Hadoop based CBIR using the Integration of Color and MDLEP

P. Rohini[1] , L Koteswara Rao [2]

[1] Asst. Professor in CSE Faculty of Sci.& Tech., ICFAI Foundation for Higher Education, India

[2] Asst. Professor in ECE, Faculty of Sci. &Tech., ICFAI Foundation for Higher Education, India

[1] rohini10@gmail.com, [2] kots.lkr@gmail.com

Abstract- In the process of image retrieval, more information can be extracted by combining two or more features. Feature vectors based on local patterns are very popular in deriving the local information present in an image. Majority of these methods are mainly based on encoding the variation in gray scale values of centre pixel and its neighboring elements. The centre pixel is assigned a value that gets reflected in a Histogram. LBP operator became the first of its kind where the intensity value of centre pixel is treated as threshold to capture the information by comparing with other neighbors. However, the information directions are not explored in the method The DLEPs are proposed to code the edge information mainly in four directions. The performance of Directional local extrema patterns can be improved by taking the magnitude into consideration. In this paper, we propose a new method to improve the performance of the retrieval system with the help of Hadoop framework. The main objective is distribution of image data over a large number of nodes over Hadoop using Map Reduce Technique. Hadoop defines a framework which allows processing on distributed large sets across clusters of computer.

Keywords- Color, LBP, DLEP, MDLEP,image retrieval, Hadoop, Mapreduce, precision, recall

1. Introduction

In recent times, due to substantial growth in few areas of digital electronics and the Internet more and more images are generated every moment around the world. These images cannot be utilized effectively for various purposes unless there is a system to manage the database. Therefore, a system is required to search and index the data for various purposes. Initially, manual annotation was followed in indexing and searching process .However, conventional text based method becomes ineffective when dataset is large. CBIR became an eye catching area for many researchers across the world to resolve the issues of existing methods. In this method, the visual contents like texture ,color, shape etc., are taken out to make the signature or the vector .The resemblance of query image with data base image is considered to explore similar images out of the dataset. In fact, capability of CBIR system mainly relies upon the method to extract characteristics like texture color, , shape, layout etc., [1]-[3].

Among various visual features specified, color and texture provides more discriminating information possessed by an image. The most useful feature of an image is the color since the eye is much sensitive to all colors. Many researchers used various methods to get color feature. Texture is another which deals with the repetitive patterns of any image. Classification and segmentation became very critical in analyzing the texture of an image. In the work [4], use of texture property to classify image was mentioned . Arivazhagan etal [5] presented an approach to classify the texture that uses wavelet transform. WPF and GMM was specified in [6] to classify the texture and segmentation. Gabor wavelets played an important role in classifying the texture for rotation invariant feature because of their closeness to the human visual syatem [7].

1.1 Our contribution

Existing Magnitude Directional Local pattern extrema (MDLEP) extracts directional and magnitude data of edges as per the minima or maxima in vertical, horizontal, diagonal, anti diagonal directions of image. In the paper, a new method is proposed that combines color feature , MDLEP and Hadoop framework to improve the output of existing MDLEP. The paper is arranged as follows. Different kinds of local patterns that are related to the work are reviewed in section 2. Section 3 mentions proposed approach for image retrieval. Sec. 4 shows results and the discussions and conclusions are provided in section 5.

1.2 Review of related work

An idea based on local binary pattern was explained by Ojala et. al [8], and the principle of LBP was applied in facial recognition and related areas as explained in [9].Even though it was used in many areas , LBP has demerit of rotational variance in identifying the texture in an image. Zhang et. al[11] developed local derivative pattern by taking n^{th} order local binary pattern. Subramanyam etal [12] created an operator called Directional local extrema pattern as a descriptor in texture analysis and classification .V B Reddy et. al enhanced the DLEP by taking magnitude in to consideration[13]. The MDLEP is different from the available Localbinary patterns and modifications in taking out directional data.

2. Different types of local patterns

2.1 Local binary pattern

T Ojala [8] et al introduced LBP operator. In LBP, gray scale value of centre pixel is assumed as maximum level, difference in the value of centre pixel and surrounding neighbors is considered to label a 0 or 1. Same procedure is followed till all elements around the centre pixel get covered in the process.

$$LBP_{X,Y} = \sum_{p=0}^{p-1} y(x_p - x_c)2^p, \; y(c) = \begin{cases} 1 & c \geq 0 \\ 0 & c < 0 \end{cases} \quad \text{---- (1)}$$

where x_c is gray value of center pixel ,x_p represents the intensity value of X equally spanned pixels on a circle of radius Y. For example, for the image given below, the pattern is 01110110

22	34	49
14	27	65
71	58	16

2.2 Local directionalpattern(LDP)

It is based on the LBP which use edge information. of neighboring pixels to code texture of image. It labels an 8-bit code to every pixel in image.

Value of 1 or 0 is coded based on the existence of an edge.

$$LDP_n = \sum_{i=1}^{8} g_i(m_i - m_k) * 2^i, \; g_i(x) = \begin{cases} 1, x \geq 0 \\ 0, x < 0 \end{cases} \quad \text{---- (2)}$$

2.3 Directional Localextrema Patterns (DLEP)

Principle of LBP was utilized by Subrahmanyam etal [12] to design a novel descriptor named DLEP .In this method, two neighboring pixel intensities of one direction are compared to value of centre pixel to code 0 or 1 .It describes the structure of local texture based on center pixel 's extrema . Maxima and minima values of four directions can be obtained by calculating the difference between the centre element and all neighbors.

The calculation is mentioned in eq.3.

$$M'(x_i) = M(x_c) - M(x_i); i = 1,2,....8 \quad \text{---- (3)}$$

The local extremas calculation is done according to the equations below.

$$\hat{M}_\beta(xc) = Y_3(M'(x_i) * M'(x_{j+4})); \; j = (1 + \beta / 45) \quad \text{---- (4)}$$

$$\forall_\beta = 0^0, 45^0, 90^0, 135^0$$

$$Y_3(M'(x_j), M'(x_{j+4})) = \begin{cases} 1 & M'(x_j) * M'(x_{j+4}) \geq 0 \\ 0 & \text{else} \end{cases} \quad \text{---- (5)}$$

The DLEP is computed as ($\beta=0^0,45^0, 90^0$ and135^0) follows:

$$DLEP(M(x_c))|\beta = \{M_\beta(x_c); \hat{M}_\beta(x_i); \hat{M}_\beta(x_z); ....\hat{M}_\beta(x_8) \quad \text{---- (6)}$$

The details about DLEP are given in fig.(1). Consequently, the image is changed DLEP output having the values 0 to 511.

In the next level, DLEP, image is denoted by getting a histogram as per the eqn. mentioned in (7).

$$H_{DLEP|\beta}(l) = \sum_{m=1}^{Z_1}\sum_{n=1}^{Z_2} Y_2\left(DLEP(m,n)\big|_{\alpha}, \ell\right); \quad \text{--- (7)}$$
$$\ell \in (0,511)$$

here the Z1. Z_2 is the dimension. Collection of DLEP data for a pixel at the centre in The procedure for calculation of DLEP for center pixel marked in blue color is given figure1.Information in directions is taken out using local difference between center pixel and neighbors.

For example, DLEP of 90^0 direction for pixel highlighted with blue color is given in fig2. For a pixel of value 36, two neighbor pixels are moving away in values. Hence, pattern is assigned 1. Similarly, remaining bits of DLEP are collected making the final outcome as 110011110. In this way, the DLEPs are computed in 0^0,45^0 and 135^0 directions.

2.4 Magnitude Directional Local Extrema patterns (MDLEP)

VB Reddy&Reddy [13] presented a technique to increase performance by collecting magnitudes of the Local patterns. MDLEP is collected according to the equation below.

$$\hat{I}_{M\beta}(x_c) = Y_3(I^{'}(x_i) * I^{'}(x_{j+4})); j = (1+\beta/45) \qquad (8)$$
$$\forall_{\beta} = 0^0, 45^0, 90^0, 135^0$$

$$Y_4(I^{'}(x_j), I^{'}(x_{j+4})) = \begin{cases} 1 & \text{abs}(I^{'}(x_j)) + \text{abs}(I^{'}(x_{j+4})) \geq \text{Thrs} \\ 0 & \text{else} \end{cases} \quad (9)$$

$$Thrs = \frac{1}{Z_1 \times Z_2} \sum_{b=1}^{Z_1} \sum_{c=1}^{Z_2} \left(abs\left(I'(x_j)|_{(b,c)}\right) + abs\left(I'(x_{j+4})|_{(b,c)}\right)\right) \qquad (10)$$

The MDLEP in 0^0, 45^0, 90^0 and 135^0 directions is defined as

$$MDLEP(I(x_c))|_{\beta} = \left\{ \hat{I}_{M\beta}(x_c); \hat{I}_{M\beta}(x_1); \hat{I}_{M\beta}(x_2); .... \hat{I}_{M\beta}(x_8) \right\} \qquad (11)$$

Subsequent to the MDLEP calculation , entire image is shown by a histogram according to eqn. (8).

72	84	43	54	10
15	82	86	59	68
22	29	36	39	94
17	75	68	92	65
12	14	45	32	42

72	84	43	54	10
15	82	86	59	68
22	29	36	39	94
17	75	68	92	65
12	14	45	32	42

72	84	43	54	10
15	82	86	59	68
22	29	36	39	94
17	75	68	92	65
12	14	45	32	42

72	84	43	54	10
15	82	86	59	68
22	29	36	39	94
17	75	68	92	65
12	14	45	32	42

72	84	43	54	10
15	82	86	59	68
22	29	36	39	94
17	75	68	92	65
12	14	45	32	42

72	84	43	54	10
15	82	86	59	68
22	29	36	39	94
17	75	68	92	65
12	14	45	32	42

72	84	43	54	10
15	82	86	59	68
22	29	36	39	94
17	75	68	92	65
12	14	45	32	42

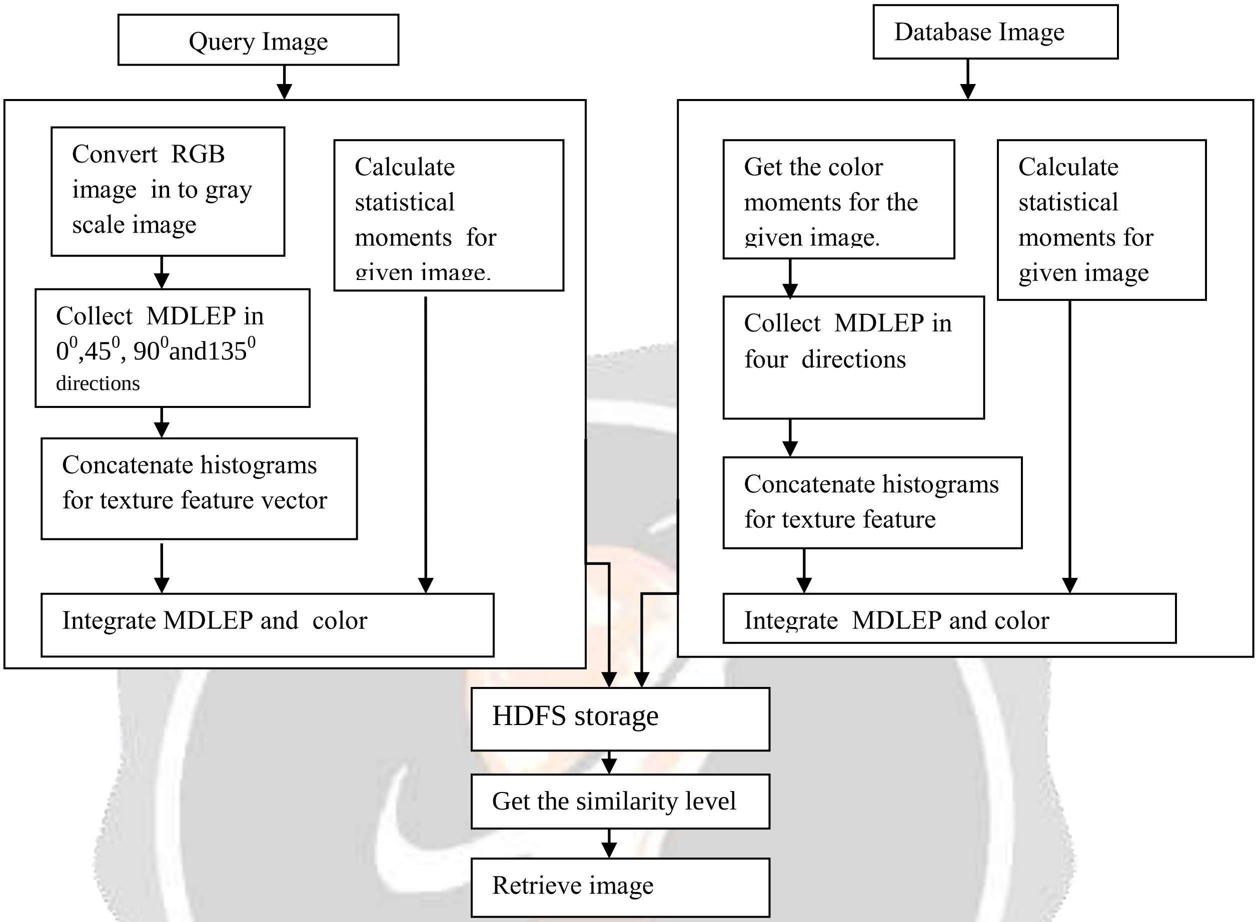
72	84	43	54	10
15	82	86	59	68
22	29	36	39	94
17	75	68	92	65
12	14	45	32	42

Fig. 1 Description of DLEP for 5 x 5 size

	$0_{(27)}$	$1_{(29)}$	$2_{(80)}$	$3_{(87)}$	$4_{(88)}$	$5_{(13)}$	$6_{(78)}$	$7_{(85)}$	$8_{(63)}$	DLEP
P (0^0)	0	0	0	0	1	1	0	1	0	26
Q(45^0)	1	0	0	1	1	1	1	0	1	317
R(90^0)	1	1	0	0	1	1	1	1	0	415
S(135^0)	1	1	0	0	0	1	1	1	0	398

Fig. Calculation of DLEP in 90^0

3. Proposed CMDLEP System



Figure(4).Block diagram of CMDLEP for Image retrieval

Algorithm:-

1. Calculate color moments for given image and convert RGB into gray scale image.
2. Compute the local extrema in $0^0,45^0, 90^0$and135^0 directions.
3. Compute the MDLEP information in all 4 directions as per step 2.
4. Get histogram of MDLEP obtained from step 3 and join to create feature vector.
5. Combine the 2 features to form a feature Vector used in the process of retrieval along with Hadoop mapreduce

Query matching:-

Once the features are extracted, the feature vector of query image is formed. Similarly, feature vectors of all images from database are collected. To recongnise relevant image to query image, distance between query image and repository images is calculated.

4.Experimental results

Capability of proposed method is tested with Corel-1K database [15]. Precision (Pr) and recall (Re) values are calculated according to the equations below.

$$Pr= \frac{\text{Number of relevant images retrieved}}{}$$

No. of images retrieved

$$Re= \frac{\text{No. of relevant images retrieved}}{\text{Number of relevant images in the database}}$$

Table 1: Results for various categories of the database(in table 1)

Category	**Existing MDLEP**	**MDLEP+ color feature**
Africans	61.3	64.4
Beach	51.25	53.7
Building	57.85	62.6
Buses	94.4	98.4
Dinosaur	97.85	99.1
Elephant	48.9	64.8
Flower	89.1	93.5
Horse	66.2	79.4
Mountain	39.4	48.5
Food	75.35	90
Average Precision (%)	**68.16**	**75.44**

Category	MDLEP	MDLEP+ color feature
Africans	39.25	43.7
Beach	33.82	37.5
Building	31.96	36.6
Buses	73.57	77.9
Dinosaur	90.28	94.5
Elephant	30.53	34.7
Flower	69.32	77.8
Horse	36.16	45.4
Mountain	29.35	34.1
Food	45.3	43.5
Average Recall (%)	**47.954**	**52.57**

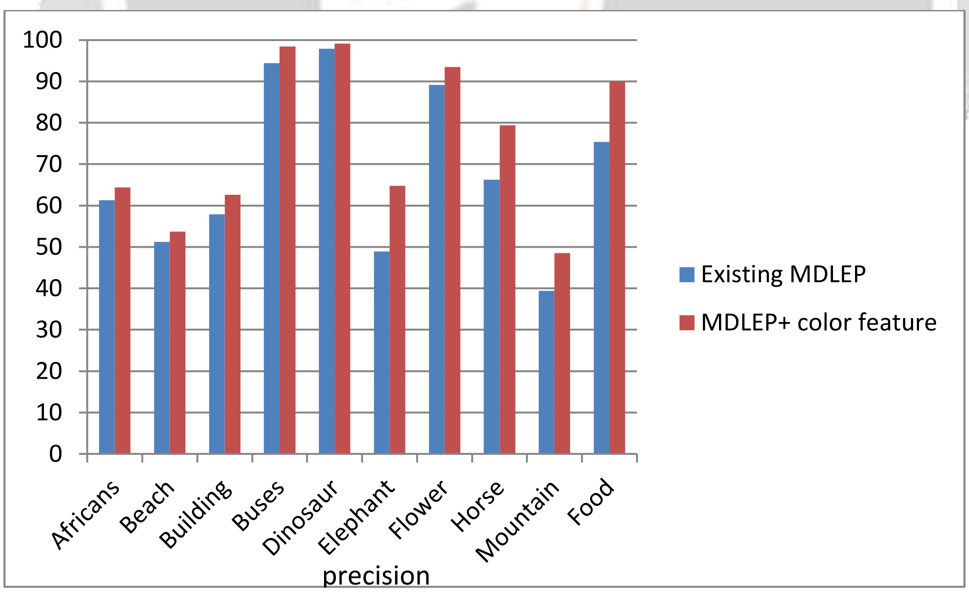


Fig 3.Average precision of MDLEP (green)and CMDLEP(red)

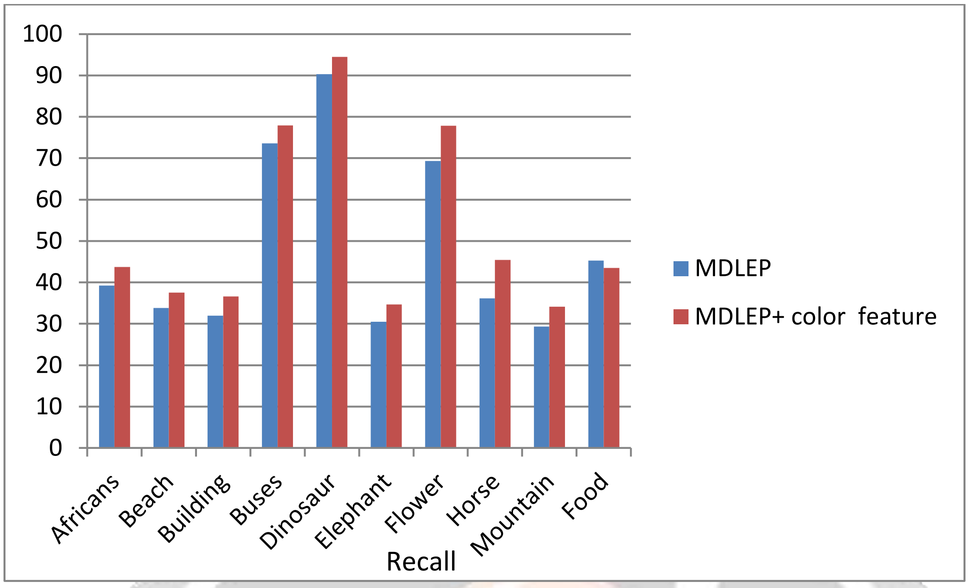


Fig 4.Average recall of MDLEP (red)and CMDLEP(blue)

6. Conclusion

This paper presents a content based image retrieval system in Hadoop framework[16]-[18]. Hadoop has been used in this work to set up a grid in a large scale environment which supports large amount of data processing. It also facilitates accurate retrieval of images similar to the query image. The proposed image retrieval system can be implemented in cloud environment with minimal overhead.

It is evident that our method is outperforming the MDLEP in terms of precision and recall. Combination of color MDLEP,Hadoop is exhibiting better performance as compared to LBP and similar local pattern based feature vectors.

REFERENCES

1. R. Datta, D Joshi J.Li and J. Wang," Image Retrieval- Ideas, influences and trends of the new age', ACM Computing surveys,vol.40,no.2,pp 1-60 2008
2. AM smeulders,M Worring,S Santini,A Gupta&R Jain,"content based Image retrieval at the end of early years"IEEE Transactions aon PAMI 22(12),pp 1349-1380,2000
3. Y Rui,T S Huang&S F Chang," Image retrieval: current techniques, promising directions& open issues. Journal of visual communications& Image representation 10(4):pp 39-62,1999.
4. R M Haralick,K Shanmugam&i dinstein," texture features for image classification ",IEEE transactions on system, man and cybernetics vol,smc-8,pp 610-621, 1973
5. S Arivazhagan and L Ganesan, "Texture classification using wavelet transform(1513-1521) vol.24,issue 9-10,June 2003.
6. Soo chang Kim,Tae Jin Kang ,"Texture classification and segmentation using wavelet packet frame and Gaussian mixture model vol 40,issue 4,april 2007, 1207-1221 elsevier
7. S Arivazhagan and L Ganesan, 'Texture classification using Gabor wavelets based rotation invariant features ,vol 27,ISSUE 16, December 2006 (1976-82)
8. Ojala T,Pietikainen M,Harwood D (1996) A comparative study of texture measures with classification based on feature distributions. J Pattern Recognition 29(1):51-5
9. A Hadid,T Ahonen and M Pietikainen,"Face analysis using local binary patterns," in handbook of Texture analysis, Imperial college press London 2008,pp 347-373
10. Raghu ,P,Yegnanarayana,"segmentation of Gabor filtered textures using deterministic relaxation, IEEE Trans. on Image Processing 5(12),1625-1636, 1996
11. Zhang B, Gao Y, Zhao S, Liu J (2010) Local derivative pattern versus local binary pattern: Face Recognition with higher-order local pattern descriptor, IEEE Trans Image Process 19(2):533-544

12. Subrahmanyam Murala, R.P. Maheswari, R.Balasubramanian Directional local extrema pattern: a new descriptor for content based image retrieval(2012)
13. Reddy et al. Content based image indexing and retrieval using directional local extrema and magnitude patterns, International journal of electronics and communication 68(2014) 637-643
14. Jabid,,Kabir, Chae Kyung H, "Local Directional Pattern for face recognition" IEEE conference 2010
15. http://wang.ist.psu.edu/docs/related/
[16] Raju et.al. Content Based Image Retrieval on Hadoop Framework,IEEE conference 2015
[17] D Yin,D Liu, Content-Based Image Retrial Based on Hadoop,Hindawi,2013

[18] Deepti Chikmurge"Implementation of CBIR Using MapReduce Over HADOOP"," International Journal of Computer, Information Technology & Bioinformatics (IJCITB)" ISSN: 2278-7593, Volume-2, Issue-2.