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REVIEW ARTICLE

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An Empirical Study on Texture Feature Extraction Methods for Image Retriveal

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***Abstract*—Feature extraction methods for images are becoming increasingly popular because selected image region provide information about the color and intensity. Texture analysis and classification are difficult which have been observed by image processing scientists since late 80s. It can be done in many areas such as face recognition, pattern recognition, and object recognition etc. In this paper, a review of texture feature extraction methods.**

Keywords— ***Local Binary Pattern, Applications***

I. Introduction

An image is made up of a series of pixels (picture elements). Most of the today's digital photos use "24-bit RGB" system to color each pixel. This means that each pixel has a 256 color range of red, green and blue [13].

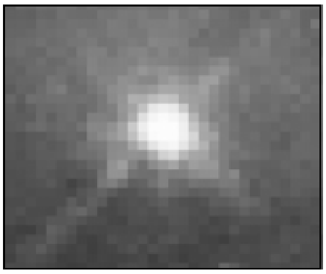

Figure 1. An image- matrix of pixels arrange in columns and rows [15]

The intense growth of digital images in our lives needs logical image data organizer system for storage and retrieval [14].Text-Based Image Retrieval (TBIR) which uses keywords that retrieval can be performed over the annotation words. CBIR retrieves images based upon features such as color, texture, and shape[12]. A wide range of possible applications for CBIR technology has been identified (e.g. Gudivada and Raghavan [1995]). Potentially fruitful areas include the military, architectural and engineering design, medical diagnosis, education and training [17].

II. Texture Feature extraction

The natural world is rich in texture: the surface of any visible object is textured at certain scale [16]. There are some characteristics about textures such as the size of granularity, directionality, randomness or regularity and texture elements. Analysis these aspects may be useful to classify the textures in one or more classes [1].

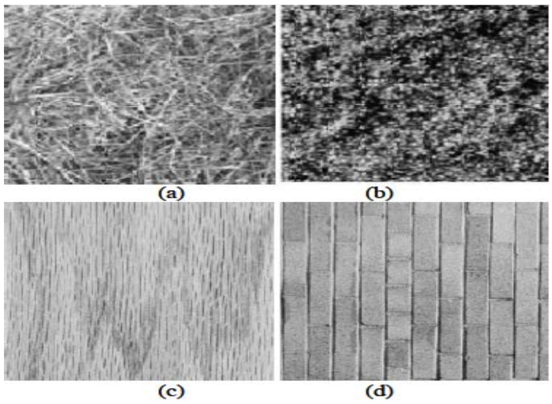

Figure 2. Some examples of texture (a) Grass (b) Leaves (c) Wood (d) Brick Wall [2]

In the last decades, various methods were profound for extracting texture features and usually used methods are local binary patterns (LBP), gray level co-occurrence matrices (GLCM), Gabor filters (GF) and wavelet methods. These methods can be mainly categorized into structural, statistical, transform and model-based methods [2].

Four major image analysis steps-:

a) Texture Classification It produces organized output of the input image where each texture region is recognized with its belonging texture class.

b) Texture Segmentation It makes a partition of an image into a set of unjoin regions based on texture properties so that each region is similar withcertain texture characteristics.

c) Texture Synthesis Texture synthesis is a common technique to create large textures from usually small texture samples, for the use of texture mapping in surface applications.

d) The Shape from Texture The shape from texture recreates 3-D surface geometry from texture information. A typical process of texture analysis is shown in fig 3 [9].

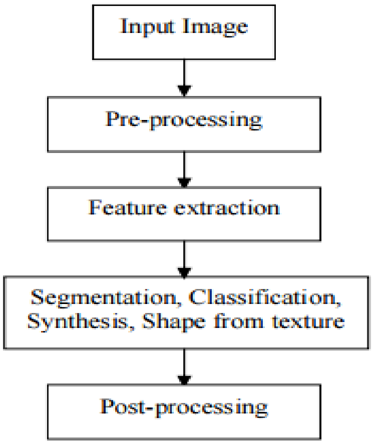

Figure 3. Image Analysis Steps [9]

III. LOCAL BINARY PATTERN

LBP was introduced as a fine scale texture descriptor. A binary pattern description of a pixel is developed by thresholding the values of the 3X3 neighborhood of the pixel against the central pixel and interpreting the result as a binary number.

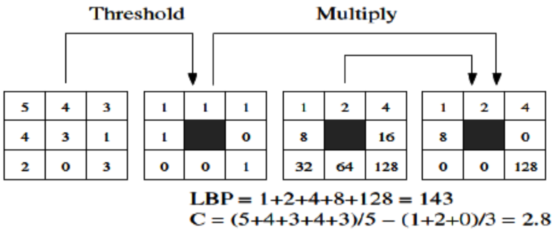

Figure 4. Calculating original Local Binary Code and Contrast Measure [3]

The present form of the LBP operator, described in fig 4, is fairly different from this basic version: the original definition is extended to arbitrary circular neighborhoods, and various types of extensions have already been developed. The basic idea behind this is, however, the same: a binary code that describes the local texture pattern is created by threshold a community by the gray value of its center. The operator relates to many well-known texture analysis methods [3].

One shortcoming of the traditional LBP operator is that its small 3x3 neighborhood cannot showsupreme features with large scale structures. To deal with the texture at different scales, the operator was later generalized to use neighborhoods of different sizes. A local neighborhood is defined as a set of sampling points evenly spaced on a circle which is centered at the pixel to be labeled, and the sampling points that do not fall within the pixels are interpolated using bilinear interpolation, thus allowing for any radius and any number of sampling points in the neighborhood. Figure4 shows some examples of the extended LBP operator, where the notation (P, R) denotes a neighborhood of P sampling points on a circle of radius of R [8].

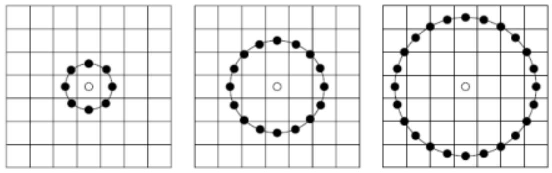

Figure 5. Example of extended LBP operator: the circular (8,1), (16,2), (24,3) neighborhoods [8]

The LBP feature vector, in its simplest form, is created in the following manner:

a) Divide the examined window into cells (e.g. 16x16 pixels for each cell).

b) For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top etc.

c) Where the center pixel's value is greater than the neighbor's value, write "1". Otherwise, write "0". This gives an 8-digit binary number (which is converted to decimal).

d) Compute the histogram, over the cell, of the frequency of each "number" occurring (i.e., each combination ofwhich pixels are smaller and which are greater than the center).

e) Optionally normalize the histogram.

f) Concatenate (normalized) histograms of all cells. This gives the feature vector for the window [4].

Advantages:

- High discriminative power.
- Computational simplicity.
- Invariance to gray scale changes.
- Good Performance [10].

Disadvantages:

- Not invariant to rotations.
- The size of the features increases exponentially with the number of neighbors which leads to an increase of computational complexity in terms of time and space.
- The structural information captured by it is limited. Only pixel difference is used, magnitude information ignored [10].

A. *Center Symmetric LBP*

The major difference between LBP and center-symmetric LBP operators is the way of labeling pixels of an image in a3×3 neighborhood, the former labels pixels of an image by thresholding the neighborhood of each pixel with the gray Value of the central pixel, the later labels pixels of an image by thresholding the neighborhood of each pair pixels which are center symmetric as the central pixel. If the gray value of the neighboring pixel is higher or equal, the gray value is set to one, otherwise to zero. Then, both operators concatenate the results binomially to form a decimal number under the specified direction. Fig 6 gives an illustration of the two operators with the 3×3 neighborhood.

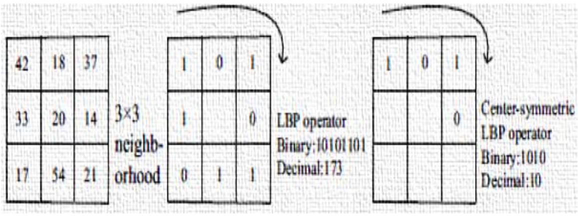

Figure 6. LBP and Center-Symmetric LBP operator [5]

Through comparative analysis, center-symmetric LBP is similar to the LBP. It should be noted that the gain of center-symmetric LBP over LBP is not only due to the dimensionality reduction but also to the fact that the center-symmetric LBP captures the gradient information better than basic LBP [5].

B. *Block Based Division*

In this approach, the image is divided into a number of blocks. These blocks can be of arbitrary size and can overlap. Then the LBP operator is applied to each block separately, and their corresponding histograms are calculated. Integration of these blocks can either be at the feature level or at the score level. For integration, at the feature level, the histograms extracted from various blocks are concatenated and the overall histogram is used for matching. On the other hand, integration at the score level involves matching the histogram extracted from each block alone then fusion of scores from these blocks. Sub-blocks are expected to be more discriminative than using the whole image [6]. The final image dissimilarity D for classification is the sum of minimum distances as presented by Eq. 3:

$$D=\sum_{i=0}^{N-1} \min_j(D_{i,j}) \qquad (3)$$

Where, N is the total amount of query image blocks and $D_{i,j}$ the distance (relative $L1$) between the ith query and jth model block histograms. An example of the approach in operation is shown in Fig 7.

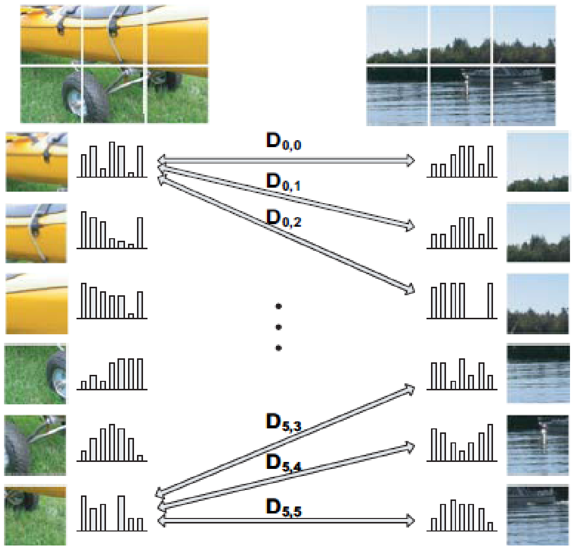

Figure 7. Block Based Division Method [7]

IV. Applications of Texture

Texture analysis methods have been used in a various application such as medical image analysis, remote sensing and face detection etc. [9].

A. *Remote Sensing*

Texture analysis has been used to categorize remotely sensed images. Land use classification where homogeneous regions with different types of terrains (such as wheat, bodies of water, urban regions, etc.) need to be identified is an important application [9].

B. *Medical Image Analysis*

Medical applications involve the preprogrammed extraction of features from the image that can be used in the variety of classification tasks. The classification task, the extracted features involve morphological, color or certain textural properties of the image [9].

C. *Face Recognition*

Face recognition is present research area, and they can be used in various applications such as supervision and security. The face is a complex multidimensional structure and needs a best computing technique for recognition. It can be used in two modes: Verification and Identification. Facial feature extraction consists face attributes like eyes, nose and mouth regions.

There are two types ofan extraction method for face images are:Geometric feature considers the deviation in shape, location, space between two eyes and length of the nose. Appearance feature presents the alteration of the face image, such as wrinkles and furrows. These feature extracted from whole face image or specific regions in a facial image [11].

CONCLUSION

In this paper, a review on texture methods is discussed, which is useful in various applications. Texture feature extraction is an active research area and many researchers work in different fields. This paper tried to summarize LBP method and its extensions CS-LBP, Block Based Division method which has been proposed in computer vision and image processing community for texture analysis. LBP methodology is easy and less computational complexity.

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