Towards
Personalized Semantic Multimedia Search for Digital Libraries

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ABSTRACT
In this paper we discuss the employment of a personalization component in an existing semantic multimedia search engine for digital libraries. There are different ways to exploit personal information in this context. First of all, the information can be utilized to re-rank the results according to the preferences of the user and of users showing similar interests. Further, the user can be offered to build customized clouds of search concepts that are relevant to the user’s interests based on his or her deliberate choice in order to present more relevant results and to inform the user about news on the topic in the future.

Author Keywords
Semantic Search, Personalization, Digital Libraries

INTRODUCTION
Cultural institutions archive an incredible wealth of multimedia content stored on carriers like books, images, tapes and films. These cultural heritage organizations face the challenge to provide citizens with Internet-based access to the knowledge contained within their vast multimedia collections. For the project CONTENTUS, we have built a Web-based interface for searching in these collections. At this current state, we are planning on including a personalization component in the system, that helps to:

- re-rank search results according to the user’s preferences;
- give users the possibility to actively create profiles of interest;
- provide recommendations to the users based on given data; and
- alert users with new information on the desired topics.

In this paper, we discuss the extension of the existing project search engine by a personalization component. Our goal is to combine state-of-the-art methods with novel semantic approaches to apply them in our setting in an intuitive fashion.

Research on the topic has shown that there are already solutions to each of the addressed problems in the domain of digital libraries. A re-ranking of search results according to the user’s preferences with the help of collaborative filtering strategies [7, 10] applying model-based approaches [8]. However, in contrast to our setting that approach as well as numerous others presumes the user’s personal rating on given books. Even though in our project such information is not accessible, we can enable access to the history of a user’s search and we have an explicit representation of knowledge about the data in form of an ontology and a knowledge base. Sieg et al. apply ontology-based user models for enhancing recommendation mechanisms [9]. Apart from that, we will consider latent semantic techniques [4] in order to counteract gaps in the knowledge base. Therefore, it needs to be investigated in which way the hybrid method proposed by Van et al. needs to be considered [11].

Another area of research that needs to be involved in our considerations are the so-called alerting services. Alerting services have been of interest in the past years as a feature of digital libraries with the help of traditional metadata [3, 1].

In the following, we will give an overview of the project CONTENTUS and the state of our semantic search engine. Further, we discuss a possible realization of the personalization component for our system.

THE CONTENTUS PROJECT
CONTENTUS is a research and technological development project led by the German National Library under the umbrella of the German government-funded THESEUS research initiative. It provides a rich toolbox of solutions for cultural institutions and other content owners that facilitate a seamless transition from raw digital data to a semantic multimedia search environment [6]. The CONTENTUS framework and the methodologies and concepts that are being devel-
opened in the project yield a system that supports cultural institutions in providing end users with access to multimedia collections at a large scale. End-users will benefit from innovative search options that contain an abundance of multimedia assets and metadata from various sources, including traditional, intellectually compiled data, automatically generated information, and Internet-based resources.

THE SEMANTIC MULTIMEDIA SEARCH ENGINE

The search engine developed within the CONTENTUS project combines two information sources: a traditional full-text index of OCR and audio transcripts, as well as semantic information held within an ontology and knowledge base. The underlying media of the Semantic Multimedia Search comprises audio-visual and audio material, scanned print media and born-digital text documents. The CONTENTUS search aims to grant access to all these information sources through a unified interface. Consequently, the main design challenges for the user interface (UI) were

- the transparent combination of different data sources;
- the seamless integration of multimedia data and associated metadata; and
- a user-friendly access to semantic search features.

In order for end users to fully utilize the integrated metadata sources and the different media, it is essential to provide a search interface that is both intuitive and provides novel semantic search capabilities. The CONTENTUS project has produced two working, web-based prototypical iterations of its Semantic Multimedia Search. We have gathered user feedback on the usability of the two prototypes since 2008 through demonstrations at trade fairs as, e.g. the Frankfurt Book Fair 2008 and 2009 and the International Broadcasting Conference (IBC) fair in Amsterdam 2009.

Before the design phase for the third demonstrator (currently under development), we held two paper prototyping [5] sessions at the Institut für Rundfunktechnik (Broadcast Technology Institute) in Munich in 2010 to reconfirm the previous (positive) feedback from trade fair visitors, this time with users from an archival and library background. We decided against confronting the test user group with our existing prototypes of our web based search engine. Instead, in a first pass we presented the participants a set of predefined search tasks and asked them for their ideas on how a UI could most easily solve these. In the second pass we then showed our test group a set of control elements to get feedback on how they would be understood and which kind of interaction the test users expected.

Our user test results show that the average user indeed prefers a classical interface for his search entry: a search slot and a textual list representation of search results. However, we suspect that one reason for this preference is that many users are not familiar with more innovative or unusual user interface elements and are thus reluctant to use them. Since we consider the explorative possibilities as the strongest advantage of semantically assisted search interfaces, we consequently had to choose an interface that encourages users to utilize the added semantic value and at the same time an interface that does not overstrain and disorientate them with unfamiliar interaction possibilities. Most users preferred a
faceted search interface for narrowing their initial result lists with disambiguated keywords over a dedicated query language and over disambiguation as a type-ahead search feature.

Figure 1 shows the main result page of the current UI after entering a search term, which in our example is “Johann Wolfgang von Goethe”. The user is logged into the system so that personalization can take place. The result page is divided into three columns. The result list is in the middle, on the right and left sides we positioned a set of dynamically created filter facets. These allow a drilldown of the results and are clustered into the categories Result type, Location, Organization, Contributor, Publication Date, Person and Topic. The filter facets only contain entries present in the current result set. The category Result type contains - besides the obvious media types - also types of entities found for the search string. “Goethe” only finds persons, while “Springfield” would result in both locations (Springfield in America) and persons (like singer Dusty Springfield).

The filter categories Location, Organization and Person offer entities recognized by automatic algorithms within the full text transcripts of media, while Contributor shows catalogue information about the media items like authors, composers and directors. Once a facet is selected, it is also shown as a breadcrumb beside the search term (in our Example “Italien” = Italy). Every breadcrumb allows for disengagement or deletion of the individual filter.

The user history below the result type filters shows a list of past searches. So far, it does not save the results of a search, only the search terms and selected filter facets. A specialty filter facet is the time line slider on the upper right. Users can narrow their results by selecting any time frame at will so that only documents and persons falling between the selected dates are filtered. The respecting dates are currently publication dates of media, dates of birth and death of persons. The only way of personalization apart from the search history saved in a users profile is the “collect” feature. Users can collect individual search results into his/her personalized collection using the “collect” button present in every result item. Using supervised as well as unsupervised learning approaches we can assign one or more topics to every media item collected and add these topics to the user’s preferred interests.

PERSONALIZED SEMANTIC MULTIMEDIA SEARCH

At the current stage of the search engine system, the history of a user’s search including all filters is saved. This is relevant for a completely automatic personalization without the user’s feedback and can be applied for making recommendations for the same and other users in similar contexts. Apart from the existing “collect” feature, we are planning to enable active participation in a personalization of the search engine. Figure 2 shows a supposable extension of the existing search engine. On the one hand, the “MyRelevance” button can be added that delivers the results in a re-ranked order that features results most relevant to the user. This feature can be enabled with the help of collaborative filtering. However, so far, we do not have logged data that can be applied for training as the search engine was employed for the mere purpose of demonstration and not displayed to real users.
Further, the user will be offered the possibility to create her or his own search context. In Figure 2 this possibility is depicted by the “Personalize” buttons. Each filter can be chosen for personalization and after all choices are made, they are summarized in the depiction of a graph. For illustration purposes, we assume a use case where the user is generally interested in the Italian period of “Johann Wolfgang von Goethe”. Therefore, she chooses the filter Italy.

Figure 3 shows the graph that is displayed to the user once she presses the main “Personalize” button. It shows the chosen filters and other relevant filters as delivered by the knowledge base of the system. She is now able to refine her choices and to add or exclude filters. For instance, she refines her search of “Goethe” in “Italy” to “Goethe” in “Rome” and adds a mandatory result type Portrait. Further, she can make links between filters such as connect the two painters “Angelika Kauffmann” and “Friedrich Bury” by an or relation. This way she will get results related to either one or both painters.

In a next step, the user can decide how to use the created search cloud. She might be interested in subscribing to news on the topic. For instance, it might turn out, there is no portrait scanned and included in the result list so far. This way, the user will be notified, once, this circumstance changes. Apart from that, the user can be offered similar graphs based on either knowledge about graphs from other users or solely on basis of semantic similarity as delivered by the knowledge base. Further, the user might be interested in other users, that work on similar topics and use similar graphs for their search.

CONCLUSION AND OUTLOOK

To summarize, our goal is to include a personalization component in the CONTENTUS Semantic Multimedia Search Engine. This component should incorporate state-of-the-art recommender techniques, ontology-based approaches and intuitive paradigms for personalization. The approach should work in favor of an automatic relevance ranking with respect to the user’s history; possibilities to interact with the decisions made by the system; paradigms to create clouds of topics; and a comparison mechanism to find similar graphs.

So far, we are still at a stage of orientation for finding the most adequate paradigms and approaches to create the personalization component. In the near future, we will implement first approaches in order to be able to conduct first user studies.

Acknowledgments

Funded by the German Federal Ministry of Economics and Technology within the THESEUS program.

REFERENCES