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Image Classification Based on Two Dimensional Wavelet Packet Spectrum

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Abstract:
We have developed a new algorithm for image classification based on two dimensional wavelet packet spectrum. Two dimensional wavelet packet is used for texture classification. Our method uses both color features and texture features the image. Our Method uses both multiple types of object features and context within the image. The generative phase normalizes the description length of images, which can have an arbitrary number of extracted features of each type. In the discriminative phase, a classifier learns which images, as represented by this fixed-length description, contain the target object. We have tested the approach by comparing it to several other approaches in the literature and by experimenting with several different data sets and combinations of features. Our results, using color, texture, and structure features, show a significant improvement over previously published results in image retrieval. Using salient region features, we are competitive with recent results in object recognition.

1. Introduction

Recognition of classes of objects in images and videos is an important problem in computer vision with applications in autonomous vehicle navigation, surveillance, aerial video analysis, and image or video retrieval systems. In the context of image annotation, image regions from various segmentations are used for recognizing object classes in images or videos [5] [10] [16] [2] [15] [6] [7]. Appearance based object recognition, which was initially proposed for recognizing specific objects, has progressed to detection of instances of object classes [12]. Most of these systems use formal learning methodologies, such as Bayesian decision making, neural nets, support vector machines (discriminative approach) or the EM algorithm (generative approach).

More recently, the learning approach has been extended by the development of interest operators [9] [4] [11] that select image windows having patterns that might be used for recognizing objects and to the ability to learn constellations of parts that make up a more complex object [11] [3] [17] [14].

Our goal in this work is to develop a classification methodology for the automatic annotation of outdoor scene images. The training data is a set of images, each labeled with a list of one or more object (or concept) classes that it contains. There is no information on the locations of these entities in the image. For each class to be learned, a classifier is trained to detect instances of that class, regardless of size, orientation, or location in the image. The solution that we propose is a generative/discriminative learning procedure that learns the object or concept classes that appear in an image from multiple segmentations of pre-annotated training images. It is significant in several respects:

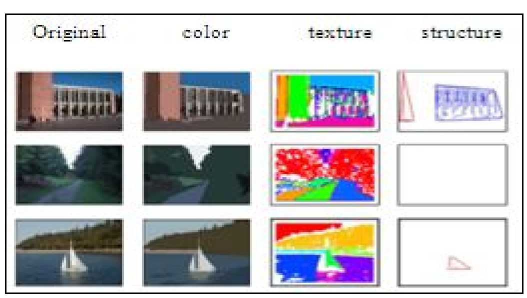

Figure 1: Abstract regions corresponding to color, texture, and structure segmentations

- It is able to work with any type of feature that can be extracted from an image by some automatic segmentation process and represented by a vector of attribute values. It can work with regions from a color or texture segmentation, groups of line segments, or small windows selected by an interest operator.
- It can work with any number of different feature types simultaneously. The formalism we developed for a single feature type generalizes easily multiple feature types (Section 3.2). Thus we can use several features types together for a more powerful recognition system.
- Like the work of Dorko and Schmid [1] and the more theoretical paper of Raina et al [13], our method consists of two phases: a generative phase followed by a discriminative phase. Our method is distinguished in the elegant framework we use for our discriminative phase. In particular, although each segmentation process can produce a variable number of instances of its features, our methodology produces a fixed-length description of each image that summarizes the feature information in a novel way. This allows the discriminative phase to be implemented by standard classifiers such as neural nets or support vector machines. Although our work was motivated by the image annotation problem, the learning framework is general and could also be used as part of an object recognition system.

In this paper we developed an algorithm based on 2D wavelet spectrum and color features based Image classification system.

2. How the System Works

Image Classification system is equipped with database of images with different set of features. User has interface to add image in the image database and retrieve images from the database. A database stores all the images from which the image similar to the query instance is to be retrieved. When a query instance is entered in the input panel, the image feature for that image is derived and this is then compared with the all image features of the images stored in the database. The image whose feature matches closest to that of the query instance will be the output. The larger the image database slower is the retrieval process [2].

2.1. Image Classification

In our IMAGE CLASSIFICATION system, it is divided into two parts: learning and querying. The learning step tells about the training process which a huge mount sample images are input in the first step, then the images' features are extracted for the clustering. K-means algorithm is selected to cluster the training data because of it is easy to implement, efficient and well developed in the recent

50 years. Finally the training output the clustering result as a learning code book. The query part describes the images searching process. Inputting the query images and matches to the training result. The output shows the most similar images for user's query. Figure 1 shows the overview of the IMAGE CLASSIFICATION.

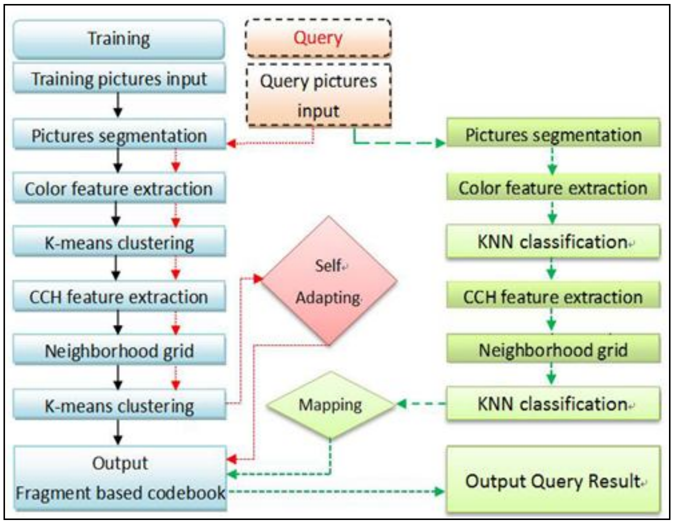

Figure 1: Overview of the IMAGE CLASSIFICATION system

2.2. Image Segmentation and Grid Module

The data images input into the system will be first processed in this module. In the images retrieval, larger images usually decrease the retrieval accuracy. Small images grids help in feature extraction and images processing. Therefore, this module first divides the images into F*F grid and every grid will divided again into S*S sub-grids while during the feature extraction module. In this stage, an input images will finally divided into (F*S) 2 grids which the F*F grids uses both in feature extraction module and neighborhood module. The inside S*S grids are only used in color feature extraction. Figure 3 shows the sample of images segmentation.

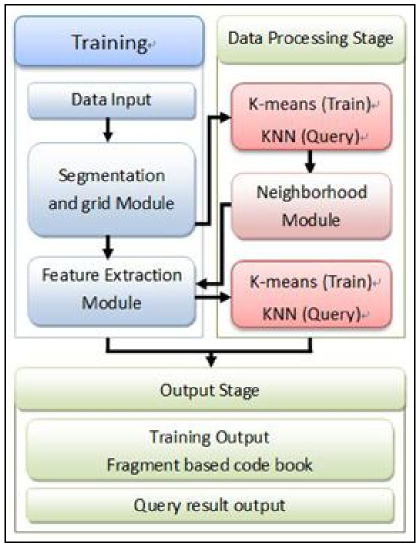

Figure 2: Flow chart of the system architecture

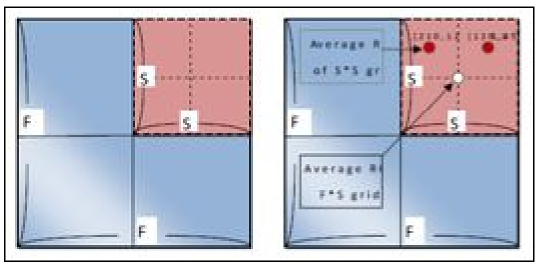

Figure 3: Sample of Segmentation and grid module and Color feature extraction

2.3. Feature Extraction Module

The input images, including the training and query stage, are all processed in this module. It is also the most important in image retrieval. Since color is the most popular and intuitive feature based on human visualization, it is applied in the system. In order to get more powerful features, the CCH method is also applied for extracting the important feature point. The two feature extractions are described as below:

2.3.1. Color Feature Extraction

Input images will be divided into F*S grids before this stage. All grids are input to extract the color feature. First, the module compute the average RGB value of the F*F grids. Second, the inside S*S grids in every F*S grids will also be input to calculate the average RGB value. The S*S grids' detail RGB information is append after the F*S grids' color feature information. All those are prepared for first K-means clustering. Figure 3 illustrates the color feature extractions of this stage.

2.3.2. 2D wavelet spectrum feature extraction

We consider the 2-D separable wavelet packet decomposition in a *continuous time signal* setting for presenting theoretical results (see [7] for the connection between the continuous and the discrete wavelet transforms). In this decomposition, the wavelet para-unitary filters *H*0 (low-pass, *scaling filter*) and *H*1 (high-pass, *wavelet filter*) are used to split the input functional space **U** Æ **W**0,0 ½ *L*2(R2) into orthogonal subspaces (sub bands):

$$
\begin{aligned}
\mathbf{W}_{0,0} &= \mathbf{W}_{1,[0,0]} \oplus \mathbf{W}_{1,[1,0]} \oplus \mathbf{W}_{1,[0,1]} \oplus \mathbf{W}_{1,[1,1]}, \\
\mathbf{W}_{j,[n_1,n_2]} &= \mathbf{W}_{j+1,[2n_1,2n_2]} \oplus \mathbf{W}_{j+1,[2n_1+1,2n_2]} \oplus \cdots \\
&\quad \oplus \mathbf{W}_{j+1,[2n_1,2n_2+1]} \oplus \mathbf{W}_{j+1,[2n_1+1,2n_2+1]}
\end{aligned}
$$

3. Implementation and Experimental Results

Based on the method provided in this paper, the experiments are designed to verify the architecture of the IMAGE CLASSIFICATION system. Also the experiments shows the modules proposed in this article perform good and well organized with the IMAGE CLASSIFICATION system architecture.

First the IMAGE CLASSIFICATION system splits and calculates the average RGB, we have implemented and figure 6 shows samples of the color feature and split result.

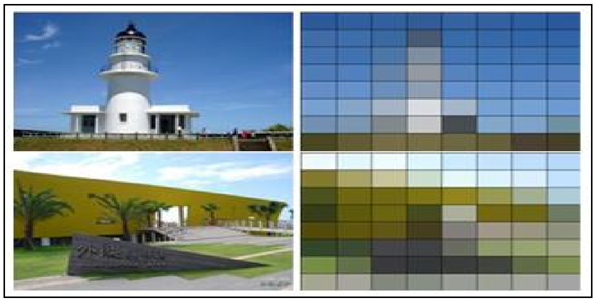

Figure 4: Samples of the color feature resul

The color features extracted from X pictures divided into Y fragments and pictures training clustered result is visualized as figure 4,5,6,7. The results show that the same color features of fragments are clustered together. Then the neighborhood module, CCH feature points are combined to be clustered to generate the training result, called the code book. Based on the fragments, image can be retrieval in detail and the clustering helps decrease the computing cost.

Figure 5: visulization of cluster no.2 derived by k-means color clustering

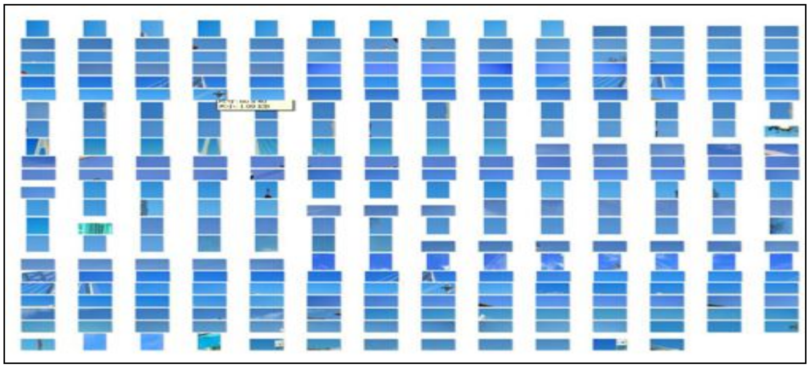

Figure 6: Cluster NO.6 derived by K-Means Color Clustering.

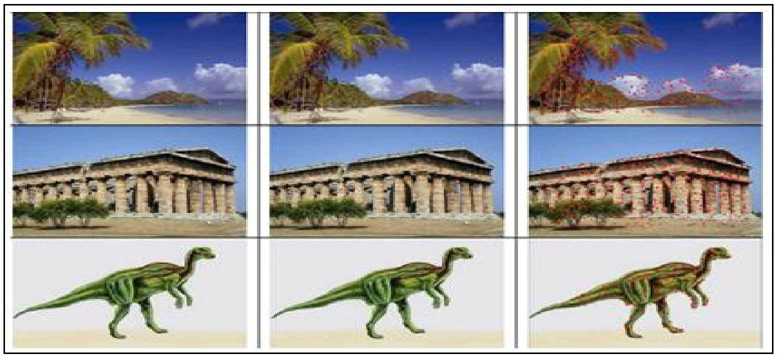

Figure 7: Image Classification Results

4. Conclusion

The proposed system is designed to operate the content based image retrieval system. It has been verified with the photos of places of interest in Taiwan and the Wang's dataset [24][25]. Our experimental results demonstrate that our Image Classification system architecture not only works well for image retrieval, but also improves its precision.

In our knowledge, this paper first combines segmentation and grid module, feature extraction module, K-means clustering and neighborhood module to build the Image Classification system. Furthermore, the concept of neighborhood module which recognizes the side of every grids of image is first contributed in this paper. Applying the concept of 2D Wavelet Packet Spectrum for Image Classification also contributes in our system architecture. The experimental results confirm that the proposed Image Classification system architecture attains better solution for image retrieval. Our model represents the first time in which combine new modules and techniques proposed in the paper have been integrated with Image Classification system.

Images can be retrieval correctly through the proposed image classification system. For

those images which are contained in the code book, all of them can be searched as the most similar result. Also for general images selected randomly, the query results are similar to the input data. Since the image classification system is based on the color feature, the retrieval results are directly and easy to tell the performances. In the future work, we hope to build a generalized query method which increase the system searching ability and provide more accurate content descriptions of places of interest places by performing color feature analysis and CCH image extraction simultaneously. As a result, the image classification system will be able to suggest more relevant annotations and descriptions. Furthermore, we hope to optimize the system architecture and modules proposed in this paper. There exists some detail setting can be discussed and optimized with the images retrieval issues.

5. References

1. Kato,T.:Database architecture for content-based image retrieval. Image Storage and Retrieval Systems, 112–123. (1999)
2. Datta, R., Joshi, D., Li, J., Wang, J. Z.: Image Retrieval: Ideas, Influences, and Trends of the New Age. ACM Computing Surveys, Vol. 40, No. 2, Article 5, April. (2008)
3. Rui, Y., Huang, T.S., Chang, S. F.: Image Retrieval: Current Techniques, Promising Directions and Open Issues. Journal of Visual Communication and Image Representation, Transaction on Systems, Man, and Cybernetics, vol. 8, 460–472. (1999)
4. Rui, Y., She, A. C., Huang, T. S.: Modified Fourier Descriptors for Shape Representation - A Practical Approach. Proc. of First International Workshop on Image Databases and Multi Media Search. (1996)
5. Gupta, A., Jain, R.: Visual Information Retrieval. Communications of the ACM, vol. 40, 70–79. (1997)
6. Gross, M. H., Koch, R., Lippert, L.: A. Dreger, Multiscale image texture analysis in wavelet spaces. Proc. IEEE Int. Conf. on Image Proc. (1994)
7. Chua, T. S., Tan, K.-L., Ooi, B. C.: Fast signiture-based color-spatial image retrieval. Proc. IEEE Conf. on Multimedia Computing and Systems. (1997)
8. Chuang, G. C.-H., Kuo, C. -C. J.:Wavelet descriptor of planar curves: Theory and applications. IEEE Trans. Image Proc., vol. 5, 56–70.(1996)
9. Faloutsos, C., Flickner, M., Niblack, W., Petkovic, D., Equitz, W., Barber , R.: Efficient and Effective Querying by Image Content. (1993)
10. Rui, Y., Huang, T.S., Mehrotra, S.: Relevance feedback techniques in interactive content-based image retrieval. In Storage and Retrieval for Image and Video Databases VI, 25–36. (1996)
11. Stricker, M., Orengo, M.: Similarity of color images. Proc. SPIE Storage and Retrieval for Image and Video Databases. (1995)
12. Smith, J. R., Chang, S.-F.: Automated binary texture feature sets for image retrieval. Proc. IEEE Int. Conf. Acoust, Speech, and Signal Proc, May. (1996)
13. Mirmehdi, M., Palmer, P. L., Josef K.: Optimising the Complete Image Feature Extraction Chain. Proceedings of the Third Asian Conference on Computer Vision, Vol. 2, 307–314, January. (1998)
14. Kwak, N., Choi, C.-H., Choi, C.-Y.: Feature extraction using ICA. Proceedings of the International Conference on Artificial Neural Networks, 568–573. (2001)
15. Huang, C. R., Chen, C. S., Chung, P. C.: Contrast context histogram - A discriminating local descriptor for image matching. IEEE International Conference on Pattern Recognition, 53–56. (2006)
16. Yu, H. H., Wolf, W.: Hierarchical, multi-resolution algorithms for dictionary-driven content-based image retrieval. Proc. IEEE Int. Conf. on Image Proc. (1997)
17. Ono, A., Amano, M., Hakaridani, M.: A flexible content-based image retrieval system with combined scene description keyword. Proc. IEEE Conf. on Multimedia Computing and Systems. (1996) Ray-I Chang et al. ComSIS Vol. 9, No. 4, Special Issue, December 2012 1660
18. Prasad, B. G., Biswas, K. K., Gupta, S. K.: Region-based image retrieval using integrated color, shape, and location index. Comput. Vis. Image Underst. Vol. 94, 193–233. (2004)
19. Deslaers, T., Keysers, D., Ney, H.: Features for image retrieval: an experimental comparison. Information Retrieval, vol. 11, 77–107. (2008)
20. Puzicha, J., Rubner, Y., Tomasi, C., Buhmann, J.: Empirical Evaluation of Dissimilarity Measures for Color and Texture. Proc. Int''l Conf. Computer Vision. (1999)

21. Smeulders, A. W. M., Worring, M., Santini, S., Gupta, A., Jain, R.: Content-based image retrieval at the end of the early years. IEEE Transactions on Pattern Analysis and Machine Intelligence, 1349–1380. (2000)
22. Tamura, H., Mori, S., Yamawaki, T.: Textural features corresponding to visual perception. IEEE Transactions on Systems, Man, and Cybernetics, 460–473. (1978)
23. Eidenberger, H.: How good are the visual MPEG-7 features?. In Proceedings SPIE Visual Communications and Image Processing Conference, Vol. 5150, 476–488. (2003)
24. Jia, L., Wang, J. Z.: Automatic Linguistic Indexing of Pictures by a Statistical Modeling Approach. IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 25, 1075–1088. (2003)
25. Wang, J. Z., Jia, L., Gio, W.: SIMPLIcity: Semantics-sensitive Integrated Matching for Picture Libraries. IEEE Trans. on Pattern Analysis and Machine Intelligence, Vol 23, 947–963. (2001)