Implementation and Evaluation of a Virtual Library Shelf for Information Science Content

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Abstract

MyShelf is an information system for browsing based on the metaphor of a virtual library shelf. Like a traditional library shelf, it allows the exploration of the neighborhood of a document. Neighborhood represents semantic closeness which usually has many facets. In MyShelf, the ordering system of a shelf can be changed and the collection is reorganized on the fly. As a consequence, different neighborhoods of a document can be explored which allows the selection of an appropriate cognitive perspective. The user can rely more on the associative nature of browsing in order to solve his vague information needs. An implementation for information science content and its evaluation with user tests is presented.

1. Heterogeneity in Information Systems

Heterogeneity is a problem encountered in many information systems [1, 2]. It can lead to a degradation of the quality from the perspective of the user when his terminology does not match the terminology of the system nor does the cognitive landscape s/he has formed of a domain match with the structures presented within an interface.

Heterogeneous ontologies occur in many areas. The most typical attempt to resolve this problem is standardization and concentration on one ontology. However, this may not always be possible and aspects of and perspectives on the domain may get lost.

Some of the problems arising from ontology mismatch are presented here with examples from information science:

- Challenges due to different terminology (e.g. usability, human-computer interaction, or interface design)
- Different hierarchy formation or poly-hierarchical structures (e.g. information science -> information retrieval -> information retrieval evaluation; or information science -> evaluation -> information retrieval evaluation)
- Different assignment of segments (e.g. information retrieval -> user interfaces for information retrieval; or user interfaces -> user interfaces for information retrieval)

As a consequence, heterogeneity treatment is necessary to overcome the incompatabilities between different ordering systems [9, 5, 11]. A traditional but expensive approach is the creation of concordances. Recently, automatic systems based on machine learning are being developed (cf. [7]).

2. The MyShelf Approach

MyShelf (cf.[8]) deals with heterogeneity in several levels. It integrates several overlapping collections indexed with different ontologies. MyShelf provides a browsing system with a user interface containing all classifications. Between the ontology entries and the documents, relations need to be established where they cannot be found in the original system. For example, when a book is only available in one library, we need to index this book with terms from other library catalogues as well. This can be done manually, semi-automatic or fully automatic.

MyShelf results in the following value added services:

- One browsing user interface serves for several ontologies
- The reach of each ontology is increased
- Ontology switching is made possible
- Thematic selections remain effective during switching

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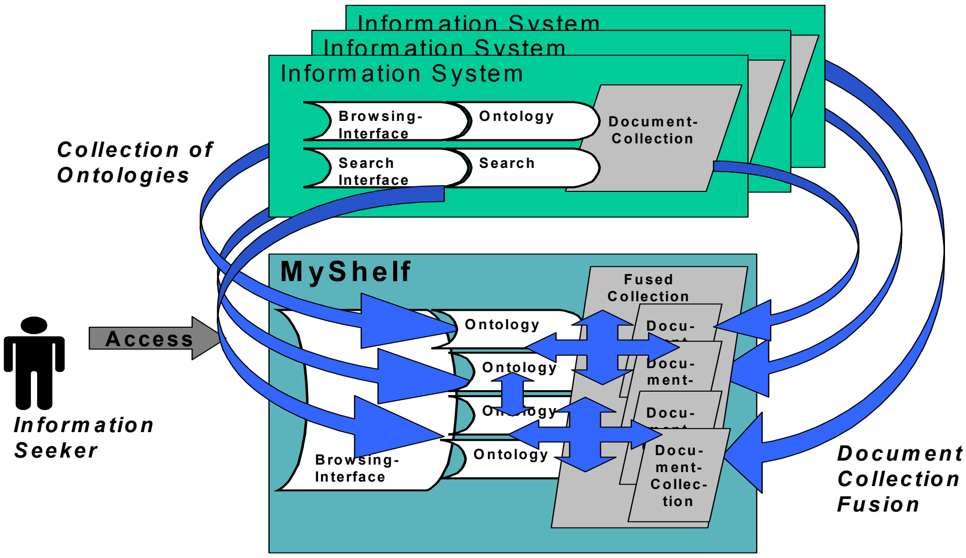

Figure 1: MyShelf as integrated information system

2.1 Ontology Development and Knowledge Engineering for Information Science Content

As first application of MyShelf, information science content was chosen. Firstly, some 6000 books from the university library of Hildesheim, Germany, were identified. These information science books were also searched in the library of the university of Constance, Germany. In a semi-automatic process, all books were assigned to categories in both ontologies (cf. [3]). Furthermore, a new information science classification was designed which better models the specific teaching and research profile of the information science at the university of Hildesheim.

This newly developed ontology is called HArmonized NomenKlature information sciencE (HANKE). It also mirrors recent developments in information science and information technology. As a result of this work, some 6000 documents were assigned with terms or categories from three classifications, the HANKE classification, the older classification for computer and information science called KID (cybernetics, information and documentation), developed and used by the university library of Constance and the catalogue of the university library of Hildesheim (cf. [3]).

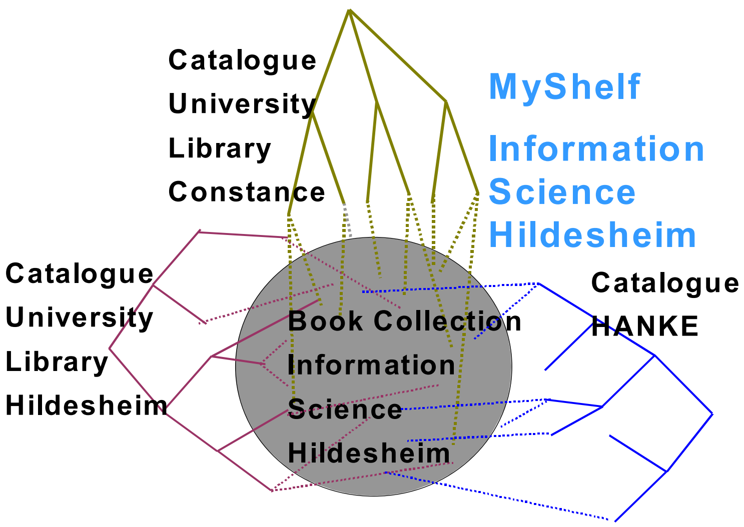

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Figure 2: MyShelf integrates different classifications for the same collection

2.2 *Implementation of MyShelf for Information Science Content*

The virtual library shelf has first been implemented for information science content (cf. [4]), however, several other uses have been envisioned. The system is available in HTML and may be used with a standard web browser. It gives the users access to the information science books in the library of the University of Hildesheim via browsing through three different hierarchical classifications. The users can select a classification and the system reorganizes the books accordingly . The system is realized apart from the infrastructure of the university library to enable further testing and modifications. However, it can be used already, because connections from each book within the system to the proper page in the internet library catalogue can be easily established.

From a librarian's point of view the virtual shelf performs the function of a hierarchical catalogue. In this case the catalogue is not based on only one classification but on three. Figure 3 and 4 show the user interface. The basic layout and structure of the system follow the example of Yahoo's web catalogue[1]. The hierarchical structure of the classifications (i.e. categories and subcategories) is represented by the varying size of file symbols and fonts. The path at the top of the site ("breadcrumbs") helps users navigate and orient themselves in the classifications (Figure 6).

3. *Evaluation and Results*

The prototype was evaluated by a user study, examining the following aspects:

- User behavior during the search process
- Overall usability issues
- Satisfaction of the users with the system
- Usefulness of the newly developed HANKE classification compared to the library classifications
- Acceptance of the parallel provision of three different classifications

Eleven subjects, all students of the course International Information Management at the University of Hildesheim[2], were recruited for the study. Four of them were in their first year, the rest in the third year or higher. The empirical study sessions included three parts: an interview, eight search tasks, and a questionnaire.

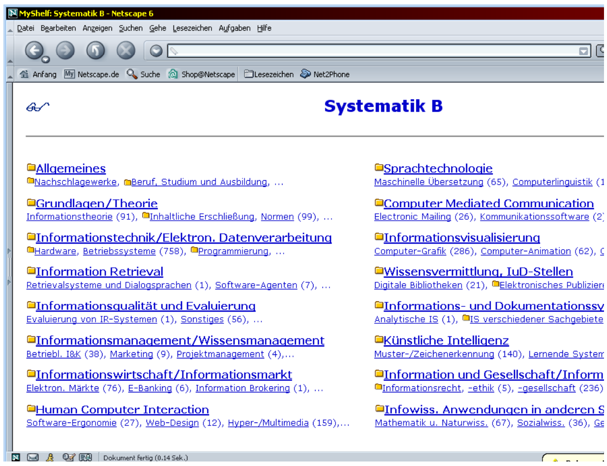

Figure 3: User Interface of MyShelf

3.1 *Interview*

The interview focussed on the subjects' research experience and practices using the OPAC of the university library. It was found that the subjects usually searched the OPAC by entering a keyword. They were not used to search via browsing through classifications.

3.2 *Search Tasks*

Each subject was asked to perform eight search tasks after a brief introduction to the virtual library shelf. The subjects were encouraged to think aloud and comment on what they were doing. Their comments as well as their actions in the user interface were videotaped and subsequently analyzed. The subjects were also informed that they could spend as much time as they wanted on each task, and that they could abandon a search without a result in cases where they thought they could not find a satisfying result.

There were two types of search tasks:

1. The subjects were asked to find literature about a particular topic. Example: "Find publications about the programming language JAVA"
2. The subjects were asked to locate a particular topic within a classification.
   Example: "Under which broader term can you find the topic multimedia within the classification?"

For the first seven tasks the subjects were told which classification to use for their search. This methodology guaranteed that each subject got to know and used all three classifications. For task 8 the subjects were free to select the classification(s) of their choice. Thus, it could be determined which classification they preferred and whether they made use of only one classification or switched between them.

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[1] http://de.yahoo.com

[2] http://www.uni-hildesheim.de/~angsprwi/iim/english_version.html
http://www.uni-hildesheim.de/studium/IIM/sb_iim.html

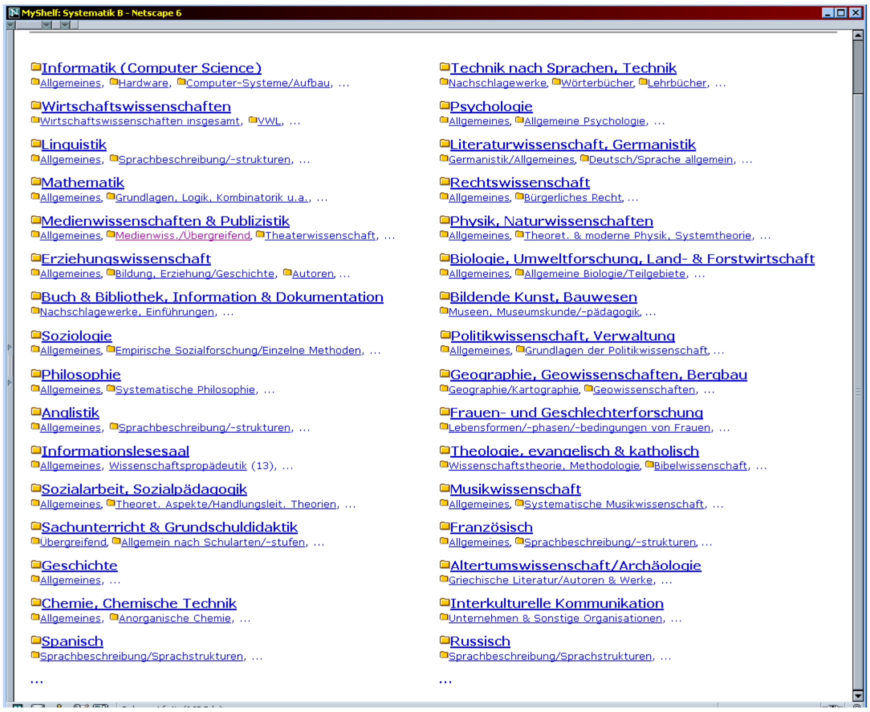


Figure 4: User Interface of MyShelf

The examination of the task results was based on qualitative and quantitative parameters. The qualitative parameters were the subjects' comments; the quantitative parameters were search times and optimal solutions to the search tasks. Search times varied widely and did not allow conclusions. It was more an indicator of time spent browsing or exploring than a performance measure. It should be noted that a positive learning effect is involved in browsing during the search tasks. Comparing the task results with the defined optimal solutions was more helpful: The subjects' results of the search tasks 1-7 were checked whether they corresponded completely/partly/not at all with the optimal solutions, or whether the search was abandoned.

The subjects' search results of tasks 1-7 indicated which classification the subjects performed best with. Figure 5 illustrates how the subjects performed the search tasks using the different classifications (measured by comparison with the optimal solutions).

This indicates that the newly developed HANKE classification was most useful for the subjects. This finding was verified by the results of task 8 and the subjects' statements in the questionnaire.

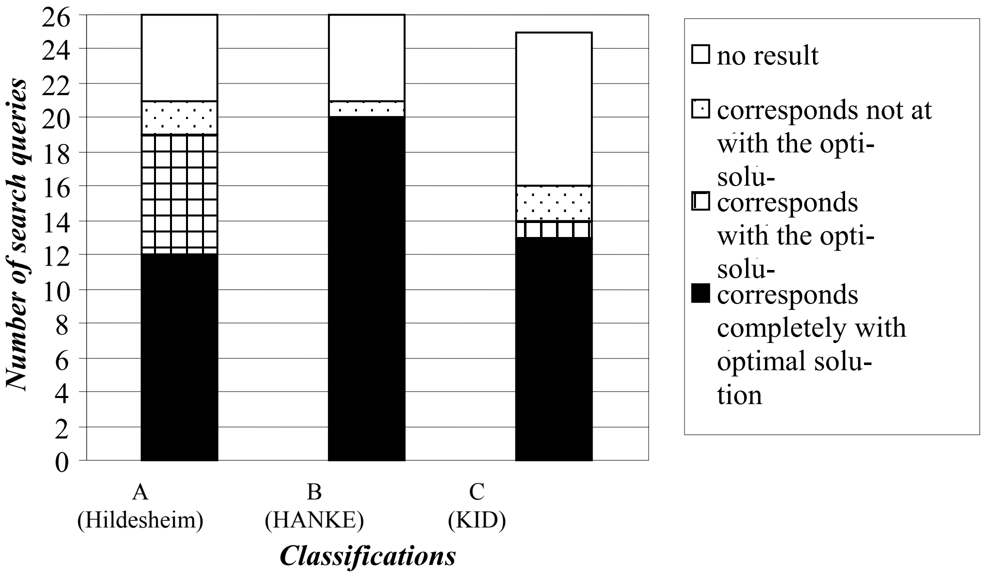


Figure 5: The classifications in comparison

Table 1: Which classifications the subjects used for task 8

Classifications	*Used*	*First choice*	*Only choice*	*Results*
A (Hildesheim)	6	1	0	3
B (HANKE)	10	9	4	8
C (KID)	5	1	1	2

As mentioned above, for task 8 the subjects were free to select one or more classifications. Table 1 shows which classification the subjects used, which classification was first choice, which was the only choice, and in which classification they found results.

The table answers the question which classification the subjects preferred: it is obviously the newly developed classification (highlighted grey). The second question regarding task 8 was: did the subjects use only one classification, or did they switch? It turned out that six out of eleven subjects changed the classification at least once. There were two reasons for that behaviour:

1. They had found no results in a classification.
2. They changed the classification in order to look at the topic from a different angle.

3.3 Questionnaire

The questionnaire focussed on the question how the test persons subjectively evaluated the classifications in comparison and the virtual library shelf as a whole. Table 2 shows the subjects' evaluation of the three classifications.

The newly developed HANKE classification turned out to be the subjects' favourite, which confirmed the trend of the results obtained from analysing the tasks. Only with regard to the structure (item 3) the HANKE classification was outperformed by the Hildesheim classification.

Table 3 illustrates how the subjects evaluated the virtual library shelf as a whole. The subjects were presented with eleven statements and were asked which they agreed with. The statements with which more than two thirds of the subjects, i.e. eight or more, agreed are highlighted.

Although the subjects missed a keyword search feature (item 4+6), they considered browsing a classification a useful alternative, especially when searching for a topic (item 5). They had no problems adjusting from one classification to another (item 7) and did not lose their bearings in the virtual library shelf because of the large number of links (item 3+10).

The concluding question the subjects were asked to answer in the questionnaire was: Would you welcome the integration of the virtual library shelf into the university library OPAC? Ten out of eleven subjects said yes. Four subjects supported the integration of all three classifications, six subjects the integration of one or two (the newly developed HANKE classification and the Hildesheim classification, respectively).

Table 2: The subjects' evaluation of the classifications

	Classification A (Hildesheim)	***Classification B (HANKE)***	***Classification C (KID)***	***No difference between the classifications***
Altogether, I got along best with ...	3	***8***	0	0
The most clearly arranged classification was ...	2	***7***	1	1
I could understand best the structure of ...	***6***	4	0	1
The names of the classes were best understandable in ...	3	***6***	1	1
The most useful classification for the searches was ...	3	***8***	0	0

Statements	*Number of subjects who agreed*
1. I could get a good overview of the topics.	6
2. The hierarchy of the classifications helped me to categorise.	5
3. The large number of links rather distracted me.	3
4. I consider searching for a concrete title in a classification too time-consuming.	***9***
5. When I search for a topic, the search via a classification is a good alternative to the keyword search.	***8***
6. I missed a keyword search feature.	***10***
7. I had some problems adjusting from one classification to another.	1
8. The provision of several classifications was helpful to look at a topic from different angles.	2
9. The navigation through the classifications was very easy.	5
10. I sometimes did not know at what point of the classification I was.	2
11. The visualization of the classifications (file symbols etc.) was successful.	7

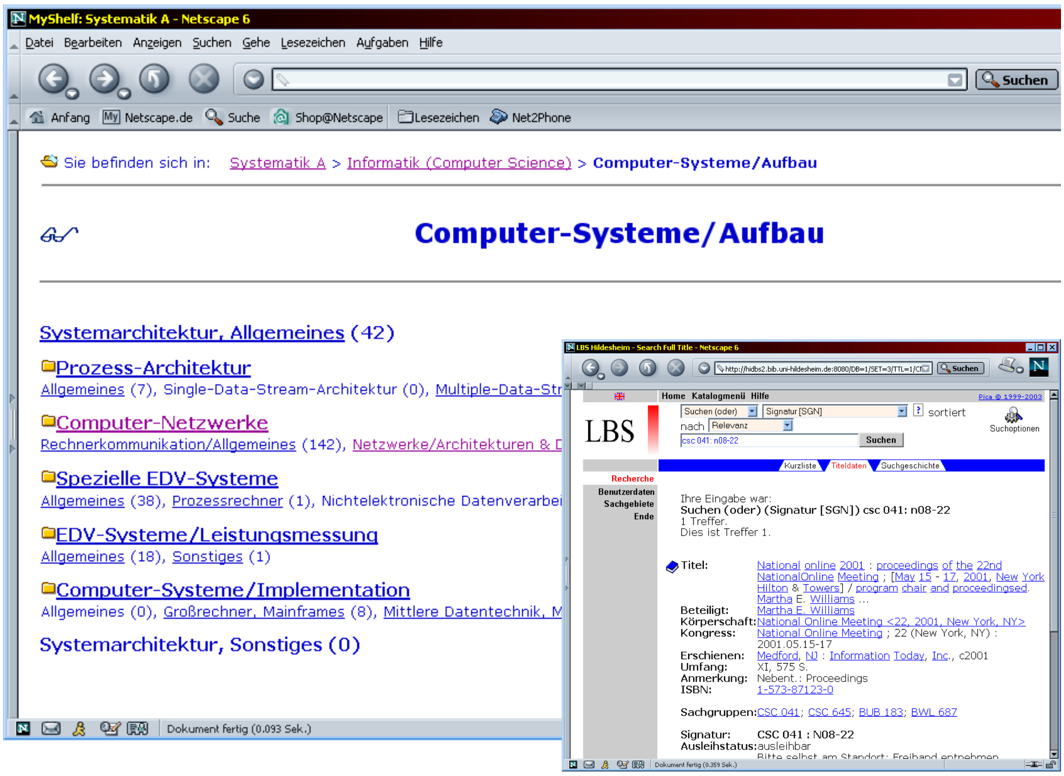
Table 3: Subjects' evaluation of the virtual library shelf as a whole

3.4 Interpretation

The goal of the design and evaluation of the virtual library shelf has been to examine the user search behaviour in a hypertext-based, browsing-oriented library system based on three hierarchical classifications. The results of the user study have shown that although the users were only used to keyword search, they appreciated browsing features as well. Furthermore, they welcomed the provision of more than one classification and were able to deliberately choose between them.

The newly developed HANKE classification proved to be best, which indicates that the "age" of a classification can be an important factor, especially in the rapidly changing world of information science.

Figure 6: MyShelf and link to internet library catalogue



It shows further that investment in the development of classifications improves interaction. Updates and adaptation of an ontology to a specific context makes a system easier to use for the users.

In our context, adaptation of the information science classification for students increases the satisfaction with the system. However, old classifications should not be omitted but much rather integrated into a holistic system like MyShelf. In that manner, neither knowledge which users obtained with former classifications nor indexing work is lost. Offering parallel access to classifications is not only subjectively valued by users, but they also make use of the switching capabilities.

4. Outlook

Challenges for heterogeneous ontologies are also posed by multilingual systems. As one of the next steps, we intend to include multilingual elements into the MyShelf concecpt. The problems and solutions for multilingual information retrieval make a good starting point for that endeavor (cf . [10]).

For the implementation of MyShelf, further work needs to be directed toward the user interface and dynamic HTML generation.

The results obtained in this study will not only support further development of the MyShelf system for information science. They also shed light on techniques necessary for the success of the semantic web which relies much more heavily on ontologies than traditional information retrieval. However, the multiplicity of perspectives in information searching (cf.[6]) needs to be implemented by future web services as well.

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