Improve the Access to Image Data by Combining Content-Based Semantic with Common Metadata Image Retrieval in a Zoomable User Interface

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ABSTRACT

This paper presents our work on an operational semantic image retrieval prototype. The original image database consists of more than 600.000 images and metadata sets. Our prototype is working with a subset of 13.421 images which we use for test purposes. The main problems we are confronted with are the amount of data and therefore the location of an item of interest, the different search strategies that are used, useful interaction techniques and how to combine content-based image retrieval (cbir) with usual metadata search to support the users in their tasks. We combine a zoom based interaction concept with a dynamic query metadata search and a cbir similarity search based on GIFT (**G**nu **I**mage **F**inding **T**ool) [2] to simplify search and exploration and to solve the stated problems. Our suggestion is that the proposed concept can also be adapted to other data spaces (e.g. videos or documents).

Author Keywords

Zoomable user interface, content based image retrieval, metadata retrieval, semantic-based image retrieval.

ACM Classification Keywords

H5.m. Information interfaces (e.g., HCI): Miscellaneous.

INTRODUCTION

There are many approaches to search and visualize images in practice and in the research community. Our approach explicitly deals with a zoomable user interface based on [3] to combine cbir and usual metadata image retrieval.

Huge amounts of images are collected by private persons (e.g. vacation, semi-professional shootings) and companies. Our focus will be on huge image collections established by companies for internal use or their customers (purposes are marketing, products, catalogues, construction, etc.). To manage these large image collections a lot of companies have image databases (often put on the web) where employees or customers are obliged to search the needed images. Traditional interfaces like they are used for intranet clients, company applications and web clients are not able to handle the enormous amount of images in an efficient and effective way. Users have problems to find specific images or even get lost in the numerous metadata descriptions. Filter possibilities are another problem, because some filter values may exclude others and in the end users have either too many images to browse or no matching images at all.

There are already systems like xcavator, retrievr or oskope[1] covering some of the mentioned problems but each lacks in relevant points concerning the user interface, the interaction concept or the retrieval possibilities.

DATA SPACE

The data space consists of a subset of 13.421 images which include metadata like id, name, title, date, owner, types and many others. Some hierarchical properties of our data space give us the opportunity to present the images in different visualizations (e.g. treemaps or networks).

REQUIREMENTS ANALYSIS AND USER TASKS

We organised some workshops, where we met domain experts, end users and technical staff to analyse the requirements, propose design solutions and discuss possible problems. The results led us to our design concept and the following user tasks and requirements.

Table 1: User tasks.

#	User task
1	Search for images by ID (used in 70-80% of cases)
2	Search for images by metadata (20-30% of cases)
3	Find similar images (not available in current system)
4	Saving images in the system and on hard disc
5	Download of image information
6	Browse images in metadata groups
7	Expand result set (combining metadata and cbir approach)

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[1] http://www.xcavator.net/, http://labs.systemone.at/retrievr, http://www.oskope.com/

FILTER, NAVIGATION AND VISUALIZATION

Figure 1 shows the user interface of our interactive prototype, which we realized with Adobe Flex 3. The zoomable result visualization shows the images as tiles with their metadata. A click on an image zooms into the image and makes the metadata readable.
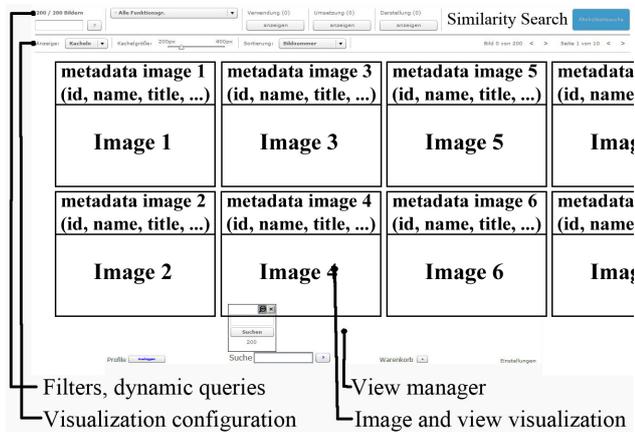

Figure 1: Prototype image tile view with 13.421 images.

By using dynamic queries or full text search in the filter area, the user can narrow down or expand the visible images as needed. It is important, that users can switch between search- and exploration-mode at any time.
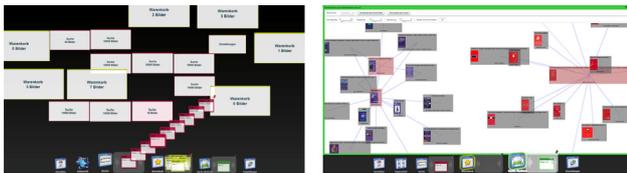

Figure 2: Prototype (1) search tiles, (2) similarity graph.

Our image system search concept supports different logins, searches and baskets to collect and save images as preferred by the user. Figure 2 (1) shows the prototype in a zoomed-out state with 17 created search tiles while figure 2 (2) shows one tile, on which the user changed the visualization to a similarity spring graph. We produced a demo video which is available on our homepage[2]. Additionally to the full text search and the dynamic query filters [1] we created a new structure for our data space by indexing the images with the GIFT framework and its standard cbir features [2].

COMBINE METADATA AND SIMILARITY SEARCH

Users can combine the similarity search with the metadata search by first using some full text / metadata searches and then use one or more found images for a similarity-based query. This search strategy helps the users to detect new image groups. The exclusive usage of full text and metadata searches may lead to zero hits. This can be avoided by providing a query recalculation (see figure 3). Based on the

previous result (938 images) the system starts a similarity search. The result is narrowed down with the previous user queries as far as possible and finally presented to the user.
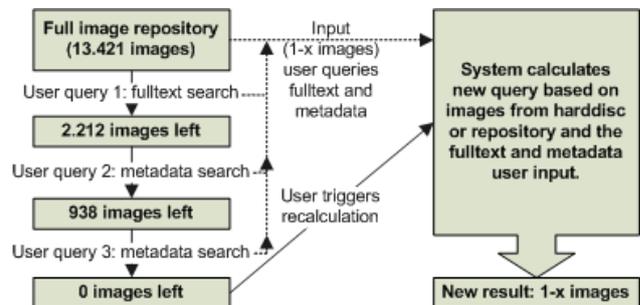

Figure 3: Process of semantic query recalculation.

CONCLUSION AND OUTLOOK

We set up a framework consisting of a web client based on an innovative zoom-based approach, a cbir server, an image database server and amfphp[3] as middleware. The framework is used to combine usual metadata queries and similarity queries to support the users with semantic possibilities and multiple ways to access the images. The used techniques enable users to adjust the zoomable user interface to their needs with respect to their current task(s). In future we will evaluate the system, further improve the interface and research new ways to combine similarity and metadata search to provide a semantic-based image search.

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[2] Website of the HCI Workgroup at the University of Konstanz (URL: http://hci.uni-konstanz.de/semanticimagesearch)

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[3] amfphp - php communication backend for Adobe Flash (see http://amfphp.org/)