REMOTE SENSING IMAGE RETRIEVAL USING DCT-BASED TEXTURE DESCRIPTOR

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ABSTRACT: In this paper, we propose an image retrieval technique using texture descriptor extracted from a block-based Discrete Cosine Transform (DCT) of the image. To construct the texture descriptor, the absolute DCT coefficients are averaged over the entire image, and the feature vector is formed up by choosing middle-frequency elements of the zigzag-scanned DCT coefficients. This extraction is applied to both query image and all images in the archive. A distance function is used to measure the similarity between two images. This technique is successfully applied to remote sensing images downloaded from www.earthexpolrer.usgs.gov of Thailand regions.

1. INTRODUCTION

Due to the development of satellite technology, voluminous remote sensing images become available. The precise retrieval of RS images from archives according to the user needs is interested. Content-based image retrieval (CBIR) plays a role in many applications. Several techniques are proposed for extracting features and retrieving directly from DCT coefficients. For example, the use of energy histograms of the low frequency DCT coefficients as features for the retrieval of DCT compressed images (Lay and Guan, 1999). A content-based image retrieval scheme in JPEC compressing domain which texture and color features extracted based on DCT coefficients (Lu et al., 2006). A simple method of DCT feature extraction that is used to accelerate the speed and decrease the storage needed in the image retrieving process. Image features are accessed and extracted directly from JPEG compressed domain (Mohamed et al., 2009). The CBIR method which used the quantized histogram statistical texture features in DCT domain. Only the DC and the first three AC coefficients having more significant energy are selected in each DCT block to get the quantized histogram statistical texture features (Malik, 2013).

In this paper, we propose an image retrieval technique using texture descriptor extracted from a block-based DCT of the image. Both of query image and all images in the archive are extracted descriptors. We create an archive with 8 categories images. A distance function is used to compare the query image with every image in the archive and the first 20 most relevant images are displayed in our experiments.

2. TEXTURE EXTRACTION AND SIMILARITY MEASURE

To construct the texture descriptor, we used a DCT-based method similar to the work presented by Sim (Sim, 2001). The image is first converted to grayscale and divided into non-overlapping blocks of 8×8 pixels. Let the size of image is $M \times N$ then the total number of sub-blocks is KL, where K is $M/8$ and L is $N/8$. All sub-blocks are transformed by the 2D DCT. After that, the average of absolute DCT coefficients are computed by:

$$\mathrm{F}(u,v) = \frac{1}{KL}\sum_k \sum_l |\mathrm{F}_{kl}(u,v)| \tag{1}$$

where $\mathrm{F}_{kl}(u,v)$ is DCT coefficient of the (k, l)th sub-block, the subscripts k and l denote the sub-block index. The DCT-based descriptor is $\mathrm{F}(p)$ is obtained by taking a logarithmic function of the DCT coefficient after zig-zag ordering:

$$\mathrm{F}(p) = \log(\,\mathrm{F}(u,v)\,) \tag{2}$$

A P-dimension texture descriptor, **F** = {F(1), F(2), …, F(P)}, is formed up by empirical selecting a consecutive elements in the middle-frequency band in DCT domain, as shown in Figure 1.

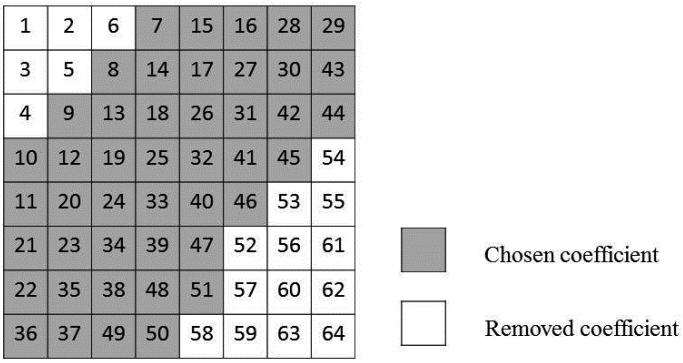

Figure 1 Middle-frequency band in DCT domain.

To compare two images between query image and all images in an archive, the distance measure is computed by:

$$d(q,f) = \sum_{p=1}^{P} \frac{|Q(p)-F(p)|}{\sigma_{Q(p)}} \quad (3)$$

where Q(p) represents pth DCT coefficient feature of query texture, F(p) represents pth DCT coefficient feature of each image texture in the archive, and $\sigma_{Q(p)}$ denotes the standard deviation of query image.

3. DATA SET

Most of images in archive are downloaded from www.earthexpolrer.usgs.gov. Many scenes of the following Thailand regions: Bangkok, Chiang Mai, Phuket, Ayuthaya, Rayong, etc, are selected and every image is cropped to the same size of 256×256 pixels. These images were classified into 8 categories: airplanes, building, river, forest, dens residential, beach, freeway, and harbor. Each category includes 20 images. All images are stored in an archive folder. One image from each category is used as a query image. Each query image is then subjected to a set of transformation such as rotation, shift, zoom, and brightness/contrast adjustment. The resultant images are also included in the archive. This is useful to evaluate the performance of the algorithm.

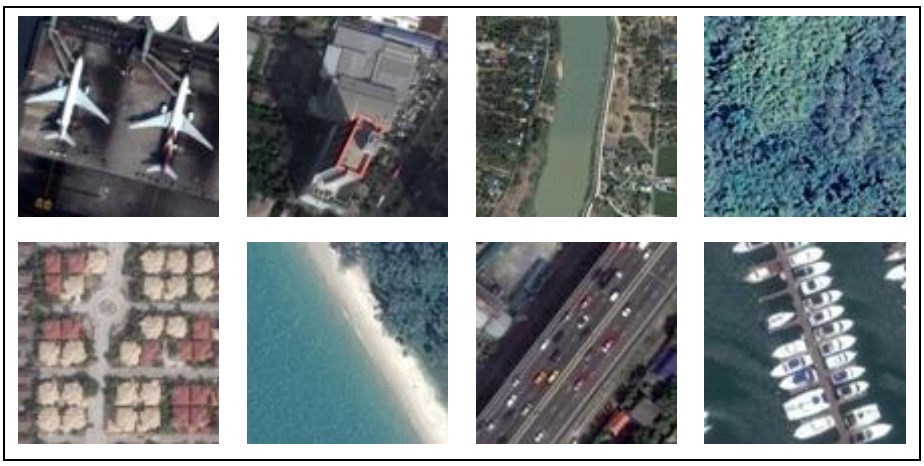

Figure 2 Query images.

Figure 3 Example of two images for each category in the archive (a) airplanes (b) building (c) river (d) forest (e) dense residential (f) beach (g) freeway and (h) harbor.

4. EXPERIMENTAL RESULTS

On the test of system, we present the results obtained when first 20 images retrieved. First, we assess the proposed technique when query image is airplane. There are 4 same query images which difference brightness and 4 varied images. Figure 4 shows retrieved airplane images.

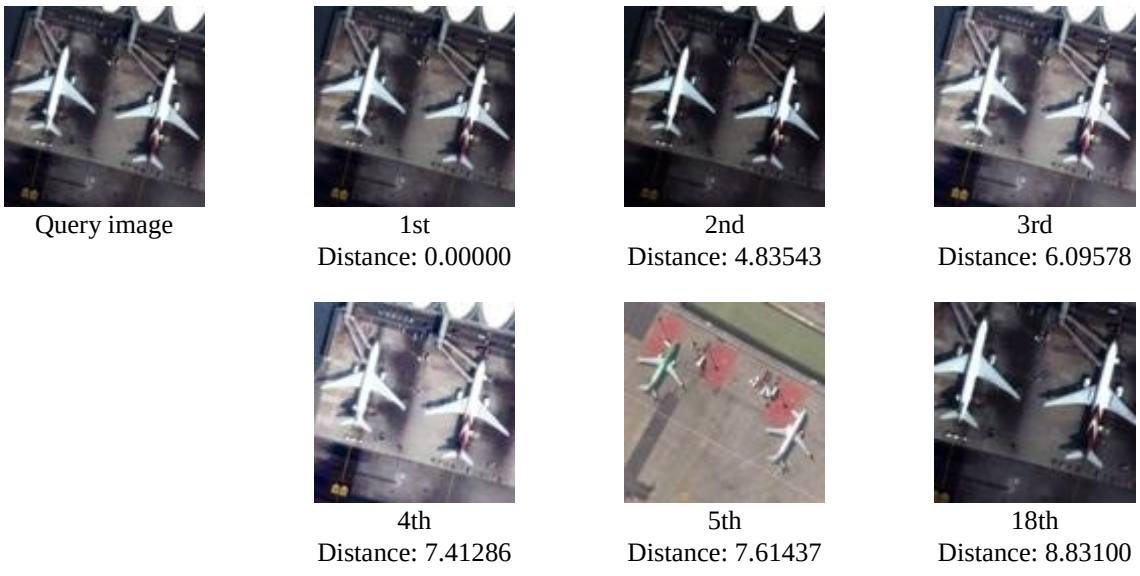

Figure 4 Airplanes image retrieval.

From consider result, most airplanes images which same as query image can be retrieved on first 4 images. Moreover, one zoom in query image and one relevant image are retrieved. Other three expected images are retrieved on first 50 images.

Secondly, a forest image is queried. There are 4 same query images which difference brightness and 2 shifted images. The result is shown in Figure 5.

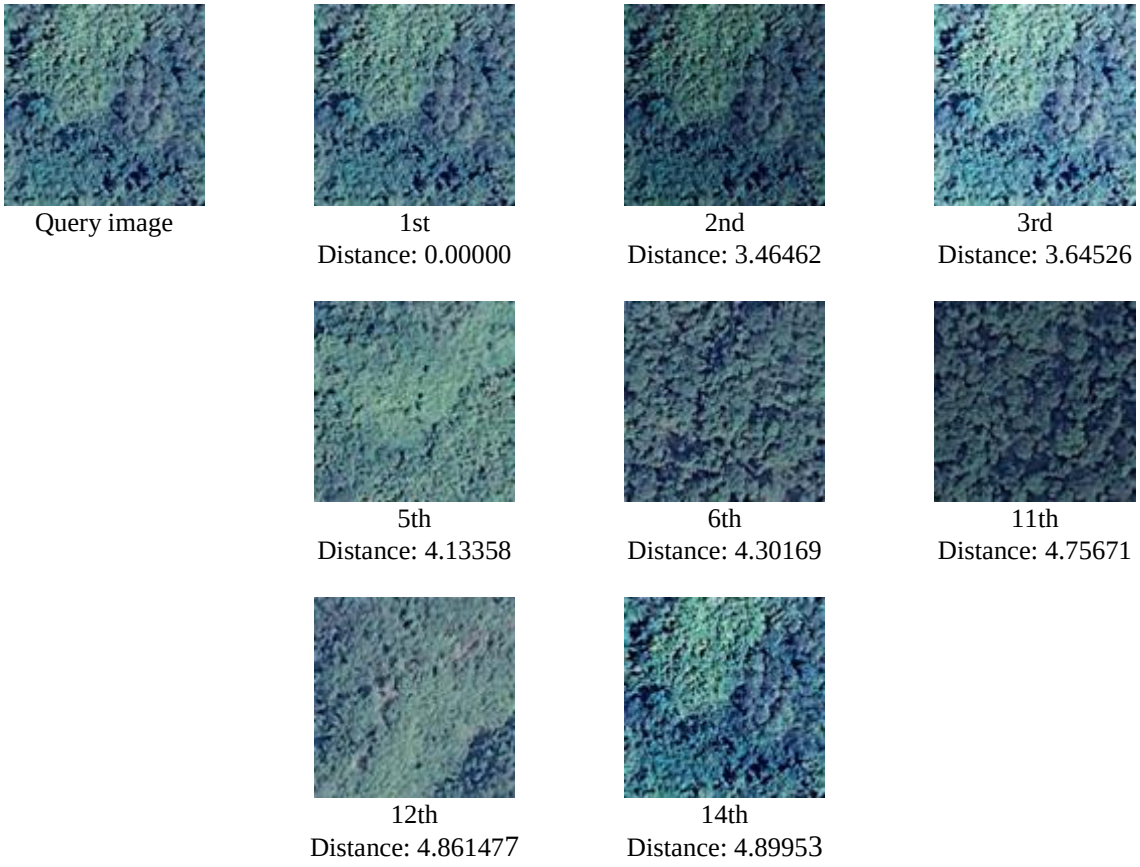

Figure 5 Forest image retrieval.

Four images which same as query image can be retrieved on first 20 images. These are the 1st, 2nd, 3rd and 14th images. Only shifted query image retrieved is the 5th image. There are three relevant query images also retrieved.

Finally, a summarized result obtained by query images from all categories is given as follows:

Airplanes		**Building**		**River**		**Forest**	
Sequence:	Distance:	Sequence:	Distance:	Sequence:	Distance:	Sequence:	Distance:
1st	0.00000	1st	0.00000	1st	0.00000	1st	0.00000
2nd	4.83542	2nd	7.55343	2nd	1.57584	2nd	3.46462
3rd	6.09578	4th	12.36700	3rd	1.66092	3rd	3.64526
4th	7.41286	12th	14.80234	4th	1.79862	5th	4.13358
5th	7.61437			5th	2.2414	6th	4.30169
18th	8.83100			14th	3.15367	11th	4.75671
				19th	3.32755	12th	4.86148
				20th	3.33715	14th	4.89953

Dense residential		Harbor		Beach		Freeway	
Sequence:	Distance:	Sequence:	Distance:	Sequence:	Distance:	Sequence:	Distance:
1st	0.00000	1st	0.00000	1st	0.00000	1st	0.00000
2nd	4.14470	2nd	9.87189	2nd	13.13445	3rd	12.44297
3rd	5.029141	5th	11.15651	3rd	13.51621	12th	16.24242
4th	6.14331	7th	11.78265	9th	14.39287	19th	18.50614
9th	7.87073						
13th	8.65979						

5. CONCLUSION

From experimental results shows that the most of same query images which varied brightness can be retrieved on first 20 images. But there is some drawback in retrieves rotated or shifted images on the first 20 images. To improve this problem, the future work will focus on color feature and feedback method for our system.

6. REFERENCES

Lay, J. A., and Guan, L., 1999. Image Retrieval Based on Energy Histograms of the Low Frequency DCT Coefficients. In: IEEE International Conference on Acoustics, Speech and Signal Processing, Arizona (USA), Vol. 6, pp. 3009-3012.

Lu, Z.-M., Li, S.-Z., and Burkhardt, H., 2006. A content-based image retrieval scheme in JPEG compressed domain. International Journal of Innovative Computing, Information and Control, 2(4), pp. 831-839.

Malik, F., and Baharudin, B., 2013. Analysis of distance metrics in content-based image retrieval using statistical quantized histogram texture features in the DCT domain. Journal of King Saud University – Computer and Information Sciences, 25, pp. 207–218.

Mohamed, A., Khellfi, F., Weng, Y., Jiang, J., and Ipson, S., 2009. An Efficient Image Retrieval through DCT Histogram Quantization. In: International Conference on CyberWorlds, Bradford (UK), pp. 237–240.

Sim, D.-G., Kim, H.-K., and Park, R.-H., 2001. Fast texture description and retrieval of DCT-based compressed images. Electronic Letters, 37(1), pp. 18-19.

Yun, F. and Runsheng, W., 2002. An image retrieval method using DCT features. Journal of Computer Science and Technology, 17(6), pp 865–873.