Web-Scale Image Search by Color Sketch

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ABSTRACT

Most existing image search engines rely on the associated texts or tags with images to index and retrieval images, which results in limited ability on searching images with visual requirement. In this demonstration, we present an image search system, which enables consumers to find images on the requirement of how the colors are spatially distributed. It is a well-designed trade-off between scalability and feasibility. To the best knowledge, this system is the first one to scale up to Web-scale images. The interface is very intuitive and requires users to only scribble a few color strokes or drag an image and mask a few regions of interest, to express the search intent.

Categories and Subject Descriptors

H.3.3 [**Information Storage and Retrieval**]: Retrieval Models

General Terms

Algorithms, Experimentation

Keywords

Image search, web-scale, color sketch

Motivation Most existing image search engines rely on the tags or texts associated with images to index and search images. For example, Flickr image search allows users to type a textual query, and matches it with images in the database, in which images are organized through the tags annotated by human. Google/Bing/Yahoo image search alternatively explores the texts surrounding the images to index the images. However, those image search engines suffer from the lack of searching into image contents because the tags/texts are not sufficient or exact to describe image contents. Although a lot of research efforts on content-based image retrieval (CBIR), such as query by example, query by sketch, and so on, were made in last century, those techniques cannot scale up to Web-scale images.

System In this demonstrate, we present a novel image search system, image search by color sketch, which enhances text-based image search and enables end-users to intuitively sketch a color map to indicate how the colors are spatially distributed in the desired images for promoting images matching the specified color map. The proposed system is motivated by intuitive observations. For the text-based image search results with the query "Brooke Hogan" (an American singer, actress, model, and television personality), a color map, with the red color on the bottom, may mean to find Brooke Hogan walking on the red carpet.

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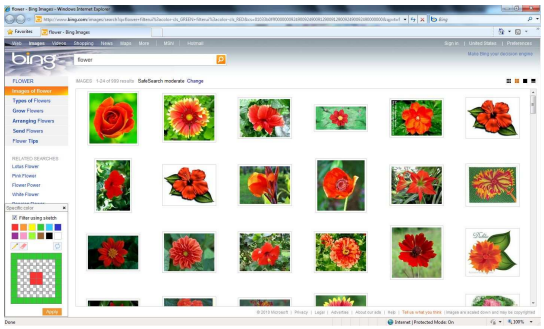

Figure 1: The snapshot of the interface.

This system presents two color-sketch modes. 1) Stroke scribbling. End-users merely scribble a few color strokes in a blank canvas; 2) Image dragging. Users may drag an image to the blank canvas and mask the color regions of interest, to show the desired spatial distribution of colors. Our system mines and formulates the search intent from the sketched color map, and reranks image search results to help users find desired images.

The snapshot of the system interface is shown in Fig. 1. Two example results are shown in Fig. 2 and Fig. 3. A user wants to find images that contain a red apple with green leaves on the top. The user may submit a target color map by drawing a few color strokes, shown in the bottom left image of Fig. 2(a), and then obtains the reordered results under the textual query *apple* as shown in Fig. 2(a). Fig. 2(b) shows another task searching for images that contain a red car on the green grass with the query *car*. As another interaction mode, the user may drag an image (e.g., an image with the query *sunset*) to find images with similar color map, shown in Fig. 3(a). Moreover, a user aims to find sunset images with the blue sky. She can draw blue strokes on the top. And the results are shown in Fig. 3(b). Furthermore, the user can erase the bottom part and gets the results shown in Fig. 3(c).

Techniques The flow chart of the online process is shown in Fig. 4. First, we process the target color map to extract

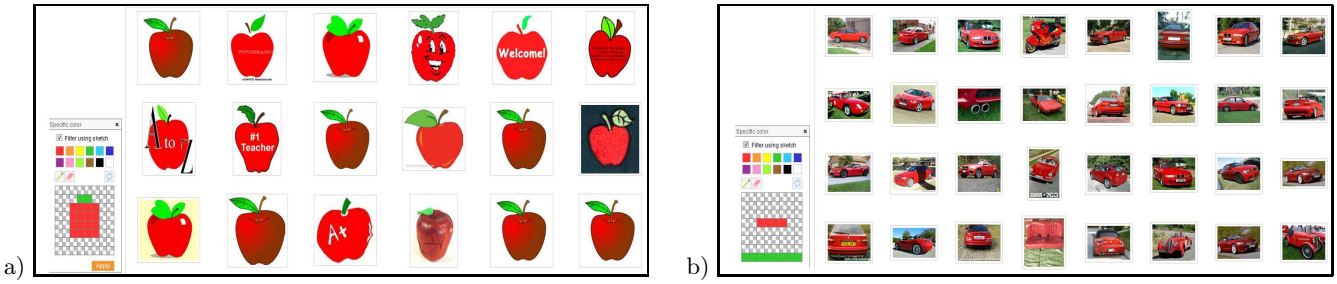

Figure 2: Two examples showing the search results using color sketches.

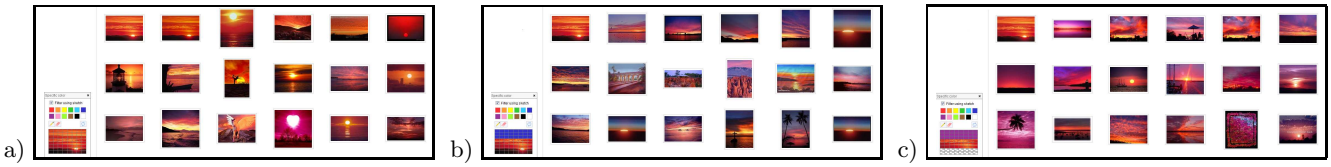

Figure 3: An example showing that our system can enable users to edit an image to illustrate the intent. (b) shows the results expecting a blue sky and (c) shows the results expecting the color pink at the top.

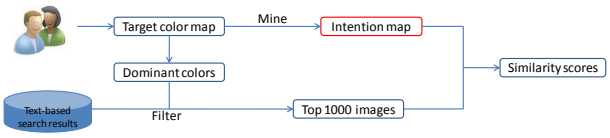

Figure 4: The flow chart of our approach.

the dominant colors and mine the intention map. Then, the dominant colors are used to filter the image search results associated with the text query. Next, we compute the similarity scores between the mined intention map and the top 1000 images that remain after dominant color filtering, and finally reorder those images.

The database images are preprocessed by extracting the dominant colors and the color map feature. The dominant colors are found from 11 colors: BLACK, BLUE, BROWN, GRAY, GREEN, ORANGE, PINK, PURPLE, RED, WHITE, and YELLOW. For each image, we compute the frequency of each color, and set the colors as dominant colors if their corresponding frequencies are larger than 10%.

To extract the color map, we divide the image uniformly into $g \times g$ grids. For each grid (x, y), we aim to find one or two representative colors by checking the frequencies for all the quantized colors. In our implementation, we find that $g = 8$ works well. In the preprocessing stage, we first transform the RGB (red, green, blue) color space into the HSV (hue, saturation, value) space, which is then quantized into $n_h \times n_s \times n_v$, where $n_h = 12$ $n_s = 4$, and $n_v = 4$.

The similarity between target color map and image color map is evaluated by mining the intention map and considering the intention consistency and propagation intention. Details can be found from [1].

User study We conducted user studies to compare our system with two Web image search engines, Google image search and Bing image search. In the following, we use engine A to represent one of the two engines, and engine B to represent the other one. We recruit 30 volunteers and collect 40 tasks for this study. To evaluate the performance, we consider two measures. The first is the degree of satisfaction (DoS) in the top 20 images. We do not check all

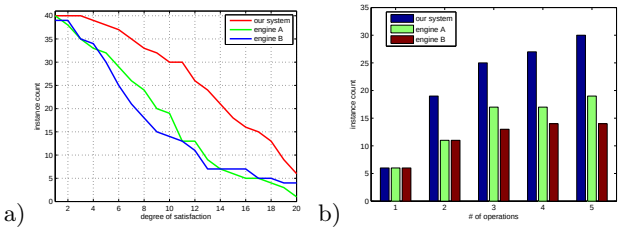

Figure 5: (a) shows performance comparison with the number of tasks (instances) against the degree of satisfaction. (b) shows the performance comparison of the number of tasks against the number of operations with the degree of satisfaction being 50%.

the search results since it is observed that users often check the images in the first several pages. The measure reflects whether users can successfully find their desired images using the search system. The second one is the number of units of operations required to get the satisfied result, which indicates the effort involved. The comparison is shown in Fig. 5.

Conclusions In this demo, we present a web-scale image search system, image search with color sketch, which enables users to find images with desired spatial distribution of colors. We have extended color map to concept map [2, 3]. Our ongoing work aims to design a more effective indexing algorithm to organize the color maps for efficiently searching for images with the target color maps in which there exist missing colors in cells.

1. REFERENCES

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