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"Comparative Study of different Texture Descriptors for Image Retrieval in CBIR"

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***Abstract*—Image retrieval is a vast area of CBIR. An image can recognize from its color, shape, and texture. A texture is a property which describes the image characteristics such as texture elements, granularity, and randomness. Today, various types of texture descriptors proposed for image retrieval. This paper presents the comparison of various kinds of texture descriptors used in CBIR.**

Keywords— ***CBIR, Local Patterns***

I. Introduction

An image is a matrix of square pixels (picture elements) arranged in columns and rows.In an (8-bit) grey-scale image each picture element has an assigned intensity that ranges from 0 to 255. A grey scale image is what people normally call a black and white image, but the name emphasizes that such an image will also include many shades of grey [1].

Image retrieval defined as a method of scanning, searching and retrieving images from a large database of digital images [2]. Retrieval of images from large database is one of the most important and focused research area through which the images are retrieved on basis of visual contents.

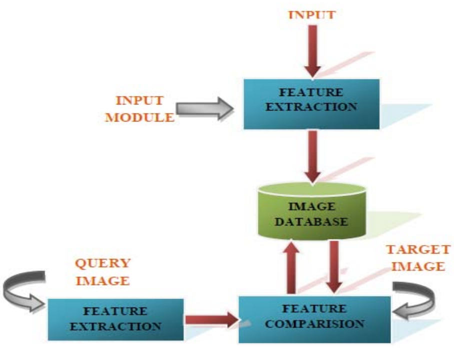

Figure1.Block Diagram of General Image Retrieval [4]

Two approaches were introducing text-based image retrieval and content-based image retrieval. Text-based image retrieval (TBIR) is a traditional method in which retrieve images with the help of annotation words. It consumes more time.

Figure 2.Text userquery[5]

To overcome this drawback, content-based image retrieval (CBIR) method introduced in which image can be recognized with color, shape, and texture.

II. Content Based Image Retrival

The CBIR tends to index and retrieve images based ontheir visual content. CBIR avoids many problems associated with traditional ways of retrieving images by keywords. Thus, a growing interest in the area of CBIR has been established in recent years. The performance of a CBIR system mainly depends on the particular imagerepresentation and similarity matching function employed [3].

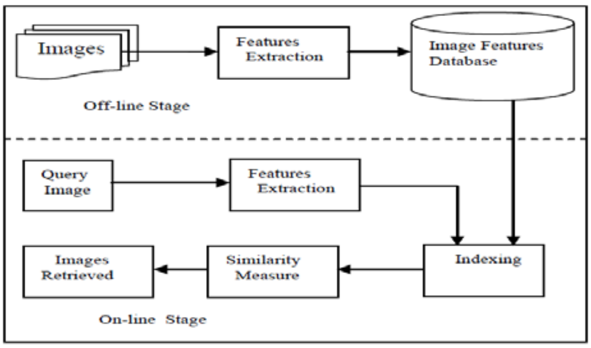

Figure 3. A typical Content Based Image Retrieval [6]

a) *Color* Examining images based on colors they contain. It is one of the most widely used techniques because it does not depend on image size and orientation.
b) *Texture* Texture measures look for visual patterns in images and how they are spatially defined.
c) *Shape* Shape does not refer to the shape of an image but to the shape of a particular region that is being sought out.

III. TEXTURE DESCRIPTORS

Image texture has emerged as an important visual primitive to search and browse through large collections of similar looking patterns. An image can be considered as a mosaic of textures and texture features associated with the regions can be used to index the image data. For instance, a user browsing an aerial image database may want to identify all parking lots in the image collection. A parking lot with cars parked at regular intervals is an excellent example of a textured pattern when viewed from a distance, such as in an air photo [7].

IV. LOCAL PATTERNS

A. *Local Binary Pattern (LBP)*

Since the LBP was, by definition, invariant to monotonic changesin gray scale, it was supplemented by an independent measure of local contrast. Fig 4 shows how the contrast measure (C) wasderived. The average of the gray levels below the center pixelis subtracted from that of the gray levels above (or equal to) the center pixel. Two-dimensional distributions of the LBP andlocal contrast measures were used as features [8].

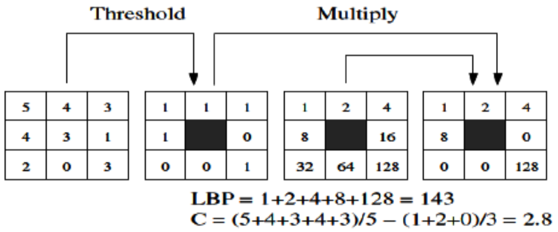

Figure 4. Calculating original Local Binary Code and Contrast Measure [9]

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 [15].

B. *Local Ternary Pattern (LTP)*

Tan and Triggs [10] extended the LBP to a three-valued code called the LTP, in which gray values in the zone of width around are quantized to zero, those above are quantized to 1, and those below are quantized to 1, i.e., indicator is replaced with three-valued function (1) and the binary LBP code is replaced by a ternary LTP code, as shown in Fig. 5, i.e., [11]

$$\hat{f}_1(x, g_c, t) = \begin{cases} +1, & x \geq g_c + t \\ 0, & |x - g_c| < t \\ -1, & x \leq g_c - t \end{cases} \Bigg|_{x=g_p}. \quad (1)$$

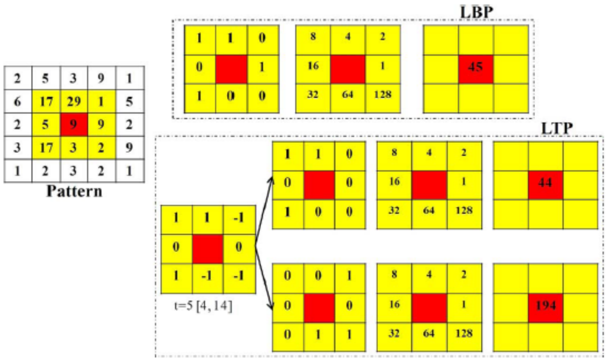

Figure 5. Calculation of LBP and LTP [11]

C. *Local Diagonal Extrema Pattern (LDEP)*

A new and efficient image feature descriptor using local diagonal extrema pattern (LDEP) from the center pixel and its local diagonal neighbors. The local diagonal extrema (i.e. maxima and minima) are extracted by using first-order local diagonal derivatives. Further, the relationship of these local diagonal maxima and minima with the center pixel is used to encode the LDEP descriptor [12].

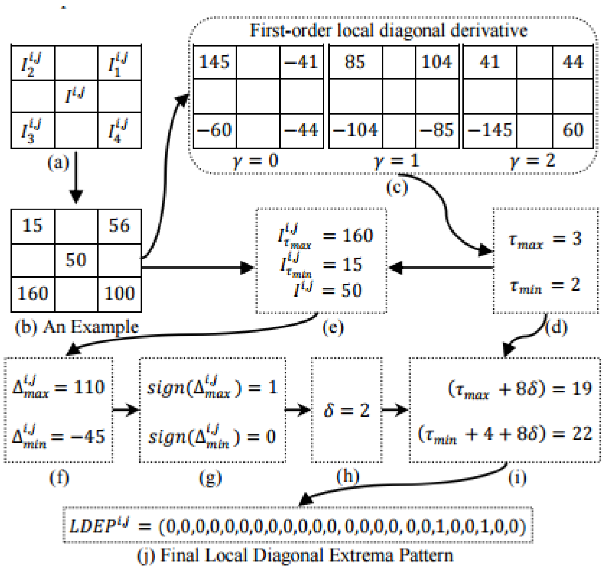

Figure 6. The computation of $LDEP^{i,j}$ pattern for center pixel $p^{i,j}$ using the flow diagram with an example

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D. Local Mesh Patterns (LMeP)

Subrahmanyam et al. [13] proposed Local Mesh Pattern (LMeP) for biomedical image indexing and retrieval. LMeP defines the local spatial structure of the texture using the relationship between surrounding neighbors for a given center pixel. Local mesh pattern for a 3x3 pattern is obtained by computing differences between two surrounding pixels around the center pixel as shown below:

$$I^1(g_i) = I(g_a) - I(g_i) \qquad (2)$$

where i=1,2,..,8 and α=1+ ((j+P+i-1) mod P).

$$LMeP^{i}_{P,R} = \sum_{j=1}^{P} 2^{j-1} \times f_1(g_s - g_j) \qquad (3)$$

$$s = 1 + ((j+P+i-1) \bmod P) \text{ and } \quad i=1, 2, 3.$$

where i represent the first three patterns, and s represents the surrounding neighbors around the center pixel. After the calculation of LMeP, the whole image is represented by computing the histogram as in (4):

$$H_{LMeP}(l) = \sum_{j=1}^{N} \sum_{k=1}^{M} f_2(LMep(j,k), l); \qquad (4)$$

$$l \in [0, P(P-1)+2]$$

Where N and M are the size of the image [14].

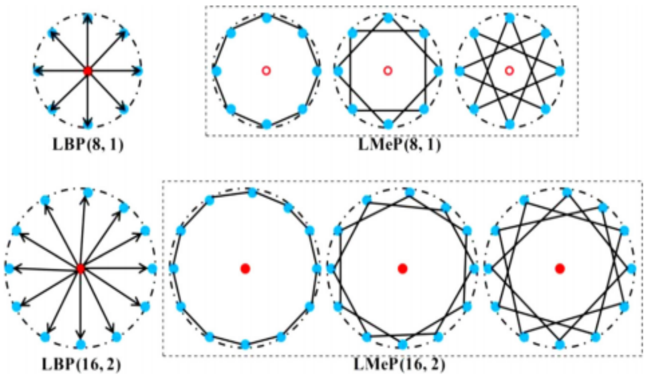

Figure 7. The LBP and first three LMeP calculations are given (P, R)

CONCLUSION

In this paper, study on texture descriptors for image retrieval in CBIR which is useful in various applications. For color and texture image retrieval various methods brief study areLBP, LTP, LDEP, LMeP. LBP methodology is easy and less computational complexity.

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