RESEARCH ARTICLE OPEN ACCESS

Multimedia Content Based Image Retrieval Iii: Local Tetra Pattern

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ABSTRACT
Content Based Image Retrieval methods face several challenges while presentation of results and precision levels due to various specific applications. To improve the performance and address these problems a novel algorithm Local Tetra Pattern (LTrP) is proposed which is coded in four direction instead of two direction used in Local Binary Pattern (LBP), Local Derivative Pattern (LDP) andLocal Ternary Pattern(LTP).To retrieve the images the surrounding neighbor pixel value is calculated by gray level difference, which gives the relation between various multisorting algorithms using LBP, LDP, LTP and LTrP for sorting the images. This method mainly uses low level features such as color, texture and shape layout for image retrieval.
Keywords-Content Based Image Retrieval(CBIR),Local Binary Pattern, Local Derivative Pattern, Local Ternary Pattern, Local Ternary pattern(LTrP).

I. INTRODUCTION

Multimedia communication refers to the representation, storage, retrieval and dissemination of computer processable information presents in many forms such as text, image, graphics ,speech, audio, video and data communications[1].The user needs a system that prepares and represents the information of interest which allows for the dynamic control of applications and provides a natural interface. To address various challenges of multimedia retrieval LBP,LTP,LDP and LTrPalgorithms have been proposed and discussed.

Local Binary Pattern is a very powerful and efficient texture operator**.**It operates in two dimensions onthe image. Input image is divided into pattern [3] which gives the relationship between the reference pixel with neighbor pixel which develop a gray value.$2^{(p-1)}$ histogram generates 256 different labels can be used as texture descriptor. Eq 1 represents LBP condition[4].

$$LBP_{P,R} = \sum_{P=1}^{P} 2^{(P-1)} * f(g_p - g_c) \qquad (1)$$

$$F(x) = \begin{cases} 1, x \geq 0 \\ 0, \, otherwise \end{cases}$$

Where,
g_c=centre pixel gray values.
g_p= gray values of neighbor pixel.
P= number of neighbor pixel.
R= radius of neighbor pixel.

Local Ternary Patternconstitutes a particular quality of texture classification.LTP codes more resistant to noise, because threshold at exactly the value of the central pixel they tend to be sensitive to noise. In which gray-levels in a zone of width ±t around center pixel is set the values zero, above that is set to +1 and below that is set to -1, t is a user-specified threshold which is shown in Eq2[6].

$$f(x, g_c, t) = \begin{cases} +1, x \geq g_c + t \\ 0, |x - g_c| < t \\ -1, x \leq g_c - t \end{cases} \Bigg| \; x = g_p \qquad (2)$$

In LDP, LBP can be considered as first-order Local Derivative Pattern with all direction. Local Derivative Pattern is a general framework to encode directive pattern feature from local derivative various. The $(n-1)^{th}$order local derivative various can encode the nth-order LDP. I is the image, Z is pattern from the image. The first-order derivatives along 0°, 45°, 90° and 135° directions, which is denoted as $I'_{\alpha}(Z)$ where α= 0°, 45°, 90° and 135°. If Z_0 is one point in $I(Z)$, Z_i, i = 1, …, 8, are the neighboring point around Z_0 So the four first-order derivatives at $Z=Z_0$ are shown in Eq 3.

$$I^1_{0°}(Z_0) = I(Z_0) - I(Z_4)$$
$$I^1_{45°}(Z_0) = I(Z_0) - I(Z_3)$$
$$I^1_{90°}(Z_0) = I(Z_0) - I(Z_2)$$
$$I^1_{135°}(Z_0) = I(Z_0) - I(Z_1) \qquad (3)$$

The second-order directional LDP can be defined in Eq4 and $LDP^2(Z)$, is defined as 32 bits sequence

$LDP^2_\alpha(Z_0) = \{f(I'_\alpha(Z_0), I'_\alpha(Z_1)), f(I'_\alpha(Z_0), I'_\alpha(Z_2)), \ldots, f(I'_\alpha(Z_0), I'_\alpha(Z_8))\}$, $\alpha = 0°, 45°, 90°$ and $135°$. (4)

Where $f(.,.)$ is a binary function describe below:

$$f(a,b) = \begin{cases} 0, \text{if } a * b > 0 \\ 1, \text{if } a * b \leq 0 \end{cases}$$

Local Tetra Pattern(LTrP)is able to encode the image in four directions and magnitude. LTrP obtains 8 bit values in each direction.

II. OVERVIEW OF ALGORITHMS

LBP is able to encode the images with binary number such as 0 and 1[4]. LTP able to encode the images with numbers such as 0, +1 and -1, later we converted into binary numbers 0 and 1.LDP able to encodes the image in different direction such as 0^0,45^0,90^0 and 135^0[5,7].

III. LOCAL TETRA PATTERN (LTrP)

Local tetra pattern(LTrp) is able to encode the image in different direction (Four Direction) and magnitude. LTrp obtains 8 bit values in each direction[8].

A. Direction construction of LTrP

LTrP extract more information with four distinct values. Which gives relation between center pixel and its neighbor pixel based on different direction and its derivative.

The given input image I(Z) in 1^{st} order derivative in horizontal and vertical direction such as 0^0 and 90^0 as shown in eq 5.

$$I^1_{0°}(g_c) = I(g_h)-(g_c)$$
$$I^1_{90°}(g_c) = I(g_v)-(g_c) \quad (5)$$

Where

$I^1_{0°}(g_c)$ – center pixel in horizontal direction.

$I^1_{90°}(g_c)$ – center pixel in vertical direction.

Direction of the center pixel can be calculated as shown in eq 6.

1, $I^1_{0°}(g_c) \geq 0$ and $I^1_{90°}(g_c) \geq 0$ $I^1_{Dir}(g_c)$= 2,$I^1_{0°}(g_c) < 0$ and $I^1_{90°}(g_c) \geq 0$

3, $I^1_{0°}(g_c) < 0$ and $I^1_{90°}(g_c) < 0$

4,$I^1_{0°}(g_c) \geq 0$ and$I^1_{90°}(g_c) < 0$ (6)

Eq (6) shows the direction of the center pixel. Image is converted into four different direction[15].

The 2^{nd} order derivative $LTrP^2$ of center pixel is given by Eq 7 and Eq 8.

$LTrP^2(g_c)=\{f_3(I^1_{Dir.}(g_c), I^1_{Dir.}(g_1)), f_3(I^1_{Dir.}(g_c), I^1_{Dir.}(g_2)), \ldots\ldots, f_3(I^1_{Dir.}(g_c), I^1_{Dir.}(g_p))\}|_{p=8.}$ ………..(7)

$f_3(I^1_{Dir.}(g_c), I^1_{Dir.}(g_p)) = 0, I^1_{Dir.}(g_c) = I^1_{Dir.}(gp)$
$I^1_{Dir.}(gp)$,else …(8)

We get 8 bit tetra pattern then they are divided into four parts. Each part is converted into three binary patterns as shown in fig 1.The direction 1 represents the center pixel value. Direction 2,3,4 represents neighbor pixel values.

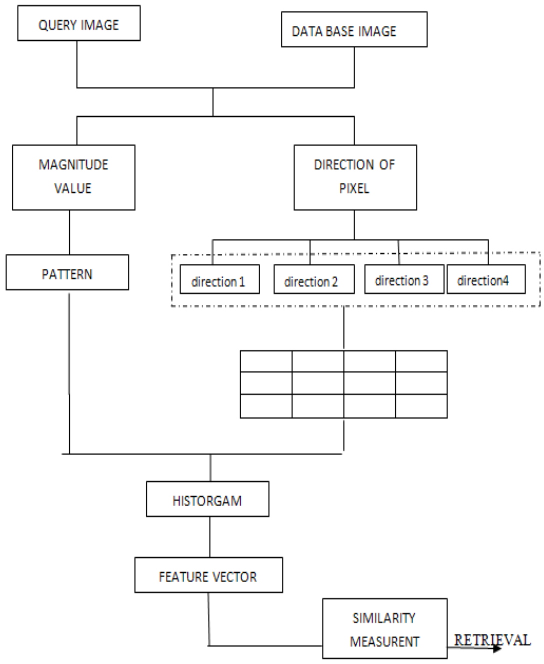

Fig 1:Eight(8) bit tetra pattern then they are divided into four parts.

B. Magnitude and Histogram Estimation.

LocalTetra Pattern of each center pixel value calculated by n^{th} order derivatives commonly used 2^{nd} order derivative due to less noise comparing other higher orders. The given input image I(Z) in different direction such as horizontal and vertical direction of 1^{st} order derivative. Four possible direction of center pixel such as 1,2,3,4 as shown in Eq (6), function of the 1^{st} order derivative is expressed as 2^{nd} order derivative. Fig 2 shows directions of LTrp.

Local Tetra Pattern values we get 3 0 3 4 0 3 2 0 thus we get 12 binary pattern .13^{th} binary pattern we get through magnitude pattern such as 1 1 1 0 0 1 0 1.Fig 3 shows values of LTrp.

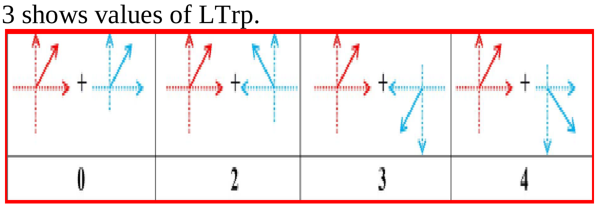

Fig 2: Different directions of LTrp

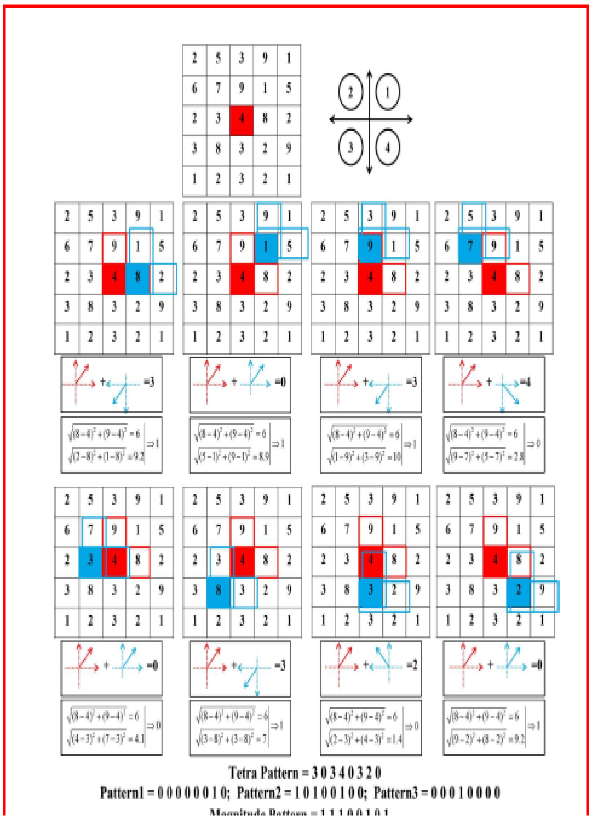

Fig 3: Values of LTrp

Algorithm for LTrP Magnitude
1. Upload the image.
2. Choose the center pixel value along with 8 neighbor pixel values.
3. Apply the first-order derivatives in horizontal, vertical and diagonal axis.
4. Calculate the magnitude value of center pixel and neighbor pixel.
5. Magnitude of center pixel value is less than neighbor pixel value, the binary value is 1 otherwise 0.
6. Magnitude pattern of 8 bit binary values obtained.
7. Calculate the histograms of binary patterns
8. Construct the feature vector
9. Retrieve the similar images.

Algorithm forLTrP Direction
1. Upload the image.
2. Choose the center pixel value along with 8 neighbor pixel values.
3. Apply the first-order derivatives in horizontal, vertical and diagonal axisdivide the patterns into four parts based on the direction of the center pixel.

4. Center pixel direction taken as 1, remaining four direction taken as 0,2,3,4 as shown in figure 2.
5. Apply mathematical formula for eachquadrant.
6. Obtained the tetra patterns, and separate them into three binary patterns.
7. Calculate the histograms of binary patterns.
8. Construct the feature vector
9. Retrieve the images based on the similarity.

C.Extraction of Color Features

Filtering of color images can be done in two ways. In the first method filtering of the three primaries(RGB) are done separately. In second approach luminosity image is filtered first and then result is utilized to a color image. Both are valid. The draw back in the first method is separate filters need to be used which is shown in Fig4.

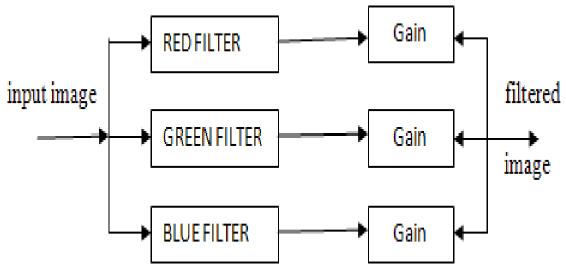

Fig 4: Separate filter for RGB

D. Query Process

Query is passed and similarity features of the image need to check. If similarity featured are matched the similar image is retrieved.

IV. CONCLUSION

This paper presents development and implementation details of LTrP. The proposed method would be greatly beneficial to retrieve the images since the pixel value is calculated by four directions and magnitude instead of two directions. This concept results improves the performance efficiency of CBIR when we relatively compare with LBP, LTP and LDP. In our future research work the experimental results of LTrP will be tabulated.

V. ACKNOWLEDGMENT

This research work was supported by University Grant Commission (UGC), New Delhi, under the major research project F.No.41-644/2012 (SR) supervised by Dr. Nagaraja G S and RajashekaraMurthy S of RVCE.We would like to thank RVCE research team support towards the project.

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