THE VIRTUAL EXHIBIT CREATOR

A presentation generator for educational use.

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Abstract

Today teachers use the Internet as an information resource for preparing material and presentations for use in their classes. However, tools currently available on the web do not provide full support for the search and preparation process. This paper presents a prototype illustrating new functionality to support information retrieval and presentation from Web accessible multimedia databases, including ideas for enhancing image retrieval for semantic visual queries through use of a shape thesaurus.

Keywords

Virtual exhibits, multimedia retrieval, information presentation, educational applications, shape thesaurus.

1. INTRODUCTION

Teachers increasingly use Internet based information to increase their own knowledge and to transfer knowledge to their students. As the time pressure on teachers has increased, more effective ways to localize and prepare needed information are required. A teacher may have several objectives for searching for information, such as; looking for background information on a subject, planning to create lecture notes for a lecture,

creating a screen presentation using a video projector, or making handouts for their pupils. Access to visual information is important for the transfer of knowledge to students.

Even though the number of Internet users has exploded, the frequency of use has increased, and the amount of information accessible on the Internet is impressive, there is still work that should be done to improve search for multimedia information and to support processing capabilities for preparation of materials based on the search result.

Consider the case of a teacher planning to prepare a lecture for a school class, where he also use a handout containing text and images about the topic, as well as an assignment for the students. Since the pupils' curriculum book does not give enough background information on the topic, the teacher chooses to use the multiple information sites on the Internet to create the lecture and handout. Since the information is most likely stored on multiple autonomous sites, our teacher must perform a series of separate processes to:

1. Locate sites with information on the current topic,
2. Search each individual site for relevant information items,
3. Extract and retrieve relevant data, and
4. Construct a local collection for 'off-line' development of an integrated presentation

Step 1 can be done using search engines, encyclopedia sites, or web sites within the topic area. These sites use text keywords to search for information, and in the case of the search engine, return a list of potentially relevant sites. Step 2 is a manual search, since the teacher is the only one knowing the actual requirements. Step 3 is commonly done by copying relevant material onto the teacher's local computer. Step 4 requires editing the material into a fitting presentation using a word-processor. Once completed, the teacher must save the lecture presentation for print and later presentation. If the presentation could be saved on the web and used from there, easy access to supplementary information could be given.

Each of the above steps can introduce time delays and frustration into the information retrieval process.

2. INFORMATION RETRIEVAL ON THE INTERNET

2.1 Locating Information

The most common tools available for starting an Internet search are the search engines such as Google, Yahoo!, AltaVista and Lycos. Actually do not provide any information directly at all, only references to sites with assumed relevant information. While the search engines reach a large number of web sites for each single search, they index less that 40% of the available sites (Kobayashi and Takeda, 2001). The search engine interface is reasonably well designed for both novice and expert users and accepts both simple and advanced queries. Google and Yahoo! also present a catalogue tree divided into different subjects in addition to the text search field. Though the catalog size and detail are impressive, a user may not be sure which category and subcategories his or her search object is defined in and can easily end up clicking back and forth and becoming frustrated. Some categories also demand some knowledge of the subject since several technical or Latin terms are used to describe the categories.

Major problems when using a search engine include the size and quality of the result set, which often exceeds 100,000 entries and commonly contains irrelevant as well as relevant information. In addition, they can only search the HTML-text and in some document files (e.g., doc-files and pfd-files). They do not have the capability to retrieve data stored in databases connected to the Internet. This is a major drawback since large amounts of the interesting information that could be retrieved while surfing on the web is contained in databases.

Institutions worldwide, such as museums, are deploying virtual exhibits and multimedia data collections for use by researchers, educators and the general public (Nordbotten, 2002). These collections contain large amounts of information within several interesting areas and topics that are often stored in databases. Unfortunately, these resources are maintained separately and the search engines are unable to access the databases. Online museums databases can therefore be a tremendous resource for information of high quality and within several topics, ***if*** general access to them can be made.

2.2 Multimedia Retrieval using search engines

Several search engines give the user the opportunity of searching for both text and visual material. Multimedia data, other than text, is assumed to be either embedded in text, as on a html page, or collected as image sets. In either case, the search is preformed using a text keyword match on the surrounding text, document title and/or image/video caption. There is no function for searching based on the visual characteristics of the image itself, i.e. the colors and/or objects within the image.

Another problem with search engine retrieval of multimedia data is that this has to be conducted as separate searches. In other words, search engines do not provide any cross-reference between text results and images. Providing such links could significantly increase the information about the objects in the result set.

2.3 Managing Result Sets

The standard result of an Internet search is given in list form. Other than saving the list, there is generally no support for keeping sections of information or objects from a search result for later use, there are very few examples of web sites or web applications where the user can reorganize, save or in some way process or edit the information presented after a search within the web site. The most common method is to copy-and-paste parts of the result into a word processor. There is therefore a general lack of support for editing the result set in most searchable web applications.

Two sites that do provide support for information processing following selection can be found at the Ohio Memory Project (www.ohiomemory.org) and King's Art Chamber (www.kunstkammer.dk). The Ohio Memory Project provides a scrapbook function in which users can make their own scrapbook out of the material available and then save the scrapbook for later access or presentation. The King's Art Chamber a virtual museum exhibition, which is a partial reconstruction of the Royal Danish Art Chamber (Gundestrup and Wanning, 2004). The web site offers the possibility of constructing a user exhibit from parts of the on-line collection. The exhibit can be saved for later access. These two examples illustrate opportunities that lie in web technology for processing and presenting displayed information in a more user-friendly or interactive way.

In summary, we claim that the information seeker today has to perform a series of separate processes using more than one application to *locate, access, extract, edit and present* relevant information from the Internet.

3. A VIRTUAL EXHIBIT CREATOR

The objective of the work described in this paper is to develop a tool that provides effective location, processing and presentation of multimedia information and brings these separate processes into one application. Required functionality includes the ability to select and extract pieces of information to a new section of the application where it can be edited by selecting the order of text, placement of images and the addition or deletion of whole objects or parts of text. Our approach is to integrate the different processes necessary to search for information, edit it, and develop a desired presentation of it into one Web application. Our information source is (a selection of) virtual museum databases. We envision that online museums databases will become an important resource for information of high quality. A web application supporting the different processes mentioned will give teachers an accessible interface to quality information.

An important difference between our application and search engines is that our application will search through museum databases while search engines search web sites. Our approach will provide access to a federation of sites and museums and be limited to the number of museums that agree to participate, giving less coverage than search engines. However, despite this difference, we see the comparison against search engines as a natural comparison since search engines are the most common used search tool as of today and therefore the most natural alternative.

3.1. The Prototype

Our prototype, *The Virtual Exhibit Creator*, consists of three central components (1) the user interface, (2) a multi, multimedia database search function, and (3) a presentation generator. Since museum databases are used as the information source for the web application, the presentation generator is being built up using a small museum metaphor, having the users to make their own virtual exhibit on a certain topic or theme.

3.1.1. User Interface

The user interface is based on a book metaphor, in which each of the two presentation pages contain different, but related information. For example, Figure 1 shows the results pages after the user has submitted a search. The left page contains (text) document results while the right side contains the image results from the query. The separation of information this way is intended to give the interface a clear layout for the query results, while it also opens for a *dynamic presentation* of two types of media in a single result set.

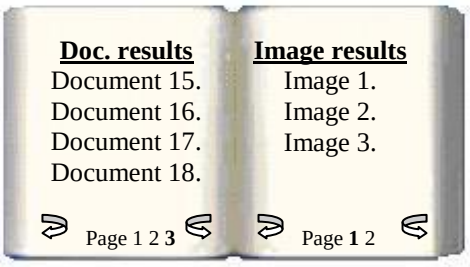

Figure 1. The book metaphor on the web.

The two result pages are connected by a *dynamic linking* function that ensures that the information shown on one side is always updated according to the information shown on the other side, i.e. according to the user's latest action. This function also makes it easier to further concentrate the search and separate relevant from irrelevant information in the result set.

For example, if a user searches for "dolphins" the initial result set will contain a series of document titles and thumbnail images related to different species of dolphins. If the user then clicks on an image of a common dolphin a full-size image will be shown on the image side while the document page will automatically update to show only documents related to common dolphins. Documents on other dolphin species, such as white-nosed dolphin or the Atlantic white-sided dolphin will disappear. Consequently, the result set on the document page has been updated and relates to the user's action on the image page, and relevant documents can easily be localized. If the user then returns to the previous result, the result set will expand to include all the dolphin species again.

3.1.2. Search Engine

The prototype contains a multi-multimedia database search engine where the user can enter a text-based search query, and retrieve relevant multimedia (i.e., text and images). Single words, phrases, and search terms including operator and wildcards can be used in the query. The search engine contains a list of member databases that provides access to each database directly. An alternative solution for the envisioned application can be an integrated database schema for the underlying databases.

3.1.3. Presentation Generator

We are in the process of developing the presentation generator for the prototype. After retrieving a search result, the user can select objects in the result set that he wishes to include in a presentation. Objects in this sense are values of structured attributes, free text attributes, images and sections of documents. Since long documents can be saved as files with only a reference stored in a database, we intend to implement section identifiers in these documents so that the user can select optional sections instead of the entire document. The selection is done by checking checkboxes located next to every object. Figure 2 shows the result after a search for "killer whale", where checkboxes are displayed next to each information object. Objects with checked checkboxes will be included in the result exhibit when saved. The checkboxes are only visible when a user is logged in.

Objects from several result sets can be included in the same presentation. The selected objects, both text sections and images, are transferred to an edit interface where the user can edit and revise the information, preparing it for printing or screen presentation. In the edit interface, the user can organize the objects in the way best suited for the planned presentation. Selected objects or part of objects that are applicable for the presentation can be deleted. The presentation can be saved to the system whenever desired. When saved, the presentations will be linked up to the user's account, so that only he has access to his own presentations.

The presentation generator integrates presentation editing with the search application making the user independent of the need for an external word processor or presentation application. There are not many tools or applications within this area that are web-based and those few are usually focused on a small topic. Our prototype provides a search interface and presentation generator that can be independent of areas and topics.

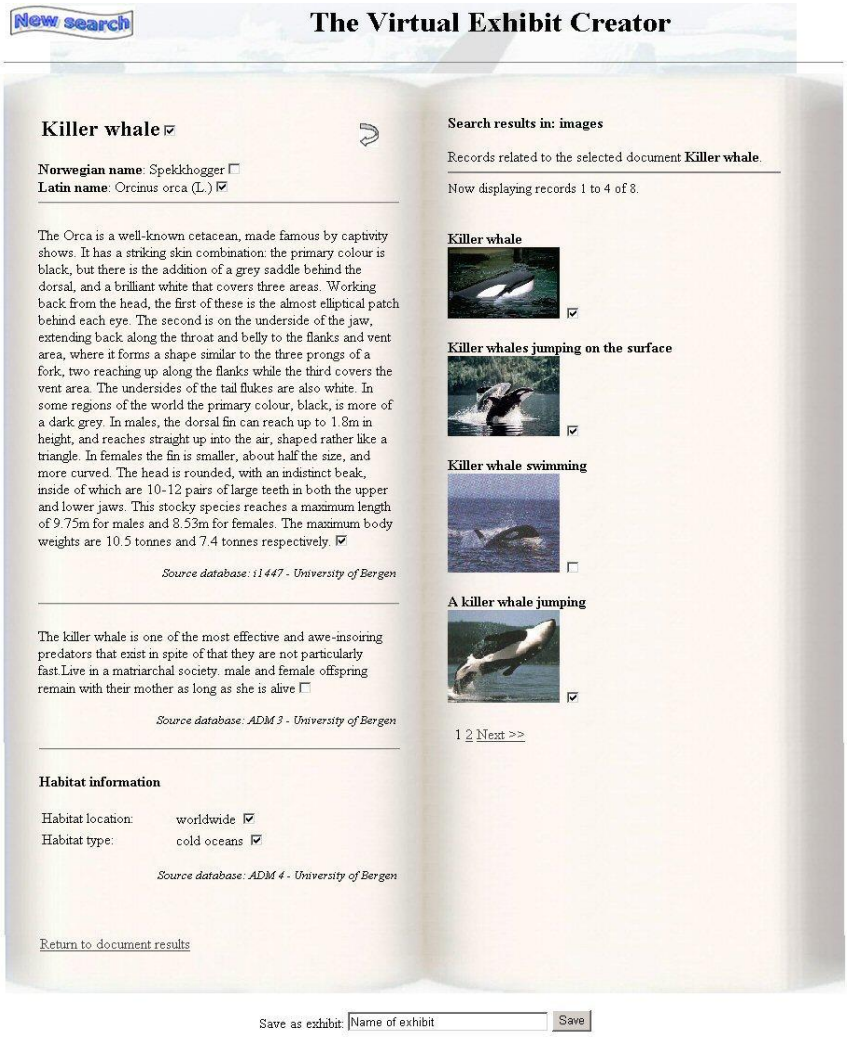

Figure 2. Result presentation with checkbox selection.

4. CHALLENGES OF MULTIMEDIA RETRIEVAL

One of the major challenges facing multimedia retrieval is the fact that multimedia data, and in particular image data, are considerably more complex in structure than text data. Consider our scenario and the case that our teacher wishes to retrieve images to illustrate his lecture. The teacher has an idea of the images he wishes to retrieve; what objects they should contain and how these objects are depicted. The problem is; how is he going to express his information need and retrieve the desired images?

Querying multimedia data is dependent on how these data have been indexed and classified. Currently, either *text based* or *feature and data pattern based* image retrieval is used (Eakins and Graham, 1999; Hove, 2004). The first approach, adopted for our current prototype, is based on techniques from text-based information retrieval. In our scenario, our teacher might use free text, such as "Find images containing dolphins", or keywords such as: "Dolphin, feeding, surface". Verbal query expression has a very high expressive power, however images are non-verbal in nature and some image characteristics can be difficult to express verbally.

Figure 3. Two different images of a "Dolphin Jumping"

Consider the two images in figure 3. Let us say our teacher wants an image similar to the first image, with a dolphin jumping out of the water. How is our teacher going to describe the actual pose of the dolphin and the perspective of the image? If he searches with "Dolphin Jumping", he might retrieve either, or none, of the images, since the result is dependent on the textual annotation of the image collection. If neither image is annotated with "jumping" or "dolphin", than neither of the images will be retrieved. If the image collection is large, it is unlikely that every image is annotated with enough information to satisfy the information need of our teacher. Finally,

the annotations might be created using other terms, or might describe different image characteristics than our teacher is interested in.

The second approach, *Content Based Image Retrieval* (CBIR), is based on image representations of low-level structural characteristics, such as colour distribution, texture, shapes and the spatial distribution of these structures. Information requests are expressed as *visual queries* using an existing example image or a drawing or sketch. Retrieval is based on identifying images that share similar structural characteristics. The success of this approach depends on the quality of the example image or creating *good* drawings. The main challenge with this approach is that images with similar *structural* content may not have similar *semantic* content, or similar semantic content may lack structural similarities, as illustrated above.

Hove (2004) addresses this problem with an approach based on utilization of a *shape thesaurus*, which has been shown to have the potential for enhancing image retrieval. This strategy is able to accept queries of both textual and visual nature. In the case of textual queries, the query interpretation process is simply a matter of text based information retrieval techniques. The textual input is compared to the semantic labelling of thesaurus objects, and if a match is found the system can perform either text based search through the image annotations, or perform a verbal-to-visual search based on the statistical descriptors. For visual queries, the retrieval system uses the shape thesaurus in an attempt to identify the object(s) present in the seed image, and uses this data to perform either text-based search through the image annotation, or structure based searches based on the statistical descriptors. We are currently working on including this approach to multimedia queries in the Virtual Exhibit Creator prototype.

5. CONCLUSION

Even though search engines and other common tools used today can retrieve an impressive amount of information, there is potential for improvement in the way information is presented, as well as a need for integrated methods and tools for additional processing and editing of the retrieved information into a local presentation. Our prototype can be a step in the direction of how the scope of these problems can be reduced.

The next steps of this work are to complete the prototype and carry out usability testing using teachers as the application users during spring 2005. The findings of the study and experiences with the prototype can be

used to improve the search and presentation tools available today or as a platform for developing new tools. Additional work with the shape thesaurus will reveal its further potential and implementation possibilities.

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