

Search Strategies in Content-Based image Retrieval

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- This paper describes two studies that looked at users' ability to formulate visual queries with a CBIR system that uses dominant image color as the primary indexing key.

CBIR

- Content Based Image Retrieval system
- The complex nature of image data and the necessity for visual queries combine to make CBIR a highly interactive process in which the user must take center stage.

CBIR(cont.)

- CBIR is an approach that automatically extracting index data from images in the form of low-level visual content such as color, shape or texture.

CBIR search tools

- sketch tools
- Users submit a rudimentary sketch or painting of the required image, and are presented with sets of images that have been ranked in terms of their similarity to the query for browsing.

CBIR search tools (cont.)

- However, frequent mismatches occur between low-level features and the user's high-level semantic expectations.
- For example, a user searching for an image of a large sea mammal could easily be returned with pictures of an aircraft.

CBIR search tools (cont.)

- Spatial querying tool
- Allowed the submission of queries by drawing and labeling rectangles.
- Improved their performance but did not have the added complexity of being used in the context of content based searching alone.

CBIR search tools (cont.)

- Structured browsing tool
- Allows users to browse the image collection according to dominant color groups.

CBIR search tools (cont.)

- Both systems work in conjunction with serial browsing of the returned set.
- The system also provides a tool for “Query-by-Image-Example”, a form of relevance feedback, which is a well-known method to allow users to point out a candidate image for the system to retrieve images that are similar to that example.

Method

- Twenty volunteers participated in the study, 10 males and 10 females, aged between 18 and 24 years, all had normal color vision.
- All participants had previous experience of keyword image searches, but had no previous experience of using a CBIR system.

Method (cont.)

- System type (sketch tool vs. browsing tool)
- Search type (searching for a previously seen image, searching for an image of a particular object, and searching for an image that conveys some abstract meaning)
- Two image sets were used each consisting of 1000 images on a variety of topics.

Results

- Subjects performed significantly more successful searches with the **browsing tool** (mean = 3.35) than with the **sketch tool** (mean = 2.8).

Results (cont.)

- Performance was best when the search task required subjects to locate an **image they had previously seen** (mean = 3.88), next best when the task required subjects to retrieve an image that **conveys abstract meaning** (mean 3.05). Subjects performed worst when required to retrieve images of a **specific object** (mean = 2.3).

Results (cont.)

- The final task allowed subjects to use all of the available search tools within the system to perform a further set of searches.
- A record was made of the tool subjects chose to initiate their searches.

Results (cont.)

Tool type	Search type		
	Seen image	Image of an object	Conveys abstract meaning
Browsing tool	46	31	52
Sketch tool	48	22	17
Serial browsing	6	47	31

Verbal data

- While they were performing the tasks subjects were asked to provide think aloud protocols. Some of the main themes emerging from the verbal data are presented below.

Verbal data (cont.)

- Image of known object : think about the color of the object rather than how it might be represented in the context of the image.
- Previously seen image : a number of occasions that the color swatch then were presented with was not a good match for the color they had in mind.

Verbal data (cont.)

- Image that conveyed abstract meaning : associating some meanings with particular colors.
- For example, tranquility was frequently associated with green.

Study two

- Within this study users were searching for images to satisfy a predefined search task, primarily so that we could observe the effects of varying the type of image users searched for.
- The study focused on the sketch tool as it allows us study the process of visual query formulation more closely.

Method

- The image collection was increased in size to 2000 images on a variety of topics
- Ten volunteers participated in this study (5 males and 5 females) their ages ranged between 21 and 26 years. All had normal color vision, no previous experience of CBIR, and had not participated in the previous study.

Result

State	Original search aim	Final selection
Florida	Beach scene : 2 Disney world : 3 Family fun : 4 Citrus fruits : 1	Beach scene : 10
Colorado	Mountain scene : 3 Wildlife : 3 Skiing : 2 Family fun : 2	Mountain : 6 Skiing : 4
New York	People shopping : 4 Sky scrapers : 2 Town scene : 1 Yellow taxi : 1 Apple : 1 Statue liberty : 1	Sky scrapers : 10

Result (cont.)

- The original aim images are quite complex and include image attributes that relate to what the picture is of, such as people shopping , and interpretive elements, such as fun, excitement, relaxation.
- When describing their desired image, color did not seem to be an important factor, as it was not mentioned by any of the subjects.

Result (cont.)

- User had problems finding what they wanted. This ranged from not being able to express the query effectively to just not liking the image they found.
- Users often stumbled across an image they believed would satisfy one of their remaining search tasks even though it was very different from their original suggestion.

Result (cont.)

- Users grew impatient with the sketch tool and stopped trying to depict images and used the tool to simply insert individual blobs of different colors to be taken to different parts of the system for browsing.

Result (cont.)

- The query-by-image-example tool was enabled for use in the study, only 3 of the subjects used the tool. For those that did, the tool seemed to help with their searches, the main reason for this was because when the user clicked to query on an image, the color representation of that image was imposed on the sketch tool. This seemed to help users produce better and more successful sketches.