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A Hybrid Approach to Feature Extraction for Content Based Image Retrieval

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Abstract–*Query image retrieval which is also known as Content Based Image Retrieval (CBIR) is defined as the retrieving of the images from the database that have content similar to the query image.It is done by extracting features according to the content in the form of colour, shape and texture from the images. There exists various techniques for the retrieval of images from the database. Though these techniques work well for retrieving the images from the database, still they lack in accuracy. In this paper, a hybrid technique is proposed for efficient retrieval of images. Rotation Invariant Uniform LBP (RIU-LBP) with colour moment and Centre-Symmetric LBP (CS-LBP) with colour moment together forms hybrid approach. The proposed technique has an accuracy of 86.1% which is fairly high in comparison to if these techniques are used in isolation.*

Keywords-*Content Based Image Retrieval, LBP operator, Uniform local pattern operator. Rotation Invariance, Centre-Symmetric LBP.*

I. INTRODUCTION

Content Based image retrieval is described as the retrieval of images from large dataset which consist of images of different classes. As it is very difficult to search for images in large database, CBIR approach is used. Texture classification is an important stimulus which is used by human beings for interpreting the images. Texture classification is to categorize an unknown image into one of the classes which are predefined classes based on the texture information. Different types of descriptors are used to characterize the textured images. Traditional methods are based on the grey level values containing spatial information. In this, the query image is taken and features are extracted from it using various techniques and then similarity is done with the features extracted from the images in the database. Fig 1represents the working of CBIR.

Now days, Local Binary Pattern (LBP) has emanated as a power boost for the classification on the basis of texture and system of retrieval. This pattern method was originally advised by Ojala et al. [8], LBP operator [7] [2] that offers invariance against the monotonic gray level changes [11] has gained a lot of popularity has led to the progress in computer vision problems. Due to its illuminance property and computational efficiency, it has been successfully utilised in

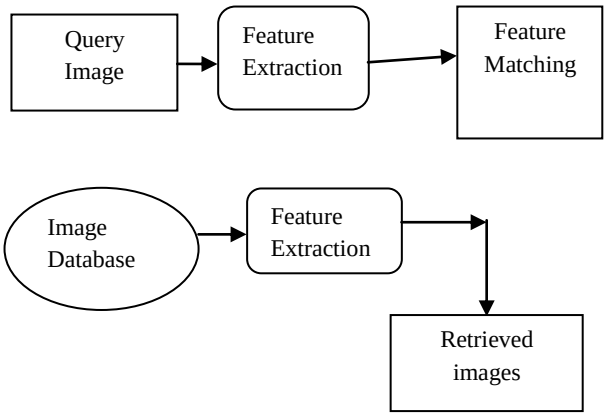


Fig1: Block Diagram of CBIR

many applications, such as face recognition and description [6],medical purposes, biomedical applications and face description etc. The statistics obtained from the resulting images are then used for the analysis. The tremendous success in LBP has led to the development of its various extensions. Centre-symmetric LBP was evaluated by Marko et al. [4] to focus on the texture features of the images in more efficient manner. CS-LBP is more stable version for the flat images with a reduced number of codes. This pattern will compare centre-symmetric pair of pixels that will halves the number of comparisons of same number of neighbours.

Other patterns are also there which are used to remove the effect of rotation for texture extraction such as Rotation Invariant Pattern and Rotation Invariant Uniform Binary Patterns.

The paper is organised as follows: Section 2 describes Literature Survey, various techniques of LBP are discussed in Section 3, Section4 describes the Proposed work followed by Section 5 that contains Results. Section 6 corresponds to conclusion followed by references in Section 7.

II. RELATED WORK

C.shan et al. [1] proposed a hybrid method by combining Local Binary Pattern (LBP) and embedded hidden Markov Model (EHMM) for feature extraction and categorization. On several databases, different techniques of classification

are examined. SVM classifier is used for accuracy of facial expression but there is limitation of using static images without exploiting temporal behaviours of facial expression.

G.Zhenhua et al. [2] introduced ALBP (adaptive local binary pattern which emphasized on statistical features such as mean and standard deviation to improve the classification of LBP. It also minimised the variations.

Abdenour Hadid [3] presented that how LBP works in spatial domain and temporal domain and also mentioned that LBP is not only used for face analysis but achieved improvement in other fields also such as motion analysis, visual inspection, image retrieval and biomedical image analysis.

Marko Heikkila et al. [4] adopted the idea of new texture feature called centre-symmetric pattern feature which has robust nature towards illumination changes and computational simplicity. In this modified version. Local Binary Pattern is used that gives short feature histograms and have computational simplicity which is compared with SIFT descriptor and performed well in tested contexts.

R.Brunelli et al. [5] analysed low level image features such as color and luminance descriptors. In it, histogram capacity was taken for calculating the effectiveness of the images.

Timo Ahonen et al. [6] used the technique of LBP for face image. Image was splitted into several regions and features were extracted for each region which were then combined into embellish factor called face descriptor. The texture description of each region describes region appearance and combination of all these region descriptions were used for describing global geometry of face which was not in other descriptors.

T.Maenpaa et al. [7] proposed a unifying approach that includes LBP aspects of statistical and structural texture analysis. Rotation Invariancereduces the feature histograms and the number of rotation invariant codes are reduced with the uniformity which is more robust towards illumination changes. Images are rotated at 45 degree that makes crude quantization of angular space inefficient.

T.ojala et al. [8] proposed texture measures which were used in various applications. For classification Kullback Discrimation method was used and different types of LBP were used for extraction of features from the images. Performance can be further improved by combining Rotation Invariant with the other descriptors.

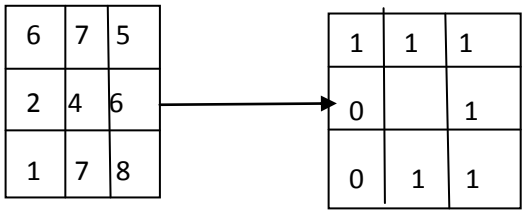
Roshi Chaudhary et al. [9] proposed that contents of image in the form of colour, shape and texture give richer information as compare to text-based image retrieval. Hybrid approach of Colour and texture feature was used for the retrieval of features from the image .

YuchunFang et al. [10] adopted RiuLBP (rotation invariant uniform local binary pattern). The feature dimension was decreased while performance in terms of precision was increased Recognition rate achieved by fusion of multi-directional rotation invariant pattern was better as compared to LBP pattern .
Karolinaet al. [11] proposed new concept of PLBP(power local binary pattern) to diminish the drawbacks of LBP and rotation invariant LBP.PLBP was mainly introduced for facial smiling display classification. This pattern considers distribution in local area that basic LBP failed to do so.

III. Various Types of LBP

3.1 Local Binary Pattern

The LBP operator (local binary operator) proposed by Ojala et al. [8] is an operator that remodels an image into array of integer labels and describes the view of the image.



Binary= 11110011
Decimal=243

Fig 2: LBP operator

The value is obtained by comparing its gray scale value with its neighbours as shown in Figure 2 In this technique , each pixel is compared with its neighbours in a (3*3) neighbourhood and then by subtracting the center pixel value if the result obtained is negative then it is encoded as"0" otherwise "1". After performing patterns on each pixel, a binary pattern is obtained by combining all these binary values in anticlockwise direction and then the obtained value is converted into decimal form which is further used for labelling the given pixel. The histogram that is generated from LBP labels is used as a texture feature for classifying the texture. The notation (X, Y) is generally denoted as neighbourhood of X sampling points on a circle of radius Y.
After the stage of thresholding, on the basis of neighbourhood and radius Y = 1 , the features of an image are represented by 256-bins.Themathematical representation of LBP histogram [4] is shown in Equation1.

$$LBP_{R,N}(x,y) = \sum_{i=0}^{N-1} s(n_i - n_c)2^i ,$$

$$S(x) = \begin{cases} 1 & if\ x \geq t \\ 0 & otherwise \end{cases} \qquad (1)$$

where$_c$ represents grey level of centre pixel of local neighbourhood and n_i represents grey levels of N equally spaced pixels of radius R [4]. i represents the value obtained by rotating in anticlock-wise direction with the

power of 2.If the resultant value is 1 then n_i is larger than n_c and if n_i is smaller than n_c ,then value is 0. Figure 3 shows the LBP histogram of the image.

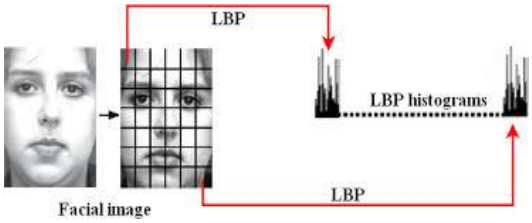


Fig 3.:Histogram of a region of an image [12]

3.2 Uniform Local Binary Pattern

Uniform local pattern reduces the feature vector obtained from an image. The pattern obtained is considered to be uniform, if it includes two – bitwise transitions 0 to 1 or 1 to 0. Uniform patterns are the patterns that have at most 0-1 and 1-0 transitions. The patterns 11111111, 00011100 are uniform patterns and patterns 00001010, 01110010 are not uniform [1]. For the reduction of feature vector length of an image, only uniform patterns are considered and with the help of LBP features the classifier performance is improved. The usual LBP contains 256 patterns of bins which will be reduced to 59 patterns in uniform local pattern operator.

Figure 4 represents the uniform and non-uniform patterns. The expression of Uniform LBP [10] is given as:

$$LBP_{M,N}^{riu2} = \begin{cases} \sum_{i=0}^{p-1} \sigma(g_p - g_c) & if\ U(LBP_{M,N}) \le 2 \\ M+1 & others \end{cases} \quad (2)$$

Where $LBP_{M,N}^{riu2}$ represents the uniform or non-uniform patterns. Where $g_c$represents grey level of centre pixel and g_p represents gray level of its neighbourhood pixels. M is number of neighbours and N is the radius of its neighbourhood..

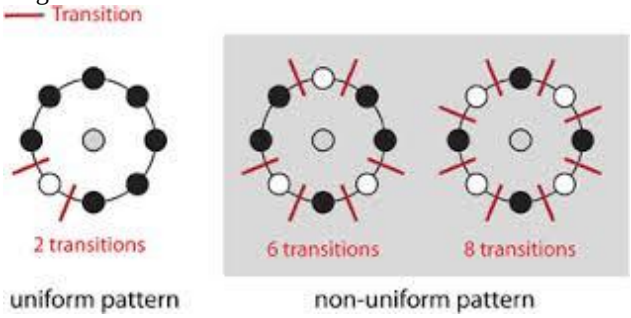


Fig 4.: Uniform and non-Uniform Pattern[13]

3.3 Center Symmetric LBP (CS-LBP)

The traditional LBP produces long histograms [4], so it is difficult to use it in the region descriptor. To overcome this limitation, another method called CS-LBP came into existence [4]. In centre- symmetric pattern, centre-symmetric pair of pixels is compared [4].This method is better than traditional LBP, where each pixel is compared with centre pixel. For 8 neighbours, LBP produces 256(2^8) different binary patterns, whereas CS-LBP reduces the patterns to 16(2^4) patterns. This binary pattern operator calculates grey level difference of a pixel with (3*3) neighbourhood in opposite direction. The pattern which is obtained by applying centre-symmetric method is half of the pattern which is given by local binary pattern.

$$\text{C-LBP}_{R,N,T} = \sum_{i=0}^{\frac{N}{2}-1} m[g_i - g_i + (\tfrac{N}{2})])\ 2^i$$

$$S(x) = \begin{cases} 1 & if\ x \ge t \\ 0 & otherwise \end{cases} \quad (3)$$

g_i and $g_{i\ +}(\frac{N}{2})$corresponds the grey values of centre-symmetric pixels which are equally spaced on radius R. The centre-symmetric binary pattern is much similar to gradient operator as gradient operator also calculate grey level difference between opposite pixel pairs. In Figure 5 centre-symmetric pair of pixels were compared instead of comparing each pixel with the centre-pixel.

LBP= $m(p1-c)^0$+$m(p2-c)^1$ +m $(p3-c)^2$+$m(p4-c)^3$+ $m(p5-c)^4$+$m(p6-c)^5$ s ($m(p7-c)^6$ + $m(p8-c)^7$

CS-LBP=$m(p1-p5)^0$ +s(p2- $m(p2-p6)^1$+ $m(p3-p7)^2$ + $m(p4-p8)^3$

p1	p2	p3
p8	c	p4
p7	p6	p5

Fig 5 : Neighbourhood Pixel in LBP and CS-LBP features.

3.4 Rotation Invariant Uniform Pattern (RIU-LBP)

Another popular texture binary patterns Rotation Invariant Uniform LBP, where the centre pixel is represented by calculating the number of times '1' appear in the code obtained after performing local binary coding for uniform patterns and for non-uniform patterns[11].The mathematical expression is given as follows:

$$LBP_{P,R}^{Riu2} = \begin{cases} \sum_{p=0}^{p} s(g_p - g_c) & uniform\ patterns \\ P+1 & others \end{cases} \quad (4)$$

Where c is the centre pixel, $g_c$represents grey level of centre pixel and g_p represents gray level of its neighbourhood pixels. P is number of neighbours and R is the radius of its neighbourhood.

IV. PROPOSED WORK

To solve the limitation of LBP operator of generating long histograms after extracting features from the image, CS-LBP is used but still there are chances that texture features are not properly extracted when image is rotated. To diminish this limitation Rotation Invariant Uniform Pattern LBP is used. In this work a technique which is hybrid of these two techniques i.e CS-LBP and RIU-LBP is proposed which combines the strengths of these two techniques as stated above to accurately classify

and retrieve an image from the database. To further increase the accuracy, colour feature extraction is done using colour moments because this descriptor will calculates mean variance and skewness which are different for different images .Mean (μ) is the first order moment, variation ($\boldsymbol{\sigma}$) is the second order derivative and skewness(S) is the third factor which is calculated in colour moment.

- Mean is defined as the average colour in an image. It can be calculated using the following formula:

Mean: $\mu_i = 1/S\sum_{j=1}^{N} f_{ij}$ (5)

where S is the total number of pixels in the image. f_{ij} describes the color value of i-th color component of the j-th image piuxel.

- Standard Deviation is the second colour moment which is calculated by taking square root of variance of the colour distribution.
  μ_I is the first colour moment for i-th colour value of the image. This factor is calculated by using given formula:

Standard Deviation: $\sigma_i = \left(\frac{1}{S}\sum_{j=1}^{N} (f_{ij} - \mu_i)\right)^{½}$ (6)

- Skewness is the third color moment which is calculated by taking cube root of the variance of the image.It is calculated by the formula given as:

Skewness: $S_i = \left(1/S \sum_{j=1}^{N}(f_{ij} - \mu_i)\right)^{1/3}$ (7)

Algorithm: Proposed Technique

For the query image (M_Q)

1. Pre-process the image to make the size of query image same to the images in the databases and convert RGB to grey level.
2. Apply RIU-LBP with colour moment to the query image M_Q obtain a texture feature vector P1.
3. Apply CS-LBP with colour moment to the query image M_Q to extract another feature vectorP2 from an image.
4. Create final feature vector P_S_Q of the image by combining P1 and P2 feature vector.
   P_S_Q ={P1,P2}
5. For every image in database D_{im} repeat 2 to 4 steps to get feature vector of database images D_{im} = { IM_{DB1} , IM_{DB2}..... IM_{DBn}}.IM_{DB} describes the feature vector of the images in the database.
6. Use Euclidean Distance for similarity matching.
7. Images are retrieved from the database which have features similar to query image.

V. EXPERIMENTAL RESULTS

In order to evaluate the performance of LBP and its extensions, the experiments are conducted. Wang database [5] is used for this purpose. This database consists of 1000 images divided into 10 different classes. Each class has100images.Africanpeople, sea, building, dinosaurs, buses, elephant, flower, horse, mountain, and food are the classes.

Fig 6. Query Image

Fig 7:Retrieval of images using RIU-LBP with color moment along with its confusion matrix.

Fig 8.:Retrieval of images using CS-LBP with color moment along with its confusion matrix.

Fig 9:Retrieval of images using proposed approach along with its confusion matrix.

Accuracy is calculated as shown in the following formula. Table 1 shows accuracy of different techniques and Figure 10 shows the graphical representation of normalized accuracy values.

$$\text{Accuracy} = \frac{Number\ \ of\ correct\ \ Predictions}{Total\ \ number\ \ of\ classes}$$

Table 1. Accuracy of different techniques

Classes	RIU-LBP with color moment	CS-LBP with color moment	Propsoed Technique
Africa	80%	80%	88%
Beach	72%	78%	80%
Monuments	80%	62%	88%
Buses	98%	94%	98%
Dinosaurs	78%	81%	85%
Elephants	50%	76%	78%
Flowers	96%	86%	98%
Horses	84%	94%	94%
Mountains	38%	68%	69%
Food	84%	74%	88%
Overall Accuracy	76%	79.3%	86.1%

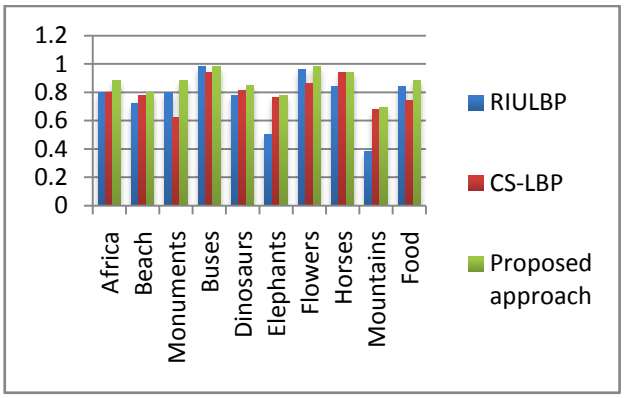


Fig10: Graph representing accuracy of RIU-LBP with colour moment, CS-LBP with colour moment and proposed approach

VI. Conclusion

In this paper we have studied content based image retrieval (CBIR) system and various feature extraction techniques with a special focus on their strengths and weakness. A technique is proposed which overcomes the limitations of these techniques when used in isolation. The proposed technique which is a hybrid of LBP (RIU-LBP) with colour moment and Centre-Symmetric LBP(CS-LBP) gives more accuracy as compared to the techniques when used separately.

REFERENCES

[1] C.Shang, S. a. (2009). "Facial Expression Recognition based on local binary pattern,A comparitive study "Image and vision computing"., (pp. 803-816).

[2] G.Zhenhua, D. Z. (2010). "Rotation Invariant as a texture classification using adaptive LBP with dirtectional statistical features". *IEEE* InternationalConference, (pp. pp.285-288).

[3] Abdenour Hadid, "The local binary pattern approach and its applications to face analysis.",IEEE.

[4] Marko Heikkila, M. P. (2008). "Description of interset region with center-symmetric local binary pattern operator. *Elesvier*

[5] O.mich,R.a.(2011)."Histograms Analysis for imageRetrieval" Pattern Recognition.

[6] Timo Ahonen and Matti Pietkianen, T. A(2006). "Face Desrcription and Recognition with local binary pattern". *IEEE.*

[7] T.Maenpaa, M.Pietikainen (2005). "Texture Analysis with local binary pattern handbookof pattern Recognition and computer vision ".

[8] T.Ojala. (2009)." Multiresolution Gray Scale and Rotation Invariant Texture Classification with Local Binary Patterns", Pattern Recognition.Spector,

[9] Roshi Chaudhary, Nikita Raina, NeshuChaudhary, Rashmi Chauhan, (2014) ,"An Integrated Approach to Content Based Image Retrieval.", IEEE.

[10] Yuchun Fang,J. L. (n.d.)."Fusion of multidirectional rotation invariant uniform LBP features for FaceRecognition".

[11] KarolinaNurzynska,BogdanSmolka,(2015), Recognition Between Smiling and Neutral Facial Display with Power LBP operator".

[12] https://www.google.co.in/search?q=lbp+histograms+images&espv=2GZQKHZMTB9Aaccesses on 25-05-2016.

[13] https://www.google.co.in/search?q=uniform+and+non+uniform+lbp+patterns+images&accessed on 01-06-2016.