design of appropriate user interfaces. The current ‘standard’ is the single search box as offered by most Web search engines, in combination with a linear result list. On the other hand, research in the area of cognitive approaches has led to the formulation of a number of cognitive IR models, which explicitly state certain user needs with regard to the IR system involved. However, the problem of mapping these needs onto system features has been addressed by only a few researchers so far.

In this paper, after briefly discussing the notion of information seeking strategies, we present a new system-oriented framework for designing IIR interfaces, and then we show how this framework can be combined with the cognitive approach.

2 Information Seeking Strategies

We follow the notion of information-seeking strategies (ISS) as proposed by Belkin et al. (see, e.g., [4] for an overview); they propose four dimensions for classifying ISSs: the method, mode and goal of seeking, and the resource used for the process. Regarding the method of seeking, scanning refers to the process of looking sequentially at each item from a certain set, whereas searching stands for a more goal-directed search. If the user can specify the wanted items, retrieval mode is specification, otherwise the mode is recognition. The goal of seeking can be either learning or selecting. Finally, users can interact either with the information objects themselves or with meta-information. An important distinction of this scheme is that between method of interaction and mode of retrieval:
There are cases where a user gives a good specification of a wanted item, but the system does not support searching according to these criteria, and so she has to scan the object in question. (e.g. the user remembers a melody from her music collection, but the system does not support music retrieval). Conversely, the user may search for a known item, but cannot give a good specification, and thus can only recognize the object when she sees it (e.g. the user remembers a book on text mining with a remarkable cover which she wants to retrieve, but she will only recognize it when she looks at each of the books on ‘text mining’).

3 The LACOSTIR Model

In our current project LACOSTIR\(^1\), we focus on layout, content and structure of documents and transformations thereof as part of the interactive IR process. The goal is the development of a framework for designing user interfaces for IIR. Here we briefly describe the major concepts of our approach.

In contrast to the distinction between information and meta-information as proposed by Belkin et al., we think that content, structure and layout are more important document facets when we are dealing with information seeking [2]. Classical IR methods usually focus on the content view. The structure view reflects the (logical) document structure and the data in specific elements thereof — this view lies within the focus of recent research, for example in the context of XML retrieval. A third view is the layout view on documents which is concerned with the display of documents on a medium — which is e.g. important for recognizing an item seen before.

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ods transfer the collection into suitable document representations, which may contain structure and layout elements besides the content. A selection operator being applied to these representations selects the documents matching the query. A projection operator extracts features from resulting documents matching the query in order to create suitable surrogates; these can contain, for instance, a summary (content), title and author (structure), or a thumbnail of the title page (layout). In the next step, an organization operator structures the projected result, e.g. a linear list, a tree or graph, or a list of sets (in the case of clustering). Finally, visualization displays this organized result in a certain way (e.g., there are many alternative methods for tree visualization). These four operators (selection, projection, organization, visualization) might be modified by the user during the seeking process; new queries might be posed (resulting in a new selection), but also the projection and organization operators might be changed, or different visualizations applied to the same result.

In most of today’s IR systems, the user can only modify the selection operator, whereas the three other operators are fixed. Although this approach might ease the handling of such the systems (especially for beginners), for many ISSs, this results in a very poor system support.

4 Supporting Information Seeking Strategies

Information seeking strategies, as they are discussed in Section 2, can be regarded as parts of an information seeking episode; during an episode, users move from one ISS to another. Different ISSs should be supported by different techniques [1]. Furthermore, search must be viewed as an interactive process. IR systems should thus be able to provide multiple intuitive interaction functionalities to give maximum support. On the other hand, user’s actions give some feedback about her needs, which should be considered by the system.

This raises the main question of our research: how can we support different ISSs using the document aspects and transformations as proposed in Section 3? As an example, let us return to the text mining book with the remarkable cover. Assuming that the user remembers exactly that the title contained the words 'text mining', this would be mapped onto a selection referring to the logical structure; alternatively, if she only knew that it was about this topic, this would lead to a content selection. In order to recognize the 'remarkable cover', projection should include the layout (mapping it to a thumbnail of the cover) — possibly along with the essential bibliographic data. Organization of the result set could produce a single list (ordered by some logical criterion, like e.g. publication year or author name); alternatively, the system could cluster the cover thumbnails. Finally, these organized results should be visualized in a meaningful way.

In order to aid the user in finding relevant information, an IR system should be able to flexibly react on different tasks, situations and contexts by supporting different ISSs. The challenge is to relate system features to search strategies, i.e. which support technique should be used for a given strategy, which projection,
which organization? We think that most of today’s systems are restricted to content searches, with specification as seeking mode and searching as retrieval mode. For this case, the projections (typically a combination of some logical elements and a query-biased summary) applied and the standard organization in form of a ranked list are appropriate. However, when other ISSs have to be involved, especially with scanning instead of searching and/or recognition instead of specification, then current systems are not flexible enough to offer appropriate support.

Given a system that implements the major features of our framework, we have the problem of choosing the right transformations for the ISS currently applied by the user. Thus, the system needs more information from the user, in order to provide the appropriate transformations. Especially for recognition and scanning, the distinction between layout, content and structure of documents is important, depending on which aspect the user currently is focusing at. Thus, the typical ‘search box’ interface of Web search engines will not be sufficient for providing appropriate support. Possible alternatives include complex forms, wizards and query by example.

5 Conclusion and Outlook

In this paper, we have described a new approach for designing interactive IR systems. By differentiating between logical, layout and content aspects of documents, and by introducing the notions of selection, projection, organization and visualization, we have laid out the design space for such systems. We have shown that different information search strategies require different parameter settings for these transformations. Currently, we are working at the development of an IIR system implementing the major concepts of our framework. Furthermore, we are investigating methods for assigning configuration of these transformations to ISSs. In addition, we want to combine this approach with an interactive information visualization cycle [3] and continue the evaluation of adaptive systems (which has started with considering only content in [4]) by adding the aspects of structure and layout.

References