A Performance Evaluation of Different Texture Models for Image Indexing and Retrieval

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ABSTRACT
In recent years, image mining techniques enters and plays a vital role in various fields. Due to the rapid development in the information technology various techniques has been emerged to process and store these information, issues in data retrieval and recognition remains continued owing to its immense voluminous. Image retrieval has been developed into a very active research area specializing on how to extract and retrieve the images. The various methods have been proposed for image retrieval and each method has advantages and drawbacks. The complexity in process and other issues affects performance of existing system which makes existing system is insufficient. In this paper image retrieval with feature vector calculates the threshold value separately and stored in feature database. The feature is generated and matching is done by Chi-square classification which is used to measure distance between two images. The experimental result shows that MBLBP method provides better retrieval rate when compared with the existing methods such as Local Binary Pattern, Elongated Local Binary Pattern Template Method.

Keywords
LBP, ELBPT, MBLBP, Chi-square.

1. INTRODUCTION
A rapid growth within the field of information technology in the development of internet and availability of image capturing devices like digital cameras, image scanners and the size of digital image assortment is increasing apace.

Image mining deals with the extraction of image patterns from a large assortment of images. Clearly, image mining is different from low-level computer vision and image processing techniques as a result of the focus of image mining is in extraction of patterns from large assortment of images, whereas the focus of computer vision and image processing techniques is in understanding and/or extracting specific features from a single image.

Efficient image searching, browsing and retrieval tools are needed by users from various domains, including remote sensing, fashion, crime prevention, publishing, medicine, architecture, etc. For this purpose, several general purpose image retrieval systems are developed.

Content-Based Image Retrieval (CBIR), the image databases are indexed with descriptors derived from the visual content of the images. Most of the CBIR systems are concerned with approximate queries wherever the aim is to find images visually similar to a specified target image. In most cases the aim of CBIR systems is to replicate human perception of image similarity as well as possible.

2. RELATED WORK
Hsu et al. [1] developed image mining as a knowledge domain effort that gives important application in machine learning, image processing, image retrieval, data processing, database, computer vision and many more.

Content based tissue image mining by Gholap et al. [2] proposed as biological data management and mining are considerable areas of recent biology research. The huge information content is significant features of any Tissue Microarray Analysis system.

Sanjay et al. [3] discussed an image mining technique using wavelet transform. The usage of common pattern harmonizing, pattern identification and data mining models with the intention that a true life scene and image can be associated to a particular class, assisting in different prediction and forecasting mechanisms.

Content based image mining approach are explained by Conci et al. [4] image mining presents unique distinctiveness suitable to the richness of the data that an image. The successful assessment in results of image mining by content requires that the user point of view is used on the performance parameters.

A new image mining approach described by Jiang et al., [5] given many images they use Attributed relational Graph to characterize them.

Chin-Chin Lai et.al. [6] proposed an interactive genetic algorithm to reduce the gap between retrieval results. They used color attributes like the mean value, standard deviation, image bitmap and also used texture features like the entropy based on the gray level co-occurrence matrix, edge histogram.

Nhu-Van Nguyen et.al.[7] proposed clustering and image mining technique for fast retrieval of images. The objective of image mining is to remove the data loss and extracting the information. The clustering gives good result when the number of samples of feedback is small.

The multiresolution approach [8] gray-scale and rotation invariant texture classification based on data point binary patterns and nonparametric discrimination of sample and local distributions.

An efficient technique [9] Multi-scale Block local Binary Pattern operator is predicated for robust image representation. The local Binary Pattern has been established effective for image representation; however it is too local to be robust. Multi-scale Block Local Binary Patterns uses sub-region average gray-values for comparison rather than single pixels.

3. METHODOLOGY

The image mining includes several image-processing techniques such as filtering, feature extraction and classification of image.

3.1 Local Binary Pattern (LBP)

Texture may be a term that characterizes the discourse property of an image. A texture descriptor will characterize an image as an entire instead it also can characterize an image domestically at the small level and by international texture description at the macro level. LBP methodology is employed to label each pixel within the image by thresholding the eight neighbors of the pixel with the middle pixel value as shown in the Fig.1. If a neighbor pixel value is a smaller amount than the threshold then a value of zero is appointed otherwise it's one.

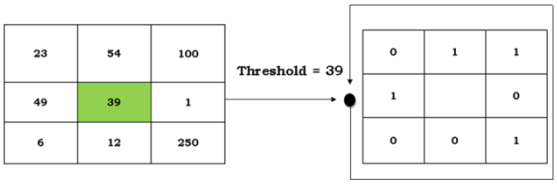

Fig 1. Local Binary Pattern

3.2 Elliptical Local Binary Template (ELBT)

Masily [12] suggested this method which is very similar to that of LBP. The only difference is that vicinity pixels lie on an ellipse relating to the central pixel rather than on a circle. To calculate coordinates of vicinity pixels, vertical radius as well as horizontal radius is required.

3.2 Multi Block Local Binary Pattern (MBLBP)

Multi Block Local Binary Pattern is used to obtain texture pattern for every pixel by considering a local region of size 3 × 3, 9 × 9, 15 × 15 etc. with center pixel. Computation of MBLBP for 3 × 3 local region is equivalent to the ordinary LBP. Local region of other sizes can be decomposed into equally sized regions. Hence, the average sum of pixel intensity for every sub regions is calculated which is then threshold with the center region average value as shown in the Fig.2. MBLBP values are computed in a similar manner as in LBP which exhibits more distinctive features.

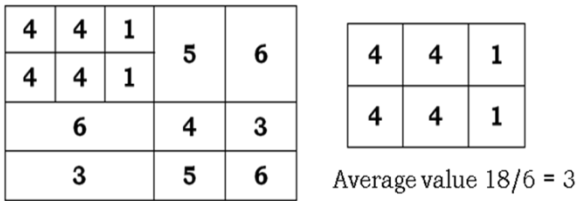

Fig 2.Multi Block Local Binary Pattern

The Process flow of the methodology is shown in fig.3.

4. FEATURE EXTRACTION

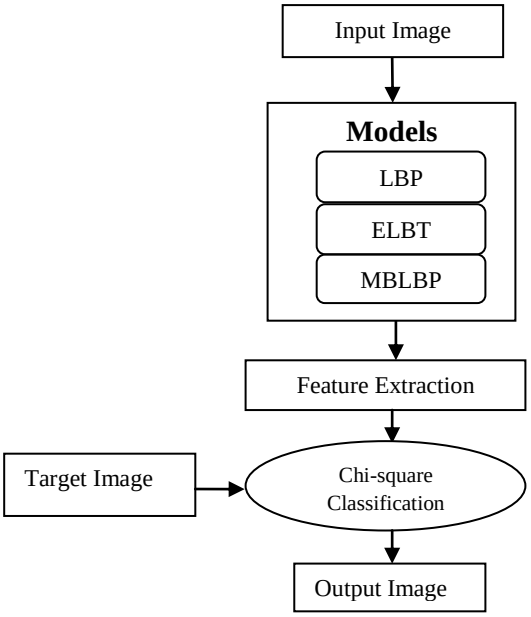

Fig.3 Process Flow

The features are located to compute the feature sets for classification. Here five feature sets are calculated for feature extraction. The feature set 1 are size of the image, feature set 2 is color features, feature set 3 is horizontal image features of the segment, feature set 4 is vertical image features of the segment and feature set 5 is shape features of the image. Feature set computed as

$$\delta_i = (SegSize_i)/imgSize \quad \text{--- (4.1)}$$

Where $SegSize_i = \sum_{\forall(x,y)\in r_i} 1$

$$Fs_1 = \{\delta_1, \delta_2, ..., \delta_n\}$$

$$Cf_i = \sum_{C=R,G,B} ColComp(C)_i / (3 * SegSize_i) \quad \text{--- (4.2)}$$

Where $ColComp(C) = \sum_{\substack{C=R,G.B \\ \forall(x,y)\in r_i}} I_i\ (x,y,C)$

$$Fs_2 = \{Cf_1, Cf_2, \ldots, Cf_n\}$$

$$Sh_i = \frac{\sum_{\forall x\in r_i} |X_i - x|}{SegSize_i * \max(|X_i - x|)} \quad \text{---- (4.3)}$$

$$Sv_i = \frac{\sum_{\forall x\in r_i} |Y_i - y|}{SegSize_i * \max(|Y_i - y|)} \quad \text{----- (4.4)}$$

Where $X_i = \sum_{\forall x\in r_i} x / SegSize_i$ and

$$Y_i = \sum_{\forall y\in r_i} y / SegSize_i$$

$$Sp_i = \frac{\sum\left(\left|X_i - x\right|\right) * \left(\left|Y_i - y\right|\right)}{SegSize_i * \max\left(\left|X_i - x\right|\right) * \max\left(\left(\left|Y_i - y\right|\right)\right.}$$

$Fs_3 = \{Sh_1, Sh_2, \ldots, Sh_n\}$ and $Fs_4 = \{Sv_1, Sv_2, \ldots, Sv_n\}$
$Fs_5 = \{Sp_1 Sp_2, \ldots, Sp_n\}$ --- 4.5

5. ALGORITHM

The process of the image retrieval takes place in two phases and defined as algorithm I and II.

Algorithm I

// generating feature sets //

Input: Input image of size (M x N) from IDB.
Output: Feature database.

Begin

Step1: *Read an image (I_i) from the image database (IDB) of size (M x N).*
Step2: *Partitioning the input image into k non-overlapped blocks, each of size (n x n).*
Step3: *Perform procedure_ threshold ( )*
Step4: *Repeat Step 2 through step3 for all blocks of the input image.*
Step5: *Generate feature set Fs={Fs1,Fs2,Fs3,Fs4,Fs5} as mentioned in equation 4.1 to 4.5.*
Step6: *Store the feature set into the feature database*
Step7: *Repeat Step 1 through Step 6 for all the images in IDB.*
End

Algorithm II

//Retrieving top *m* relevant images corresponding to the target image //

Input: Target Image (T_i) of size (M x N) and images from IDB
Output: List the top m relevant images corresponding to the target image.

Step1: *Read the Target image (T_i).*
Step2: *Partitioning the Target image by k non-overlapped blocks of size (n × n)*
Step3: *Perform procedure threshold_feature ( )*
Step4: *Repeat Step 2 through Step 3 for all blocks of the target image.*
Step5: *Generate feature set Fs= {Fs1, Fs2, Fs3, Fs4,Fs5} as mentioned in equation 4.1 to 4.5.*
Step6: *Perform procedure chi_square dist ( )*
Step7: *Retrieve the top m relevant images from the image database.*
End

Procedure _ threshold ( )

//Computing images for threshold value//
{
Step1: *Input M, N //size of input image*
Step2: *Read the image with even row and column*
Step3: *Convert gray scale values into matrix format.*
Step4: *Apply sorting method for an array by using step 3.*
Step5: *Find out the middle gray scale values of lower range and upper range.*
Step6: *Find out the average value of middle gray scale values and take whole number in sorted array and also known as threshold value.*
Step7: *Convert binary matrix by using threshold value.*
Step8: *Repeat step 3 to step 7 for all images in the database.*
Step9: *Return*
}

Procedure chi_square dist ( )

//Computing distance measure of images from IDB with the target image//
{
for i=1 to N // N ← number of images in IDB
{ // csdm –chi square distance measure

$$x^2(I,T) = \sum \frac{(I_i - T_i)^2}{(I_i + T_i)^2}$$ *//geometric features of chi square*

$$NGF = \frac{X^2(I,T)}{Max\ x^2(I,T) - Min\ x^2(I,T)}$$ *// normalize dissimilarity measure*

}
Return
}

6. EXPERIMENTATION AND RESULTS

The proposed feature extraction is experimented with the images collected from the standard database CORAL and Brodatz images as shown in fig.4 and generated feature set images considered for this experiment are of the size (m x n). The Table.1 shows that recognition percentage of the query images with MBLBP. The experimental results show that the MBLBP produces higher retrieval accuracy of 93.53%. The performance was evaluated using the chi-square classification; by analysis of the values in the table the MBLBP and chi-square classification method is better for image retrieval.

Table.1 Comparison Values

Methods	Percentage in recognition
LBP	91.29%
ELBPT	82.89%
MBLBP	93.53%

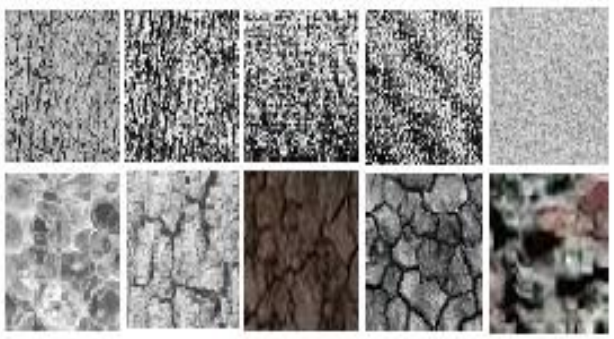

Fig 4.Retrieval result for image database

The Fig. 5 shows the pictorial representation of the performance evaluated. By analyzing the obtained results the MBLBP method produced the best results.

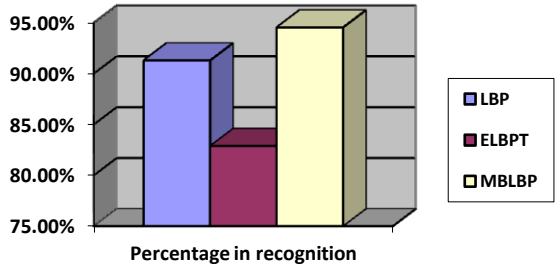

Fig. 5 Performance Evaluation

7. CONCLUSION

In this paper, the image retrieval with feature extraction based on LBP, ELBPT and MBLBP models has been presented. The experimental result proves the effectiveness of the MBLBP method which provides good retrieval rate when compared to existing methods. The performances of MBLBP method when compared to existing methods such as Local Binary Pattern and Elongated Local Binary Pattern Template method are investigated independently. The MBLBP method produces better retrieval results with 94.53% accuracy compared with existing methods where Local Binary Pattern method gives 91.29% accuracy and Elongated Local Binary Pattern Template with 82.89% accuracy. The computational cost of the algorithm is very low also used for image retrieval.

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