Local Colour Occurrence Descriptor for Colour Image Retrieval

IET Image Processing, 2015

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Introduction

- Local color occurrence descriptor (LCOD) from local neighborhood information is proposed for image retrieval.
- To reduce the dimension, color is quantized into few shades.
- The occurrence of each quantized color shade in local neighborhood is encoded to form the descriptor.
- LCOD is tested over natural as well as color texture databases including rotation, scale, and illumination cases.

Color Quantization

The color quantization technique is illustrated in Fig.1. The Red, Green and Blue channels of the image are having the values in the range 0 to 255. After quantization, it becomes one channel with the values in the range of 1 to 64.

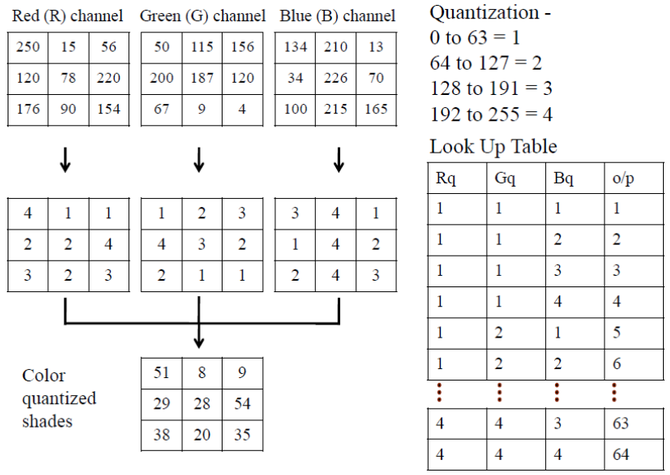

Fig.1. Color quantization technique.

Descriptor Construction

The computation of the local color occurrence binary pattern $\mathfrak{FP}$ for a given pixel is illustrated in Fig. 2 using an example local neighborhood having values from 1 to 5. The $\mathfrak{FP}$ pattern for the middle pixel (i.e. $\mathfrak{FP}_{(3,3)}$) having shade value 3 (highlighted in green in Fig. 2) is computed by considering the value of D as 2 and 1, where (2D+1)× (2D+1) is the size of neighborhood. In Fig. 2(a), the maximum possible value of $\mathbb{N}^{c,2}_{(3,3)}|_{c\in[1,5]}$ (i.e., occurrence of any shade) becomes 25 (i.e., $(2D+1)^2$). The number of occurrences of shade c (i.e. $\mathbb{N}^{c,2}_{(3,3)}$) is 6, 5, 4, 5, and 5 for c = 1, 2, 3, 4, and 5 respectively. The value of k (number of bit) is 5 for D=2. The local color occurrence binary pattern for D=2 (i.e., $\mathfrak{FP}^2_{(3,3)}$) is computed by concatenating the binary patterns for each shade $\mathscr{bp}^{c,2}_{(3,3)}$ for c = [1, 5] which is binary representation of $\mathbb{N}^{c,2}_{(3,3)}$. Similarly, the local color occurrence pattern for D=1, $\mathfrak{FP}^1_{(3,3)}$ is computed in Fig. 2(b) for the same example of Fig. 2(a). The value of k is 4 in Fig. 2(b) because D=1.

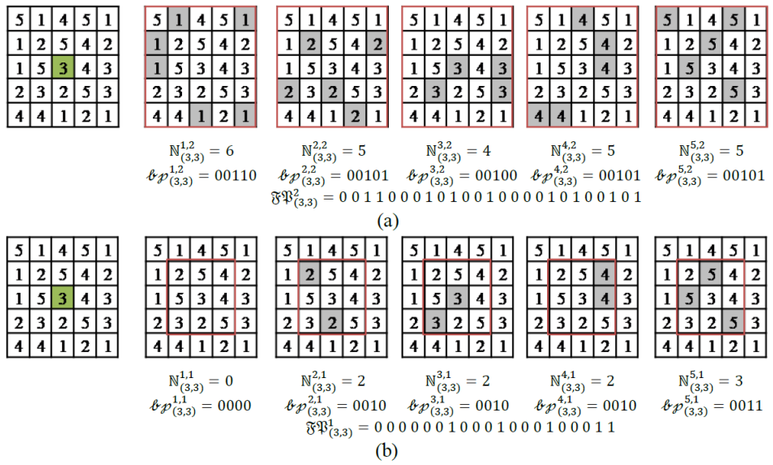

Fig.2. An illustration to compute the local colour occurrence binary pattern for (a) D = 2, and (b) D = 1. The number of shades is considered as 5 in this example.

The final LCOD descriptor is computed by aggregating the binary patterns over whole image as follows,

$$des(z) = \sum_{i=D+1}^{m-D} \sum_{j=D+1}^{n-D} \mathfrak{FP}^D_{(i,j)}(z) \qquad \forall\, z = [1, \quad k \times q^3] \tag{1}$$

where m×n is the dimension of the image, q^3 is the number of quantized colour shade, and k is the number of bit required to encode$(2D+1)^2$.

Databases

1. Corel-1k database [1] - 10 categories, 1000 images.
2. Corel-10k database [1] - 80 categories, 10800 images.
3. MIT-VisTex database [2] - 40 categories, 640 images.
4. STex Database [3] - 26 categories, 7616 images.
5. Corel-rotated database - angles 0, 90, 180, and 270 degrees, 10 categories, 4000 images.
6. Corel-scale database - scales of 0.5, 0.75, 1, 1.25, and 1.5, 10 categories, 5000 images.
7. Corel-illumination database - monotonic intensity change by -60, -30, 0, 30, and 60 in all channels, 10 categories, 5000 images.

Experimental Results

The image retrieval results in terms of precision are shown in Fig.3 and Fig. 4.

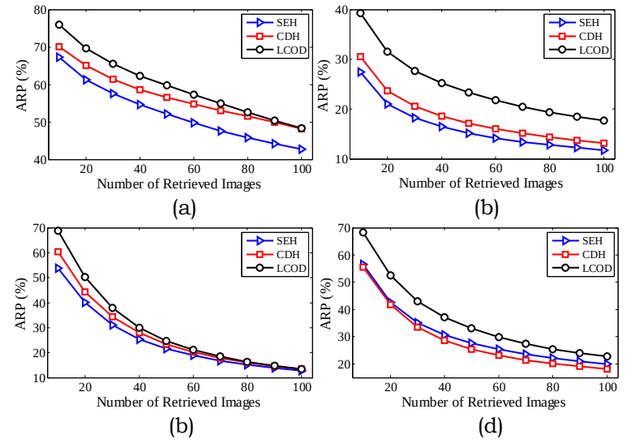

Fig.3. Comparison of proposed LCOD descriptor with SEH [4] and CDH [5] over (a) Corel-1k, (b) Corel-10k, (c) MIT-VisTex and (d) STex databases using average retrieval precision (ARP) plot.

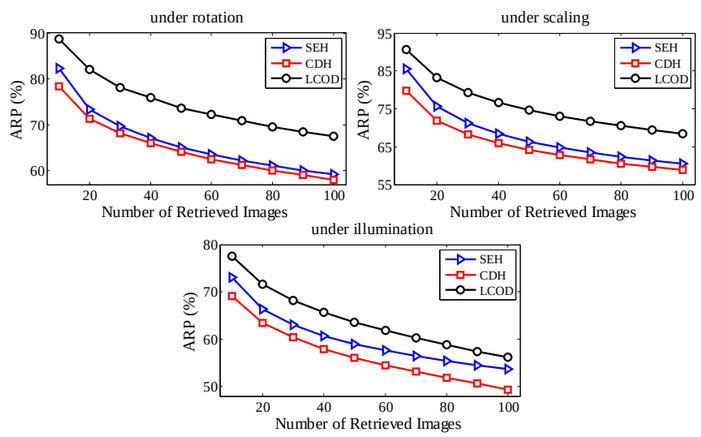

Fig.4. Comparison of proposed LCOD descriptor with SEH and CDH over *Corel-rotated*, *Corel-scale* and *Corel-illumination* databases.

References

[1]. 'Corel Image Database', https://sites.google.com/site/dctresearch/Home/content-based-image-retrieval.

[2]. MIT Vision and Modeling Group, Cambridge, 'Vision texture', http://vismod.media.mit.edu/pub/.

[3]. Salzburg Texture Image Database, http://www.wavelab.at/sources/STex/.

[4]. Wang, X., Wang, Z.: 'A novel method for image retrieval based on structure elements' descriptor', *Journal of Visual Communication and Image Representation*, 2013, 24, (1), pp. 63-74.

[5]. Liu, G.H., Yang, J.Y.: 'Content-based image retrieval using color difference histogram', *Pattern Recognition*, 2013, 46, (1), pp. 188-198.