MagicBrush: Image Search by Color Sketch*

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ABSTRACT

In this paper, we showcase the MagicBrush system, a novel painting-based image search engine. This system enables users to draw a color sketch as a query to find images. Different from existing works on sketch-based image retrieval, most of which focus on matching the shape structure without carefully considering other important visual modalities, MagicBrush takes into account the indispensable value of "color" related to "shape", and explores to make use of both the shape and color expectations that users usually have when they're imaging or searching for an image. To achieve this, we 1) develop a user-friendly interface to allow users to easily "paint out" their colorful visual expectations; 2) design a compact feature "color-edge word" to encode both shape and color information in a organic way; and 3) develop a novel matching and index structure to support a real-time response in 6.4 million images. By taking into account both shape and color information, the MagicBrush system helps users to vividly present what they are imagining, and retrieve images in a more natural way.

Categories and Subject Descriptors

H.3.1 [**Information Storage and Retrieval**]: Content Analysis and Indexing

General Terms

Algorithm, Design, Experimentation

Keywords

Color Sketch, MagicBrush, Painting-based Image Retrieval

1. INTRODUCTION

Sketch-based image retrieval has been studied for over thirty years. Most existing works [1, 2] in the literature mainly focus on shape silhouettes matching between a binary sketch and images, without careful consideration over the value of "color" information when human express their visual expectations. Some other works [3, 4], although being aware of the importance of color, only make use of very weak color information, such as the global dominant color, grid-based color layout, or wavelet-based color distribution, without precise shape constraints.

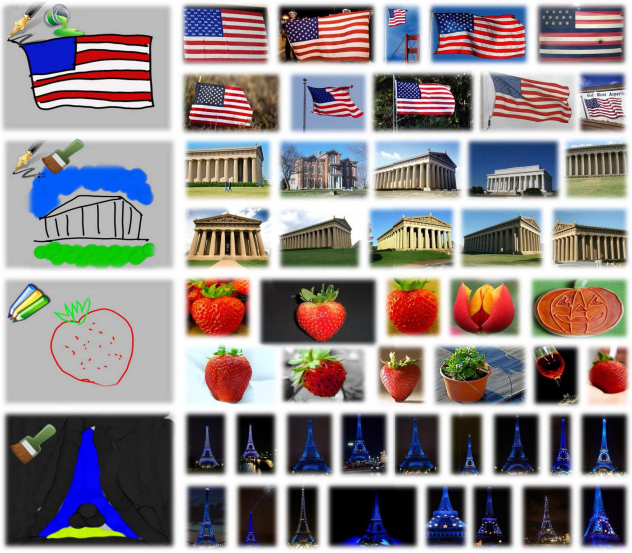

Figure 1: Examples of image search by color sketch (MagicBrush). The first column shows user-drawn color sketch queries, and the rest of columns show the search results matching both shape and color intention in users' paintings. Each row explains one of the four painting modes designed for natural painting input: pen + color bucket, pen + color brush, color pencil and pure color brush.

However, color information is not an isolated attribute, but strongly related to particular shape structures. For example, although a red circle in left-top corner in the green background may have similar color layout with a red rectangle located in the same position with a same background, actually they are dissimilar due to the shape difference of related objects. Both shape and color are inseparable visual elements in human visual system. Besides, in many computer vision tasks, combining both color features and intensity-based features were proved to increase features' discriminative ability, however, such a valuable insight was rarely uti-

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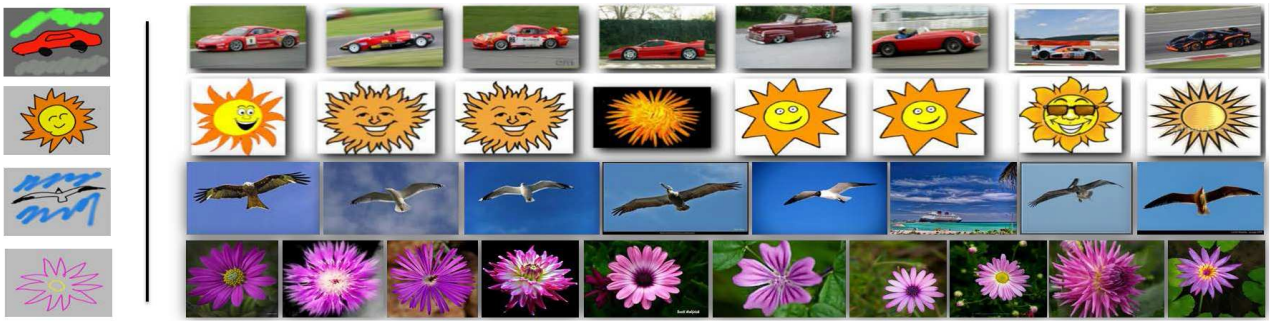

Figure 2: Example color sketch queries and the corresponding top results of MagicBrush.

Figure 3: User interface with canvas panel (left-top), painting tool panel (left-bottom), and the result panel (right).

lized in the search-by-drawing problem. Moreover, in many cases, users indeed have the need to express their search intentions using both color and shape, such as, searching for "a blue shirt with a red rectangle logo" in on-line shopping, or searching for "a white house locating at the foot of green hills under the blue sky" when preparing slides. For such intentions, matching with only shape or only color layout might not lead to satisfactory results.

In this work, we develop a painting-based image retrieval system which allows users to draw a color sketch as a query to search images. It utilizes both the shape and color information expressed in a sketch to provide a better image search experience. To help users better express the visual search intentions, we first develop a flexible painting interface which enables users to freely draw curves and paint colors with multiple interaction modes, as illustrated in Fig.1. The challenges in matching such a free painting query with natural images in the database mainly lie in two aspects: 1) effective representation and matching scheme to incorporate both shape and color information in a sketch or an image; and 2) efficient index structure to support realtime image search in a large-scale database. These two aspects are actually coupled with each other, making the problem more challenging. To capture the local shape and color information of a sketch and an image, we introduce an edge-based patch-like representation, i.e. *color-edge word*, which is composed of a contour fragment and two local regions split by the contour. Based on this representation, a generalized Chamfer matching algorithm is proposed for matching a color sketch and an image. Finally, an inverted index-like structure is leveraged to speed up the matching process in a large-scale database. Under this framework, we collected 6.4 million images including Flickr images, Bing product images and clipart images, based on which we built a real-time painting-based image search system *MagicBrush* with 8.4G-B memory cost on a common server. Some example results of the *MagicBrush* system are illustrated in Fig.2.

2. SYSTEM INTERFACE OVERVIEW

In this section we briefly introduce the system's interface and painting modes.

User Interface Our system has three major panels (Fig.3): *canvas panel*, where users can express their search intentions by drawing color sketch with specific painting tools; *painting tool panel*, which provides several flexible painting tools, such as binary pen, color bucket, color pencil, color brush, and a set of color picker tools; *result panel*, an image wall displaying the top search results related to the color sketch drawn by users in the canvas panel.

Painting Modes To facilitate users to draw the color sketch query, we design four painting modes: (1) **binary pen + color bucket** (Row 1 in Fig.1), enabling users to first sketch the silhouettes of a shape with a binary pen tool, and then flood fill colors in any closed region with the bucket tool; (2) **binary pen + color brush** (Row 2), enabling users to indicate colors for open regions in a sketch with the brush tool. The color will be automatically propagated to the closest side of nearby strokes; (3) **color pencil** (Row 3), enabling users to directly draw colorful lines to indicate the shape while the color of the lines will be propagated to the interior of closed regions; (4) **color brush** (Row 4), enabling users to directly paint color patches or regions with the color brush tool. The boundaries of color regions will be extracted as main features lines to reflect the intended shape.

3. ACKNOWLEDGEMENTS

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