Direction and Neighbourhood Based LBP for Image Retrieval using Texture

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Abstract- Today's innovation of internet and digital technologies made the necessity to have the digital images abundantly for easier categorization and retrieval. Thus in this scenario there is an urge to develop a technology for easier retrieval. The area of texture analysis has undergone rapid development in the recent years and has been the vital method in retrieving images playing a major role in computer vision and pattern recognition. LBP coding is a state of art marked for its simplicity and efficiency which is a powerful method for analyzing textures. In this paper the system that is proposed is based on the relationship with the sequential neighbors and specified distance. It is where all the pixels in the given orientation are compared with its neighborhood sequentially. For an input image, based on the orientation and pixel value of the neighbors, the new LBP value is computed and the histogram is constructed for those values. The features are extracted from the histogram and the feature vector is created. The dataset considered for testing is Brodatz which contains texture images. The Brodatz is categorized into Brodatz 1 and Brodatz 2.The proposed technique is applied to Brodatz 1 and Brodatz2 and the feature vectors are constructed. The features of the input images are compared with the dataset features and the relevant images are retrieved. Precision and Recall are used for measuring the accuracy of the proposed method.

Keywords – LBP, nLBP, dLBP,ARR.

I. INTRODUCTION

Texture analysis specifies the characterization of regions in an image. It refers to the terms such as rough, smooth, silky, or bumpy as a function of the spatial variation in pixel intensities. An image texture is a set of metrics calculated in image processing designed to quantify the perceived texture of an image. Image texture gives us information about the spatial arrangement of color or intensities in an image or selected region of an image. Texture is a crucial image property used by various computer vision and recognition of patterns. It is characterized by the spatial distribution of gray levels in a neighborhood and has applications in the field of remote sensing, face identification, analysis of documents. This feature describes the structural arrangement of a region and represents the characteristics such as smoothness, coarseness, roughness of a region. There are several other methods like gabor filters, wavelet methods and gray level co-occurence matrices.

One of the methods that is easiest to analyze the texture analysis is the Local Binary Pattern (LBP).It was proposed by Ojata er al. It compares the neighborhood pixel with the center pixel and form the binary pattern which is then converted to different histograms. Local texture descriptor has attained much advantages in various applications due to its low computationally complexity, robustness to elimination changes, gray scale and rotation invariance and excellent performance. Despite of its advantages there are few drawbacks like sensitive to noise, it cannot properly detect large scale textural structures. It has small spatial support, generates large histogram and sensitive to image rotation. Because of these advantages, LBP has been employed in many applications. The main objective of this was to obtain a novel descriptor based on the spatial distance and orientation between the pixels.

The rest of the paper is organized as follows. Related Works is explained in section II. The proposed system is discussed in section III. Experimental results are presented in section III. Concluding remarks are given in section IV.

II. Related Works

1. Traditional local binary pattern

The LBP operator was used in texture analysis. A binary pattern was obtained by comparing the neighboring pixels with the pixel in the center of them. Initially only 8 neighboring pixels were taken to compare, but it has been extended to any number of pixels. If the neighboring pixel value is greater than or equal to the value of the center pixel, a binary value 1 is assigned otherwise a value 0 is assigned. The obtained binary pattern is converted into a decimal value as shown in figure. The LBP operator was introduced by in [12] for texture classification. Given a center pixel in the image, the LBP value is computed by comparing its gray value with its neighbors [13], as shown below

$$\mathrm{LBP}_{P,R} = \sum_{p=1}^{P} 2^{(p-1)} \times f_1(g_p - g_c)$$

$$f_1(x) = \begin{cases} 1, & x \geq 0 \\ 0, & \text{else} \end{cases}$$

Where g_c is the gray value of the center pixel, g_p is the gray value of its neighbors, P is the number of neighbors, and R is the radius of the neighborhood.

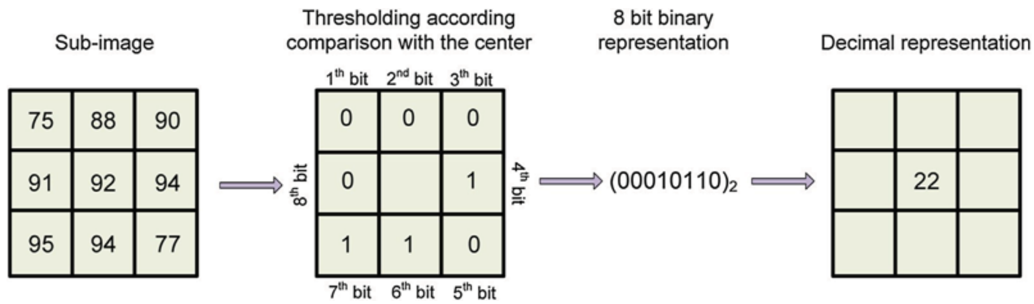

Figure 1.Local Binary Pattern

By applying this, a LBP histogram, which has pixel value ranging between 0 and 255 is formed. Each and every value in the histogram corresponds to a different pattern.

2. Local Binary Pattern by Neighborhood:

This method [1] depends on the relation of neighboring pixels with each other. In comparison, the value of each particular pixel is compared with the pixel next to it and takes the value either 1 or 0 and the other process is same as explained in LBP.If the distance is 1, the comparison will be done as follows:P0 is compared with P1,P1 compared with P2,P2 compared with P3 and this process continues till P7 compared with P0.Likewise if the distance is 2,the comparison will be done as :P0 compared with P2,P1 compared with P3 and continues till P7 compared with P1.

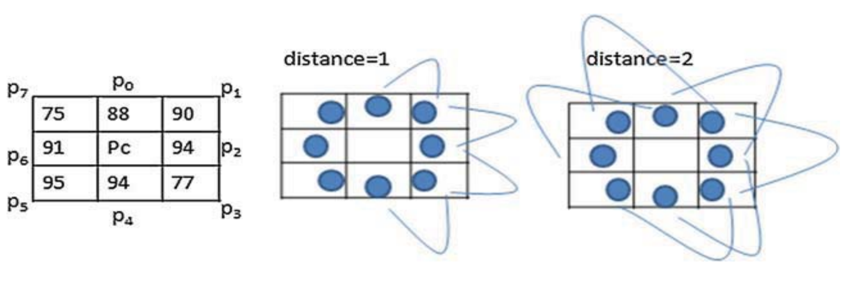

Figure 2. Local Binary Pattern by neighborhood

Additionally in this method comparisons can be done not only with sequential neighbors but also with in the neighbors defined by distance parameter.

3. Directional Local Binary Pattern:

In the method [1], the comparison is done through the pixels in the same orientation based on the angle, which might take 0˚,45˚,90˚ or 145˚.After identifying the neighbors ,pixel value of them are compared with the center pixel and the other process is same as explained in LBP.The values are computed as follows:

α=0◦

Pc = {S(210 > 217), S(210> 255), S(210 > 255),S(210 > 241),S(210 > 181), S(210 > 177), S(210> 146), S(210 > 119), }and Ic = {0, 0, 0, 0, 1, 1, 1, 1} so Pc takes the value 15.

Likewise the values are computed when **α=45◦, α=90◦, α=135◦,**

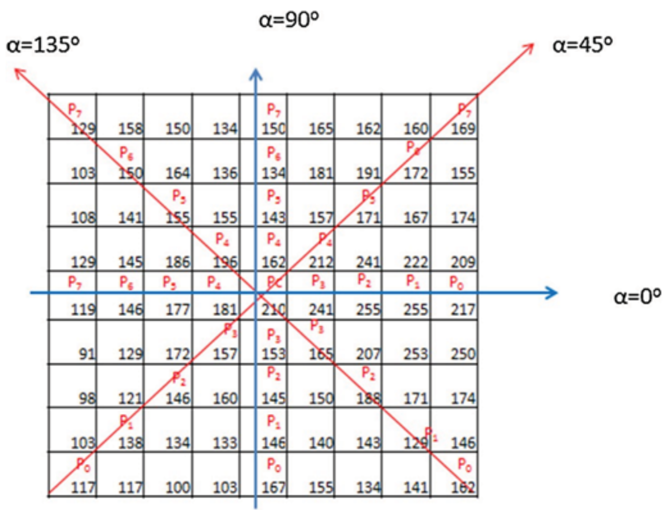

Figure 3. Directional Local Binary Pattern

III.PROPOSED SYSTEM

In nLBP [1] the neighboring pixels are compared with the adjacent pixels based on their distance factor and in dLBP the comparison is done through the pixels based on the orientation .Combining these two methods the new method is proposed. In this method the comparison is done through the pixels in the same orientation based on the angles which may take the 0˚, 45˚, 90˚ or 135˚.Once the neighbors are identified the pixel values of them are compared with the pixel next to it. While the other process is same as explained in LBP. Additionally the comparison is made with the neighbor defined by the distance parameter.

The center pixels take the decimal value as its binary value is:

$$Ic = \{S(I_0 > I_1), S(I_1 > I_2), S(I_2 > I_3), S(I_3 > I_4), S(I_4 > I_5), S(I_5 > I_6), S(I_6 > I_7), S(I_7 > I_0)\}$$

where S denotes the comparison and calculated as

$$(I_i > I_j) = \begin{cases} 1 & \text{if } I_i > I_j \\ 0 & \text{if } I_i \le I_j \end{cases}$$

The decimal value of texture in Figure 4 can be calculated as follows for α= 0◦, 45◦, 90◦and 135◦, respectively.

α=0◦

Ic = {S(115 > 146), S(146 > 177), S(177 > 181),S(181 > 241), S(241 > 255), S(255 > 255), S(255 > 217), S(217 > 115)}and Ic = {0, 0, 0, 0, 0, 0, 1, 1} so Ic takes the value 3.

α=45◦

Ic = {S(194> 138), S(138 > 159), S(159>167),S(167>212), S(212> 171), S(171>144), S(144>169), S(169>194)}and Ic = {1, 0, 0, 0, 1, 1, 0, 0} so Ic takes the value 140.

α=90◦

Ic = {S(150 > 134), S(134 > 120), S(120> 125),S(125>153), S(153> 142), S(142 > 146), S(146 > 199), S(199 > 150)}and Ic = {1, 1, 0, 0, 1, 0, 0, 1} so Ic takes the value 201.

α=135◦

Ic = {S(136 > 150), S(150 > 155), S(155 > 196),S(196 > 165), S(165 > 188), S(188 > 129), S(129 > 195), S(195 > 136)}and Ic = {0, 0, 0, 1, 0, 1, 0, 1} so Ic takes the value 21.

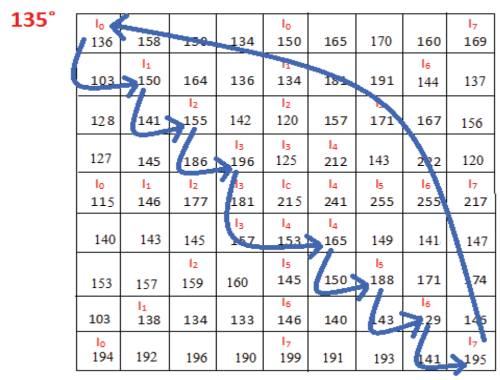

Figure 4. Directional Neighborhood Local Binary Pattern

By applying the proposed method the LBP values are calculated and the histogram is constructed for the LBP values. The histogram contains the pixel values ranging between 0 and 255 and each value in the histogram corresponds to a different pattern. The features like mean, standard deviation, energy, entropy, maximum, minimum, skewness, kurtosis, median, mode, root mean square, covariance, correlation are extracted. The Brodatz dataset contains 112 texture of images. Figure 5 and Figure 6 represents the two datasets namely Brodatz-I and Brodatz-II of 36 images .Each texture is of size 512X512 pixel. The texture image 512 X 512 is subdivided into 16 sub images. For each sub image the proposed method is applied and the features are extracted. Hence the feature vector for Brodatz I and Brodatz II were constructed.

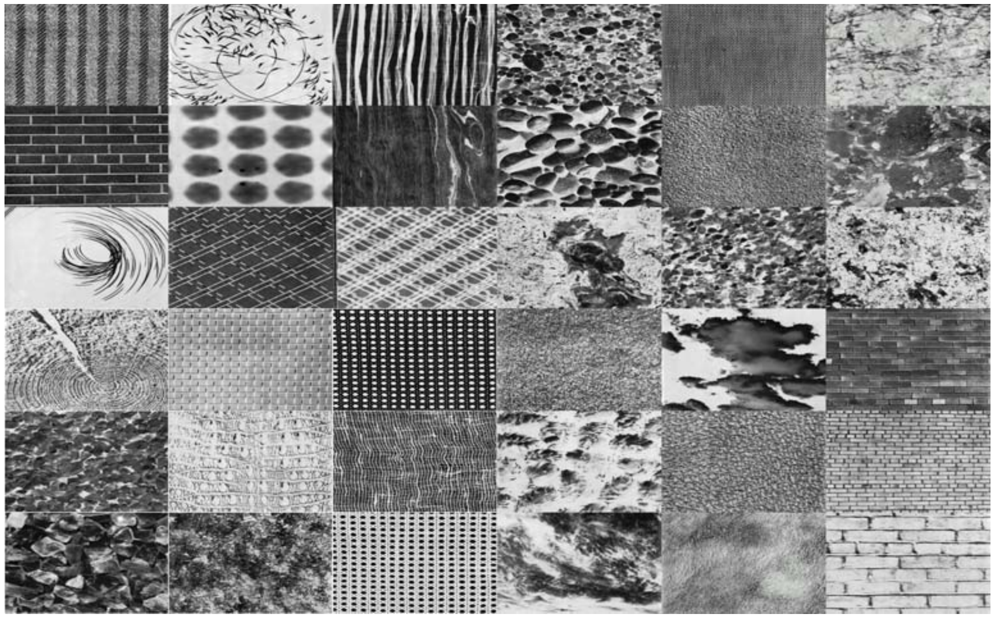

Figure 5. Sample of texture images in Brodatz I Dataset

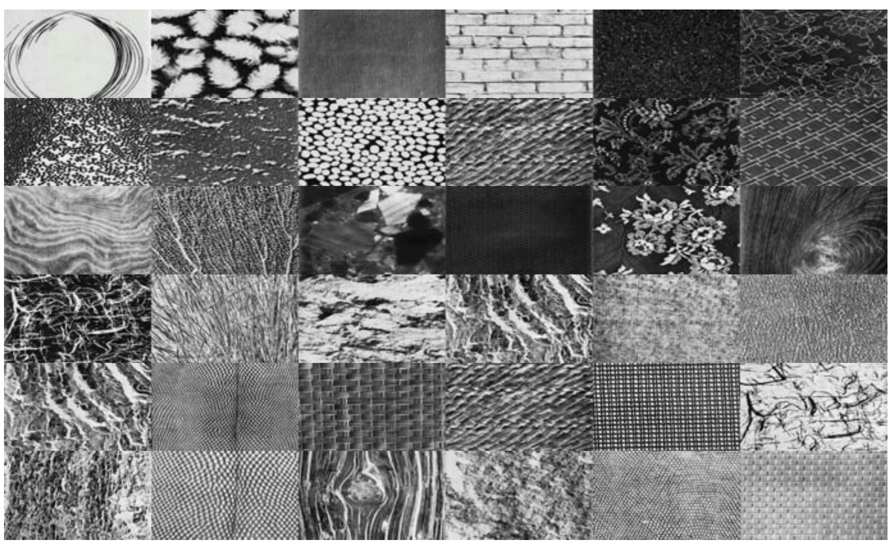

Figure 6: Sample of texture images in Brodatz-II dataset

IV.RESULTS AND DISCUSSION

The dataset described in the previous section were used to evaluate on the various textures. The input image shown in figure 7 is chosen from Brodatz I and given to the proposed method .For an input image of 512X512, the image is subdivided into sub images as shown in the figure and the proposed method named Directional and neighborhood LBP value is calculated .The histogram is constructed as shown in figure 8 and the various features described in the section III are extracted.

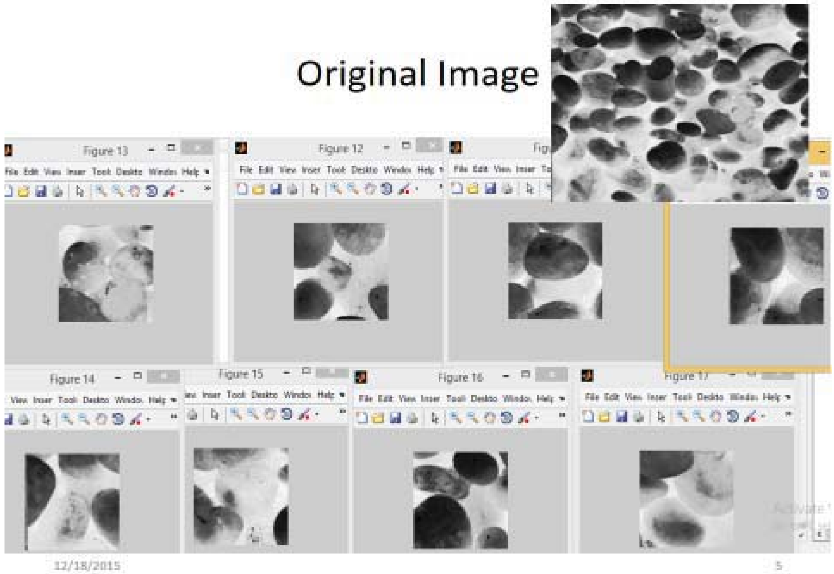

Figure 7: Input image from Brodatz-I and the sample sub images

The features extracted were classified by artificial neural network (ANN) in the manner of 10 fold cross validation. The parameters used to measure the performance metrics are Precision and Recall. Precision is the fraction of retrieved instances that are relevant to the query image. **Recall** is the fraction of relevant instances that are retrieved.

Precision:

$$\text{Precision} = \frac{\text{Number of relevant items retrieved}}{\text{Number of items retrieved}}$$

Recall:

$$\text{Recall} = \frac{\text{Number of relevant items retrieved}}{\text{Number of relevant items in the collaction}}$$

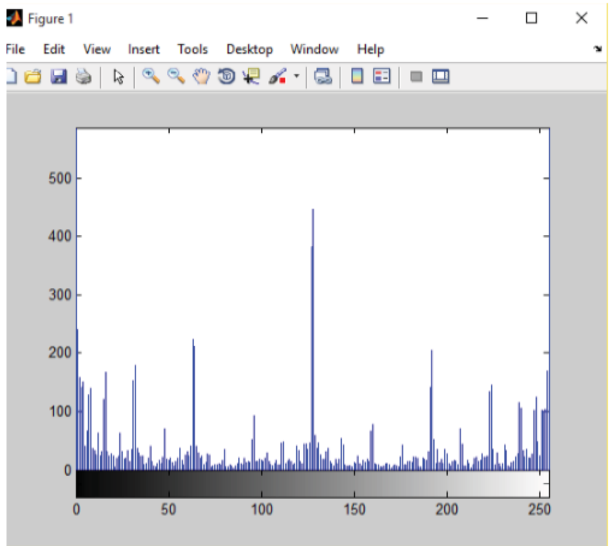

Figure 8:Histogram of an original Image

Table-1

	Precision	Recall
Brodatz-I	93%	95%
Brodatz-II	96%	93%

V.CONCLUSION

The two techniques namely nLBP and dLBP can retrieve the images by comparing the pixels with the neighborhood and by comparing the pixels in the same orientation respectively. But the method proposed in this study, the directional and neighborhood LBP which could calculate the values by comparing the neighborhood pixels in a particular orientation. In this comparison the images are retrieved from the dataset in an effective manner. The precision and recall are used to measuring the accuracy of the proposed work.

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