Image and Vision Computing 19 (2001) 1011–1018

www.elsevier.com/locate/imavis

A new system for trademark segmentation and retrieval

Jau-Ling Shih*, Ling-Hwei Chen

Department of Computer and Information Science, National Chiao Tung University, Hsinchu, Taiwan, ROC

Received 2 August 1999; received in revised form 14 February 2001; accepted 5 June 2001

Abstract

With the increase in the number of trademarks, trademark imitation has become a serious problem. Thus, building an efficient trademark retrieval system is imperative. In this paper, such a system is presented. First, a semi-automatic segmentation method is proposed to extract the shapes of those representative objects, called 'masks', in each trademark. Next, some features are selected to describe a mask. These include invariant moments, the histogram of edge directions, and two kinds of transform coefficients that are robust to geometric deformation. Then, based on the rank of the feature distance, a similarity measure is provided to do the similar trademark retrieval. Finally, a feedback algorithm is also proposed to automatically determine the weight of each feature according to the user's response. Furthermore, in order to show the effectiveness of the proposed system, two databases from MPEG-7 test database are used to compare the performances of the proposed system and those methods using chain code, Zernike moments or MPLV as features. The experimental results show that the proposed system is superior to others. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Trademark segmentation; Trademark retrieval; feedback algorithm

1. Introduction

Trademarks are specially designed marks that identify companies, products, and services. The imitation of a registered trademark is illegal. However, there are so many trademarks around the world and how to avoid designing a trademark similar to an existing one becomes an important problem. To treat this problem, developing an automatic and fast content-based trademark retrieval system is necessary.

In general, trademarks can be divided into three types: character-in-mark, device-mark and composite-mark (Fig. 1). Since a character-in-mark trademark contains only characters, the traditional character recognition techniques can be applied. The device-mark trademarks contain only geometric shapes, while the composite-mark ones contain both characters and geometric shapes. The QBIC system proposed by IBM [1–3] places more emphasis on the device-mark and composite-mark trademarks. However, the QBIC system does not work very well for some trademarks with geometric deformation or partial change. In addition, if the users do not satisfy the retrieval results, the QBIC system cannot take the user's response to retrieve again.

Kim [4,5] uses the Zernike moment magnitudes (ZMMs), which are rotation and scale invariant and robust to noise and slight shape deformation, to do retrieval. But for some geometric deformation, such as the sphere transformation, the retrieval result is poor. Mehtre also introduced a retrieval system [6,7]. A color clustering algorithm and a shape clustering algorithm are provided to find connected components in a trademark. Then, some invariant moments of these components are used as the features for trademark retrieval. Since these moments are sensitive to shape deformation, only using these moments as features cannot correctly extract those trademarks with similar shapes.

Some methods [8,9] use the histogram of the edge directions of the shape boundary in a trademark as the feature. However, the histogram does not contain the location information. Zhang [10] proposed a dynamic shape matching algorithm which uses the eight-directional chain code to describe the binary shape. The chain code is robust to scale changes and small, non-rigid deformation. However, chain code is not rotation invariant. The eigenvalues and eigenvectors of each sub-region in an object are used as shape descriptor [11]. They are invariant to rotation and scale, but not invariant to geometric deformation. Some methods use boundary information to do image retrieval. These include the boundary matching algorithm [12],

* Corresponding author.
E-mail addresses: sjl@chu.edu.tw (J.-L. Shih), lhchen@cc.nctu.edu.tw (L.-H. Chen).

0262-8856/01/$ - see front matter
PII: S0262-8856(01)00063-4

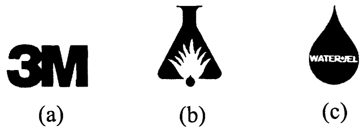

Fig. 1. Examples of three types of trademarks: (a) character-in-mark, (b) device-mark, and (c) composite-mark.

Fourier descriptor [13] and multiscale curve matching [14], etc. The performances of these methods depend on the accurate detection of the shape boundary. If there are some small cracks or overlap in the components of a trademark, the retrieving result will be much different. Moreover, the Fourier descriptor and curve matching method are sensitive to boundary pixel number. To treat these problems, we provide a new system for trademark retrieval in this paper. The system includes three phases: the trademark segmentation, feature extraction, and trademark retrieval. In the trademark segmentation phase, a semi-automatic and user-friendly trademark segmentation sub-system is proposed. Using this sub-system, a user can locate those representative masks from a trademark. In the feature extraction phase, four kinds of features are extracted. These include invariant moments, two kinds of transform coefficients and the histogram of edge directions. The invariant moments are invariant to rotation, scaling and translation. Two kinds of transform coefficients are obtained by combining the polar-coordinate transform, an edge detector [15], derivative, and the Fourier transform [15]. They are invariant to rotation, scaling and translation and robust to shape deformation. Besides, the histogram of edge directions is a suitable feature vector to search for those similar masks with different mass centers. In the trademark retrieval phase, based on the extracted features, a similarity measure is first provided to search for similar trademarks in the trademark database. Then, a feedback algorithm is proposed to automatically determine the weight of each feature via the user's response. The information contained in the database includes trademarks, masks, and feature set. Furthermore, in order to show the effectiveness of the proposed system, based on the MPEG-7 test database [11], some experiments have been conducted on the proposed system and other methods using chain code [10], Zernike moments [5], or MPLV [11] as features. The experiment results show that the proposed system is superior to others.

In Section 2, we will introduce the proposed trademark segmentation sub-system. In Section 3, feature extraction methods will be described. The similarity measure and feedback algorithm will be described in Section 4. Section 5 will present the experimental results. Finally, conclusions will be given in Section 6.

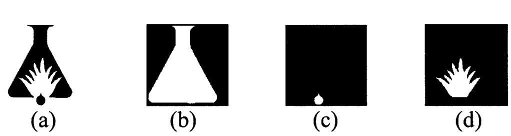

Fig. 2. The original trademark and three suggestive masks: (a) an original trademark, (b) the first mask, (c) the second mask, and (d) the third mask.

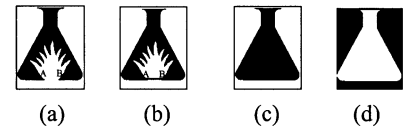

Fig. 3. An example to illustrate the process of segmenting a desired mask from Fig. 2(a): (a) the result of using 'Region-delete' to take off the little black spot from Fig. 2(a), (b) the result of using 'Draw-black-line' to connect points A and B, (c) the result of applying the 'Region-growing' on the interior white area of (b), and (d) the desired mask (white part) obtained by applying the Region-growing on the black bottle of (c).

2. Trademark segmentation

For real world trademarks, those belonging to one company usually are designed as the same shape with various colors. This means that the trademark shape is a more important feature than the color during the retrieval process. Thus, in this paper, the trademark shape will be used to do similar retrieval. For most trademarks, it is hard to extract their representative shapes automatically. One example shown in Fig. 2 is given to illustrate this fact. Fig. 2(a) shows an original trademark in which there are three different subjective representative shapes shown in Fig. 2(b) – (d). From this figure, we can see that developing a segmentation method to automatically extract these three shapes is impossible. Due to this fact, we will propose a semi-automatic (i.e. interactive) trademark segmentation sub-system to extract those desired shapes called 'masks'. Using this sub-system, a trademark will be first segmented into some masks. A mask represents a meaningful object in the trademark. Based on these extracted masks, the features used to do retrieval are extracted.

In the proposed sub-system, some primary functions are provided and described as follows: (1) Thresholding: using binary thresholding method to get a binary image from a given gray level trademark image. (2) Region-growing: using the Region-Growing algorithm [15] to find a connected area. The seed of the Region-Growing algorithm is selected by the user. (3) Region-delete: using the Region-Growing algorithm to delete a connected area. The seed is also selected by the user. (4) Draw-black-line (Draw-white-line): draw a black (white) line segment. It is used to restrict the area of the Region-growing and Region-delete. The starting and ending points of this line are identified by the user. An example is shown in Fig. 3. This interactive sub-system can be operated easily and help the user to get the desired masks.

3. Feature extraction

After all masks are extracted from a trademark, users can use one of these masks (called query mask) to search for