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An effective solution for trademark image retrieval by combining shape description and feature matching ☆

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ABSTRACT

Trademark image retrieval (TIR), a branch of content-based image retrieval (CBIR), is playing an important role in multimedia information retrieval. This paper proposes an effective solution for TIR by combining shape description and feature matching. We first present an effective shape description method which includes two shape descriptors. Second, we propose an effective feature matching strategy to compute the dissimilarity value between the feature vectors extracted from images. Finally, we combine the shape description method and the feature matching strategy to realize our solution. We conduct a large number of experiments on a standard image set to evaluate our solution and the existing solutions. By comparison of their experimental results, we can see that the proposed solution outperforms existing solutions for the widely used performance metrics.

1. Introduction

With the rapid increases of multimedia information, multimedia information retrieval, e.g., content-based image retrieval (CBIR) [1,2], has drawn more and more attention. There is a growing interest on CBIR from both academia and industry. As a branch of CBIR, the research of trademark image retrieval (TIR) is of great practical significance. For example, if a company want to register a new trademark, they must find whether there are any similar trademarks in existing database to avoid trademark infringement. Existing trademarks retrieval is mainly based on manual classification code [3]. With the increase of registered trademarks, finding similar trademarks by human becomes laborious; thus, it is of great importance to find effective solutions for TIR [4].

For realization of TIR, two important issues must be addressed. One is how to extract appropriate feature vectors to represent image content correctly, and the other is how to carry out the image retrieval based on the extracted feature vectors effectively. For trademark images, the shape feature vectors are usually used to represent image content, so in this paper we concentrate on shape-based solution for TIR. Jain and Vailaya [5] proposed the weight-based solution (WBS), in which the extracted feature vector includes two shape features: edge directions and invariant moments, and a weight-based strategy was presented for feature matching. Wei et al. [6] proposed the two-component solution (TCS), in which centroid distances, contour curvature and Zernike moments were selected as the shape features, while a two-component strategy was applied in feature matching. Now, let us look at a simple example to investigate the performance of these two solutions.

In this example, we use a standard image set: "MPEG7 CE Shape-1 Part-B", in which the images are classified into 70 classes and there are 20 similar images in each class. Two sample images are shown in Fig. 1. The image "deer-5" in Fig. 1(a) is selected as a query to retrieve similar images. After querying, the top-10 retrieval results by applying WBS and TCS are listed in Table 1. As we know, there are 20 images belong to "deer" class in "MPEG7 CE Shape-1 Part-B". But from Table 1, we can see that, in the top 10 retrieval results, there are only 6 and 5 similar images are found by WBS and TCS, respectively. So the precision of the retrieval results by applying WBS or TCS is low. According to further analysis on these two solutions, we find that there are two problems:

- For shape description, edge directions in WBS, contour curvature and centroid distance in TCS only represent the feature of each boundary point, without considering the relationship between adjacent boundary points. And the moment-based features are complex to compute, especially Zernike moments. If an approximation method is used in solution, the retrieval accuracy cannot be guaranteed.
- For feature matching, we have to get the weight value in WBS and the threshold value in TCS. In general, it is hard to determine these values empirically. In their work, they got appropriate values for

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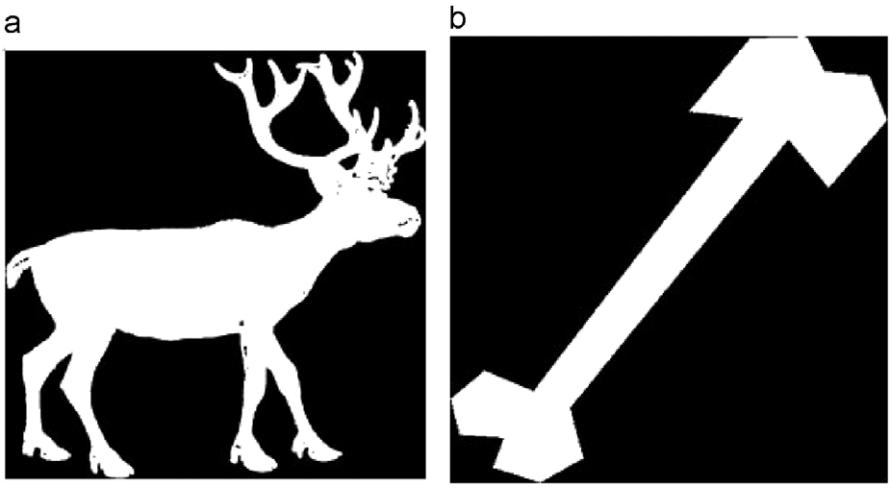

Fig. 1. Sample images in "MPEG7 CE Shape-1 Part-B" image set. (a) The image "deer-5"; (b) the image "Bone-10".

Table 1
Top 10 retrieval results of image "deer-5" based on the weight-based solution and the two-component solution.

Method	Retrieval Results				
The weight-based solution [5]	Rank: 1	Rank: 2	Rank: 3	Rank: 4	Rank: 5
	Rank: 6	Rank: 7	Rank: 8	Rank: 9	Rank: 10
The two-component solution [6]	Rank: 1	Rank: 2	Rank: 3	Rank: 4	Rank: 5
	Rank: 6	Rank: 7	Rank: 8	Rank: 9	Rank: 10

their image database, and the retrieval results of their solutions were ideal. But if the image database is changed, the results are not ideal. This can be seen from the above example. It is not considered in WBS and TCS how to select the new weight value or the new threshold value for different database.

To address the above problems, we propose an effective solution for TIR in this paper, which consists of both shape description and feature matching. The main contributions of this paper are summarized as follows:

- We propose an effective shape description method to extract the feature vector from images. In our method, two new shape descriptors are used. The contour-based shape descriptor not only represents the feature of every boundary points but also consider the relationship among two adjacent boundary points and the centroid. The region-based descriptor based on improved feature points matching to avoid the complex calculation of Zernike moments.
- We present an effective feature matching strategy to compute the dissimilarity value between a query image and an arbitrary image in the database. In our strategy, a statistics-based