Multichannel Decoded Local Binary Patterns for Content Based Image Retrieval

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Introduction

- Local binary pattern (LBP) [1] is widely adopted for simplicity and efficient image feature description.
- To describe the color images, it is required to combine the LBPs from each channel of the image.
- We introduced adder and decoder based two schemas for the combination of the LBPs from more than one channel.
- The introduced descriptors significantly improve the retrieval performance and outperform the other multichannel based approaches.

Method

The framework of feature description of color image using adder and decoder based multichannel LBP is shown in Fig. 1.

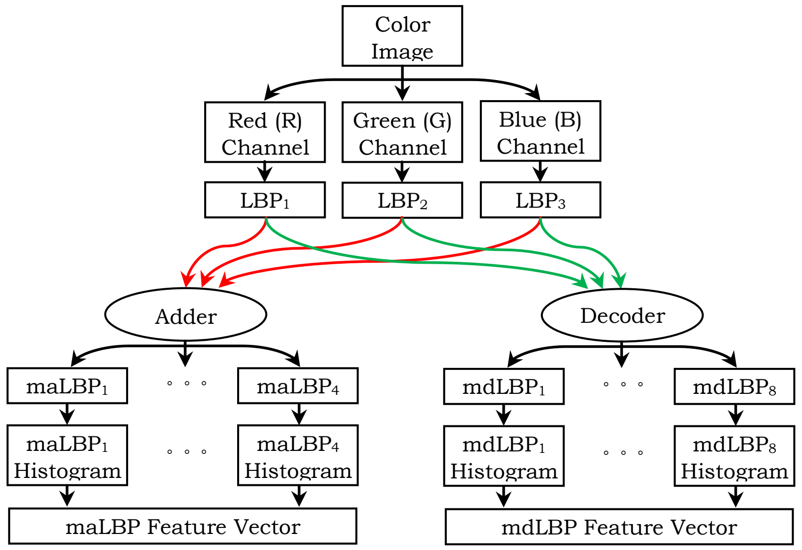

Fig.1. The flowchart of computation of multichannel adder based local binary pattern feature vector (i.e. *maLBP*) and multichannel decoder based local binary pattern feature vector (i.e. *mdLBP*) of an image from its Red (R), Green (G) and Blue (B) channels.

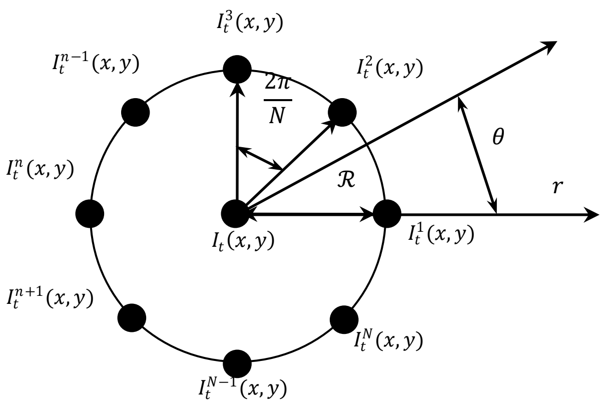

Fig.2. The local neighbors $I_t^n(x,y)$ of a pixel $I_t(x,y)$ in t^{th} channel for $n \in [1,N]$ and $t \in [1,3]$.

The position of local neighbours of any pixel of the image is depicted in Fig.2. A local binary pattern $LBP_t(x,y)$ for a pixel (x,y) in t^{th} channel is generated as follows,

$$LBP_t(x,y) = \sum_{n=1}^{N} LBP_t^n(x,y) \times f^n, \qquad \forall t \in [1,3] \tag{1}$$

where,

$$LBP_t^n(x,y) = \begin{cases} 1, & I_t^n(x,y) \geq I_t(x,y) \\ 0, & otherwise \end{cases} \tag{2}$$

and f^n is a weighting function defined by the following equation,

$$f^n = (2)^{(n-1)}, \qquad \forall n \in [1,N] \tag{3}$$

The truth map of adder map (i.e. $maM^n(x,y)$) and decoder map (i.e. $mdM^n(x,y)$) are shown in Table 1.

TABLE I

Truth Table of Adder and Decoder map with 3 input channels

$LBP_1^n(x,y)$	$LBP_2^n(x,y)$	$LBP_3^n(x,y)$	$maM^n(x,y)$	$mdM^n(x,y)$
0	0	0	**0**	**0**
0	0	1	**1**	**1**
0	1	0	**1**	**2**
0	1	1	**2**	**3**
1	0	0	**1**	**4**
1	0	1	**2**	**5**
1	1	0	**2**	**6**
1	1	1	**3**	**7**

The computation of $maLBP_{t_1}$ for $\forall t_1 \in [1,4]$ and $mdLBP_{t_2}$ for $\forall t_2 \in [1,8]$ from input $LBP_t^n(x,y)$ using an example of three LBP patterns is illustrated in Fig. 3 for $N = 8$.

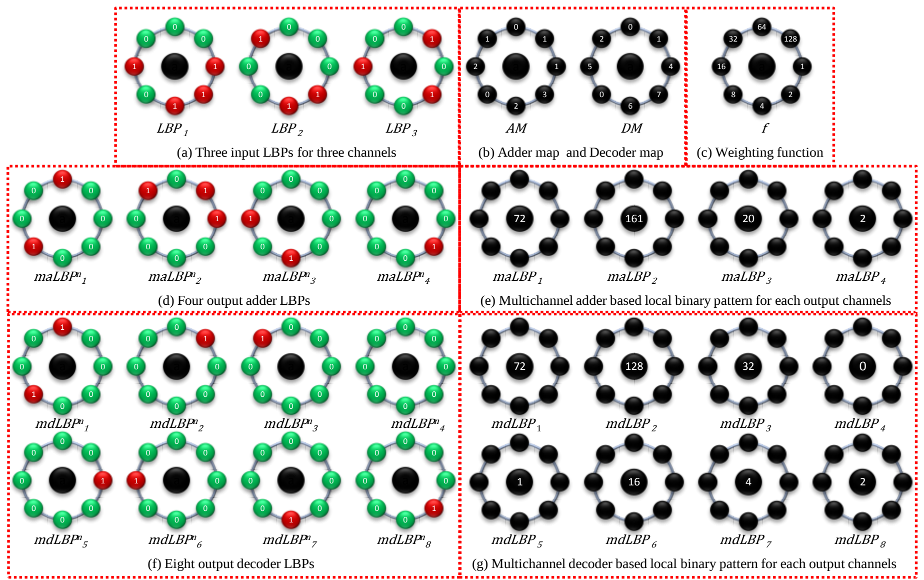

Fig.3. An illustration of the computation of the adder/decoder based local binary pattern maps, adder/decoder based local binary pattern bits, and adder/decoder local binary pattern decimal values from three 8-bit input LBPs. Green and Red circles represent 0 and 1 respectively.

Performance Evaluation

Image retrieval experiments are performed to test the performance of proposed descriptors in terms of average retrieval precision (ARP). Precision is the percentage of correct number of retrieved images out of total number of retrieved images. Results are compared with basic LBP [1] and other color based local descriptors such as cLBP [2], mscLBP [3], and mCENTRIST [4]. Here, results are presented over natural Corel-1k [5] and textural MIT-VisTex [6] databases in Fig.4.

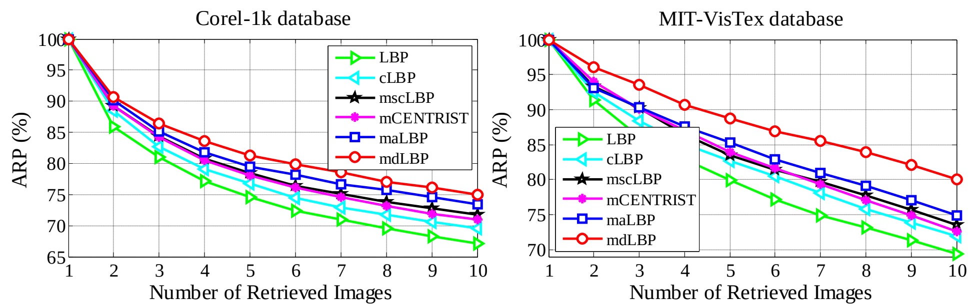

Fig.4. The performance comparison of proposed maLBP and mdLBP descriptor with existing approaches such as LBP, cLBP, mscLBP, and mCENTRIST descriptors over Corel-1k and MIT-VisTex databases.

Fig.5. Top 10 retrieved images (columns) using LBP (1st row), cLBP (2nd row), mscLBP (3rd row), mCENTRIST (4th row), maLBP (5th row) and mdLBP (6th row) descriptors from Corel-1k database. Images in the 1st column are query images as well as the top most similar images.

References

[1]T. Ojala, M. Pietikainen and T. Maenpaa, "Multiresolution gray-scale and rotation invariant texture classification with local binary patterns," *IEEE TPAMI*, 24(7): 971-987, 2002.

[2]J.Y. Choi, K.N. Plataniotis and Y.M. Ro, "Using colour local binary pattern features for face recognition," *17th IEEE ICIP*, 2010.

[3]C. Zhu, C.E. Bichot and L. Chen, "Multi-scale Color Local Binary Patterns for Visual Object Classes Recognition" *IEEE ICPR*, 2010.

[4]Y. Xiao, J. Wu and J. Yuan, "mCENTRIST: A Multi-Channel Feature Generation Mechanism for Scene Categorization," *IEEE TIP*, 23(2): 823-836, 2014.

[5]Corel Photo Collection Color Image Database taken from: http://wang.ist.psu.edu/docs/realted/.

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