Multimedia Content Based Image Retrieval Iii: Local Tetra Pattern

Nagaraja G S¹, Rajashekkara Murthy S², Manas M N³, Sridhar N H⁴
¹(Department of CSE, RVCE, Visvesvaraya Technological University, Bangalore-59, Karnataka, India)
²(Department of ISE, RVCE, Visvesvaraya Technological University, Bangalore-59, Karnataka, India)
³(M. Tech, Department of CSE, RVCE, Visvesvaraya Technological University, Bangalore-59, Karnataka, India)
⁴(Research Scholar, Department of CSE, RVCE, Visvesvaraya Technological University, Bangalore-59, Karnataka, India)

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) and Local 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 Tetra Pattern (LTrP).

1. 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 system that prepares and presents 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 LTrP algorithms have been proposed and discussed.

Local Binary Pattern is a very powerful and efficient texture operator. It operates in two dimensions on the 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].

$$LBP_{p,r} = \sum_{p=1}^{p} 2^{p-1} * f(g_p - g_c)$$

(1)

Where,
$$f(x, g_c, t) = \begin{cases} +1, & x \geq g_c + t \\ 0, & |x-g_c| < t \\ -1, & x \leq g_c - t \end{cases}$$

(2)

In LBP, 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 $I'(Z)$ where $\alpha = 0°, 45°, 90°$ and 135°. If $Z_0$ is one point in $I(Z)$, $Z_i$, $i = 1, \ldots, 8$, are the neighboring point around $Z_0$. So the four first-order derivatives at $Z=Z_0$ are shown in Eq 3.

$$I_0'(Z_0) = I(Z_0) - I(Z_0)$$
$$I_{45}'(Z_0) = I(Z_0) - I(Z_0)$$
$$I_{90}'(Z_0) = I(Z_0) - I(Z_0)$$
$$I_{135}'(Z_0) = I(Z_0) - I(Z_0)$$

(3)
The second-order directional LDP can be defined in Eq 4 and LDP2(Z), is defined as 32 bits sequence
\[ \text{LDP}^{2}(Z_{0}) = \{f(\Gamma_{0}'(Z_{0}), \Gamma_{90}'(Z_{0})), f(\Gamma_{45}'(Z_{0}), \Gamma_{135}'(Z_{0})), \ldots, f(\Gamma_{0}'(Z_{2}), \Gamma_{90}'(Z_{2}))\}, \quad \alpha = 0^\circ, 45^\circ, 90^\circ \text{ and } 135^\circ. \]  
Where \( f(\ldots) \) is a binary function describe below:
\[ f(a, b) = \begin{cases} 
1, & \text{if } a < b \\
0, & \text{if } a > b \\
0, & \text{if } a = b \leq 0 \end{cases} \]

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\(^\circ\), 45\(^\circ\), 90\(^\circ\) and 135\(^\circ\)[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\(^{th}\) and 90\(^{th}\) as shown in eq 5.
\[ I_{0}'(g_{c}) = I(g_{0})-I(g_{c}) \]
\[ I_{90}'(g_{c}) = I(g_{90})-I(g_{c}) \]  
Where
\[ I_{0}'(g_{c}) \] – center pixel in horizontal direction.
\[ I_{90}'(g_{c}) \] – center pixel in vertical direction.
Direction of the center pixel can be calculated as shown in eq 6.
1. If \( I_{0}'(g_{c}) \geq 0 \) and \( I_{90}'(g_{c}) \geq 0 \) then \( L_{DP}(g_{c})=2, I_{0}'(g_{c})<0 \) and \( I_{90}'(g_{c}) \geq 0 \)  
2. If \( I_{0}'(g_{c})<0 \) and \( I_{90}'(g_{c})<0 \) then \( 4, I_{0}'(g_{c})=0 \) and \( I_{90}'(g_{c})<0 \)  
3. If \( I_{0}'(g_{c}) \geq 0 \) and \( I_{90}'(g_{c})<0 \) then \( 0, I_{0}'(g_{c})=I_{90}'(g_{c}) \)  
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.
\[ L_{TRP}^{2}(g_{c}) = \{f_{0}(I_{0}'(g_{c}), I_{90}'(g_{c})), f_{1}(I_{45}'(g_{c}), I_{135}'(g_{c})), \ldots, f_{7}(I_{0}'(g_{c}), I_{90}'(g_{c}))\} \]  
\[ f_{d}(I_{0}'(g_{c}), I_{90}'(g_{c})) = \begin{cases} 
1, & \text{if } I_{0}'(g_{c}) < 0 \\
0, & \text{if } I_{0}'(g_{c})=I_{90}'(g_{c}) \end{cases} \]

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.
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 for LTrP 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 axis divide 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 each quadrant.
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 Fig 4.

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 RajeshkaraMurthy S of RVCE. We would like to thank RVCE research team support towards the project.

REFERENCES


