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Indexing Techniques in Trademark Image Retrieval Systems

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Abstract*: The development of automatic trademark image retrieval systems becomes a necessity because of the increasing number of registered trademarks in all countries. The goal is to protect the registered trademarks from counterfeiting and infringement. This paper introduces a trademark image retrieval system using indexing techniques. The proposed system is described by giving an overview about its architecture and describing in details all its components. The goal is to allow researchers and developers in image retrieval to build their own trademark retrieval system using the indexing techniques. Each part of the proposed system is considered as a component that can be improved or replaced. The reader can have a clear idea on: (1) the type of visual features to extract from the trademark images, (2) the indexing technique that can be used to organize the extracted features and speed-up the search and (3) how to perform a similar search for a new trademark image. The proposed system has been evaluated using several global features and the best performance is obtained when using Zernike moments coefficients with order 12.

Keywords: Content-based image retrieval, indexing techniques, trademark systems.

I. INTRODUCTION

Face recognition, fingerprint identification, art pictures and trademark registration are examples of applications that utilize the Content-based image retrieval (CBIR) systems. The development of trademark image retrieval (TIR) systems is crucial due the huge number of trademarks registered around the world. A trademark is the design, symbol or sign used to identify the services or products of a company. It could be represented as an image or graphic, text or a combination of both. The rapid and continuous increase of registered trademarks makes the development of automatic trademark image retrieval systems a necessity to protect the registered trademarks from counterfeiting and infringement and avoid any confusion between a new trademark image and the existing trademarks. Numerous trademark image retrieval systems have been developed, the most popular TIR systems and widely referred in research studies are ARTISAN [1], STAR [2] and TRADEMARK [3].

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In ARTISAN system, the trademark images are characterized by shape features [4] (aspect ratio, circularity, transparency, and relative area).

Then they are grouped into families based on the shape similarity using clustering techniques to facilitate the matching and retrieval process. STAR system considers the shape components and spatial relationship between them; it uses moment invariant, gray-level projection, gray-level change projection and Fourier descriptor as visual features to represent the trademark images. While in TRADEMARK system the visual content of trademark images is represented with graphical features (GF) and the retrieval is based on a subjective similarity that relies on human perception.

Multiple methods have been proposed in TIR; some of them utilize global features such as shape features [5] and color features [6, 7].

In some studies a combination of global features is utilized, like the integration of shape and textures features in [8] and shape and color features in [7]. In order to allow the partial matching, methods that utilize local features have been proposed such as [9, 10] using SIFT features and [11] using Harris corners.

While in [12], trademark image retrieval methods that rely on both global and local visual features are proposed, in 24 Zernike moments coefficients represent the global features and the edge-gradient co-occurrence matrix is the local feature. Recently, with the availability of large datasets, several research works based on deep learning have been proposed [13, 14].

Feature extraction and feature indexing and matching are the two main research directions in CBIR. However, most of the research works in trademark image retrieval focused on the identification of suitable visual features.

The indexing, search and matching in TIR systems are crucial, the indexing allows to organize the visual features of registered trademarks with the goal of accelerating the search of similar features with a new trademark. In this paper, a TIR system using an indexing technique is proposed and the architecture of system is described.

The rest of the paper is organized as follows: the different components of the proposed retrieval system are described in Section 2. Then, Section 3 presents the experiments considered in the evaluation of the proposed retrieval system along with results. Finally, the conclusion and the future directions that could be considered are presented in Section 4.

II. PROPOSED SYSTEM

The Figure 1 illustrates the architecture of the trademark image retrieval system, it is composed of two phases; the off-line phase, which starts by extracting the visual features from all trademark images of the trademark datasets, after that, the visual features are organized in a hierarchical structure(called index) obtained after application of the high-dimensional indexing method NOHIS [15].

The indexing technique is used to accelerate the search and the matching processes. The second phase is the online phase, when a new trademark is entered into the system, its visual features are extracted and a search is performed on the index NOHIS-tree using those features. Finally, the similar trademarks obtained as results from the search are displayed.

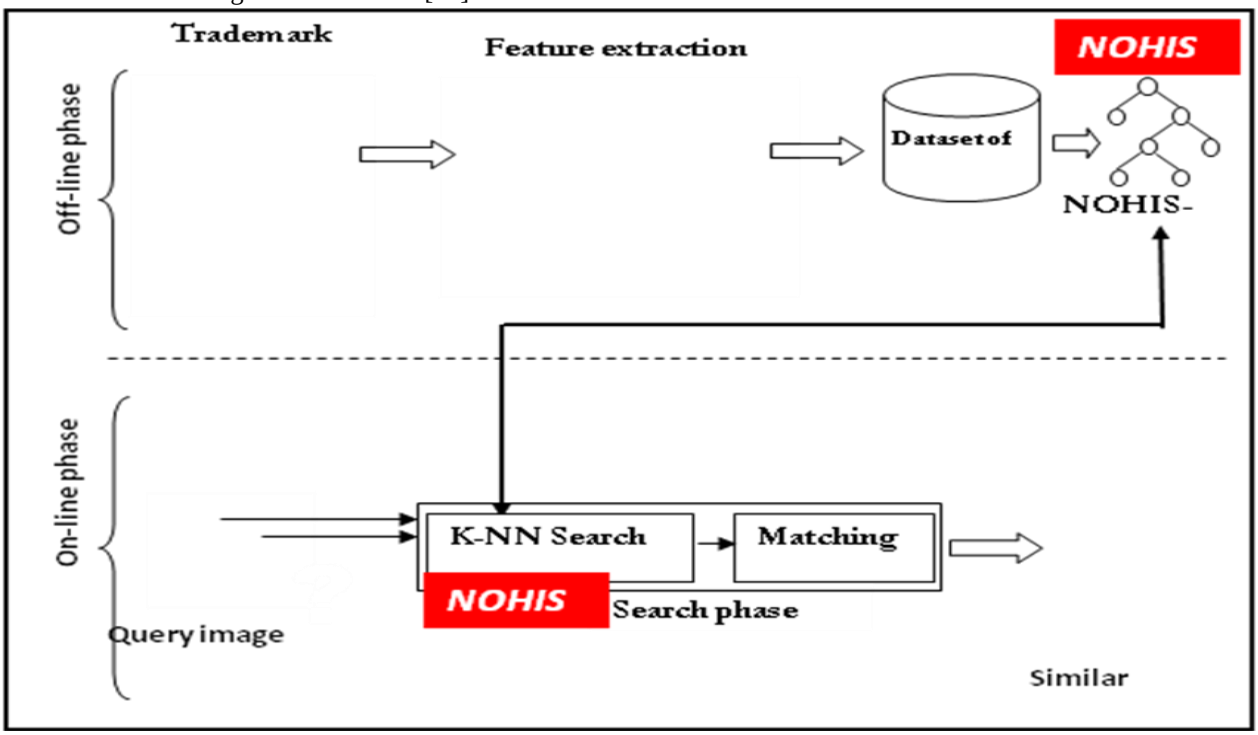

Fig. 1. System Architecture

A. The off-line phase

The different activities performed in the off-line phase of the proposed system are described in the following sub-sections.

1. Feature Extraction

We have considered two global features to build the TIR system: Zernike moments coefficients with different orders (4, 8 and 12) and Edge Histogram Descriptor (EHD). The EHD features are extracted using the tool given in [16]. A comparative study is performed between the global features.

2. Feature Indexing

B. There are two approaches in literature to obtain a multi-dimensional index; the first approach is the use of a multi- dimensional indexing technique such as SS-tree [17] and R-tree [18]. The other approach is the use of clustering techniques to regroup data (visual features) into clusters then organize the clusters into a hierarchical structure called index. In the proposed system, after extraction of visual features from the trademark images, the features are indexed using the high-dimensional indexing technique NOHIS and an **The On-line Phase**

During this phase the search and retrieval are performed when a new trademark image is entered to the system. The search and retrieval of similar trademark images to a new trademark involves the following activities:

a. Extraction of the global visual features from the new trademark image.

b. Search the K-nearest neighbors (K-NN) of the global visual feature. The similarity between features in the K-NN search algorithm is calculated using the Euclidean distance. The K-NN search algorithm is given in [15].

c. Display the trademark images that correspond to the nearest neighbors obtained from the previous step.

index called NOHIS-tree is obtained. The indexing technique has a key role in the search and retrieval process, it helps to accelerate the search process. The input of the indexing technique is the matrix of all visual features extracted previously and the output is a binary and non-balanced high-dimensional index.

Fig. 2. Example of Search Results with EHD Features.

III. EXPERIMENTAL RESULTS

The proposed TIR system has been evaluated using MPEG-7 shape database. The total size of the database is 1400 images distributed on 70 categories and each category contains 20 images. The global visual features explained previously are used in the search and retrieval processes and a comparative study is performed. The experimental evaluation is just to show that the proposed TIR system as a working prototype capable of retrieving similar trademark images to a new one. All the images of MPEG-7 shape database are considered as queries, thus the metric considered in the evaluation is the Bull's Eye score (BES) [19], it represents the fraction of the number of correctly retrieved trademark images to the total number of correct matches (which is 20 x 1400). The formula is as follows:

$$BES = \sum_{i=1}^{1400} \frac{q_i}{(1400 \ x \ 20)} \quad (1)$$

Where q_i is the number of correct matches for each query image. The correct matches are obtained using K-NN algorithm where K = 20 since the number of images in each category is 20.According to the results presented in Table 1, the best Bull's Eye score is obtained when using Zernike moment coefficients with order 12.

Table- I: Bulls Eye Scores

EHD	Zernike (order 4)	Zernike (order 8)	Zernike (order 12)
40.3%	41.2%	44.3%	45%

A similarity search example is provided in Figure 2. The visual feature considered in the search is EHD and the number of neighbors (K) or similar images is equal to 20.

IV. CONCLUSION AND FUTURE WORK

A TIR system using the indexing technique NOHIS is proposed in this paper and its components are presented in details. As mentioned earlier, each component of the system can be improved or replaced by another with a different technique. It is worth to mention that the consideration of global features was just to complete the build of the retrieval system in order to test it and make sure that all the system components are working well together. A comparative study between the visual features was performed and the best performance is obtained when using Zernike moment coefficients with order 12. As future work, the global features will be replaced with local features or both global and local features will be considered to obtain better performance with the retrieval system. The matching process will be adapted as well when using the local features.

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REFERENCES

1. J. P. Eakins, M.E. Graham and J. M. Boardman, "Evaluation of a trademark image retrieval system," in Proceedings of the 19th Annual BCS-IRSG conference on Information Retrieval Research, Aberdeen, 1997.
2. J.K. Wu, C.P. Lam, B.M. Mehtre, Y. J. Gao and A. Narasimhalu, "Content-based retrieval for trademark registration," Multimedia Tools Application, vol. 3, pp. 245-267, 1996.
3. K. Toshikazu, "Database architecture for content-based image retrieval," in Proceedings of SPIE Image Storage and Retrieval Systems, 1992.
4. J. P. Eakins, M. E. Graham, J. M. Boardman, and K. Shields, "Retrieval of trade mark images by shape feature," . British Library, London, 1996.
5. C. Zhang and F. C. You, "The technique of shape-based multi-feature combination of trademark image retrieval," Advanced Materials Research, vol. 429, pp. 287-291, 2012.
6. C. Lam, J. Wu and B. Mehtre, "Star-a system for trademark archival and retrieval," World Patent Information, vol. 18, 1996.
7. M. Rusinol, F. Nourbakhsh, D. Karatzas, E. Valveny and J. Llados, "Perceptual image retrieval by adding color information to the shape context descriptor," in Proceeding of the 20th International Conference on Pattern Recognition (ICPR), 2010.
8. D. Agrawal, S. Jalal and R. Tripathi, "Trademark image retrieval by integrating shape with texture feature," in Proceeding of the International Conference on Information Systems and Computer Networks (ISCON), 2013.
9. P. Kochakornjarupong, "Trademark image retrieval by local features", PhD thesis, University of Glasgow, 2011.
10. C. Lin and Y. Zhao, "Trademark retrieval algorithm based on sift feature," Computer Engineering, vol. 23, pp. 257-277, 2008.
11. A. Zeggari, F. Hachouf and S. Foufou, "Trademarks recognition based on local regions similarities," in Proceeding of the 10th International Conference on Information Sciences Signal Processing and their Applications (ISSPA),, 2010.
12. O. Tursun and S. Kalkan, "METU dataset: A big dataset for benchmarking trademark retrieval," in Proceeding of the 14th IAPR International Conference on Machine Vision Applications (MVA), 2015.
13. S. J. Hassen, A. Taha and M. M. Selim, "Trademark Image Retrieval using Transfer Learning," Journal of Engineering and Applied Sciences, vol. 14, pp. 6897-6905, 2019.
14. T. Lan, X. Feng, L. Li, and Z. Xia, "Similar Trademark Image Retrieval Based on Convolutional Neural Network and Constraint Theory", in Proceeding of the Eighth International Conference on Image Processing Theory, Tools and Applications (IPTA), 2018.
15. M. Taileb, S. Lamrous and S. Touati, "Non-Overlapping Hierarchical Index Structure for Similarity Search," International Journal of Computer and Information Engineering, vol. 2, pp. 106-112, 2008.
16. M. Bastan, H. Cam, U. Gudukbay and O. Ulusoy, "BilVideo-7: An MPEG-7 Compatible Video Indexing and Retrieval System," IEEE MultiMedia, vol. 17, pp. 62-73, 2010.
17. D.A. White and R. Jane, "Similarity indexing with the SS-tree," in Proceeding of the 12th Internatioanl Conference of Data Engineering, New Orleans, Louisiana, USA, 1996.
18. A. Guttman, "R-trees: A dynamic index structure for spatial searching," in Proceedings of the ACM SIGMOD International Conference on Management of Data, Boston, 1984.
19. T. Zuva, K. Zuva, S. O. Ojo and S. Ngwira, "Image Representation Using Epanechnikov Density Feature Points Estimator," Signal & Image Processing: An International Journal (SIPIJ), vol. 4, pp. 75-82, 2013.

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