VOL. 10, NO. 6, APRIL 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

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# A COMBINED FACE RECOGNITION APPROACH BASED ON LPD AND LVP

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## ABSTRACT

Face recognition is mainly used to identify the person by comparing the facial features. To extract the facial feature several techniques are used. In this paper a novel local pattern descriptor is used to extract the features. This feature extractor is called local vector pattern (LVP). The LVP used in this paper extract the features in high-order derivative space for face recognition. The LVP is mainly used to reduce the high redundancy and feature length increasing problem. The feature length increasing problem is solved by a comparative space transform. It is used to encode various spatial surrounding relationships between the referenced pixel and its surrounding pixels. The linking of LVPs is compacted to produce more distinctive features and reduce the redundancy problem. The LVP extracts the micro patterns encoded through the pair wise directions of vector by using an effective coding scheme called Comparative Space Transform (CST) for successfully extracting distinctive information. The histogram intersection methods are used for evaluating the similarity between the spatial histograms of two distributions extracted from the LVP and recognize the face image.

**Keywords:** local vector pattern (LVP), recognition rate, histogram.

## INTRODUCTION

Face recognition has been an active area of research in image processing due to its extensive range of prospective applications such as biometrics, identity authentication, smart cards, advanced three dimensional facial recognition and identity verification, centralized and secure facial identity management solution, video surveillance, information security, access control systems among the different applications, facial recognition may not be the most reliable and efficient technique [2].It is a computer application for automatically and clearly identifying a person from a digital image or a video frame from a video source. The steps to recognize the face from the input image is in Figure-1.

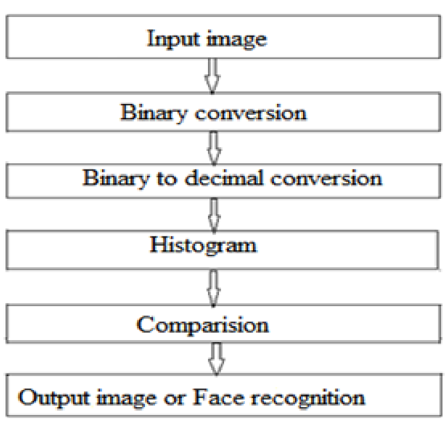


**Figure-1.** Flow chart of face recognition.

In previous days several local pattern descriptors are used to recognize the face such as Local Binary Pattern, Local Derivative Pattern, and Local Tetra Pattern. LBP operator is one of the best performing texture descriptors and it has been widely used in various applications such as texture classification, image retrieval, etc. [1]. In this method the original input image is divided into sub-regions.

To create a micro pattern, the reference pixel is compared with neighborhood Pixel. Then the binary value is converted to the decimal value, and the corresponding statistical histogram is appeared. The histogram of the new incoming image is compared with the referenced histogram if it is matches with this referenced histogram then that image is an output image. LBP is used to link binary comparative solution for producing the micro patterns according to the detailed definition from LDP, LDP [5] is another existing method which is used to compare both first order derivative and second order derivative for face representation.

The proposed method is Local Vector Pattern, and it is used to compare first second and third order derivative in all directions. This method identifies the face exactly with the reference image even if the input image has different facial expression. The rest of the paper is described as follows in section II the existing method for face recognition is described. In section III the proposed method is described with suitable diagram. In section IV the experimental results with graph is discussed. In section V I have concluded the paper with future work.

## EXISTING METHOD

There are many existing schemes for face recognition such as LBP, LDP, LTrP. Some of the techniques are discussed below.

### Local binary pattern

In this method, the input image is equally partitioned into 3×3 pixels. And this is shown in Figure-2.

VOL. 10, NO. 6, APRIL 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

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Here $A_C$ is reference pixel.$A_{1,1}$, $A_{2,1}$, ................ $A_{8,1}$ are the neighborhood pixels. Here suffix of $A_{1,1}$ is represents the angle and distance of the pixel.

| | | |
|---|---|---|
| $A_{4,1}$ | $A_{3,1}$ | $A_{2,1}$ |
| $A_{5,1}$ | $A_C$ | $A_{1,1}$ |
| $A_{6,1}$ | $A_{7,1}$ | $A_{8,1}$ |

**Figure-2.**The 8-pixel around $A_c$.

The Figure-3 shows the example for deriving the LBP pattern. Here the reference pixel is 100.Now the reference pixel is compare with neighborhood pixel [2]. If the neighborhood is greater than the reference pixel the value is 1.otherwise the value is 0.here the reference pixel 100 is compared with the neighborhood pixel 188.And it is greater than the reference pixel. So the value 1 is generated. Likewise the reference pixel is compared with all the neighborhood pixel. Then the corresponding value is generated.

| | | |
|---|---|---|
| 10 | 15 | 50 |
| 150 | 100 | 188 |
| 200 | 255 | 250 |

**Figure-3.** LBP method.

And the generated output is shown in Figure-4. The generated output is generated in a clockwise direction and this is known as a pattern. It contains only 0's and converted to the decimal value. Repeat this procedure, for remaining 3×3 of the image by using this decimal value, the histogram graph is generated. This histogram is stored as the reference image. If a new input is arrived the same procedure follows for generating histogram diagram. The newly generated histogram is compared with the reference histogram. If it is matches then that is the output image. This method takes large number of cycles. Because the input image is partitioned into several 3×3 matrix and so it takes more time to complete the task. The disadvantage faced in LBP is that the basic LBP operator has is its small 3x3 matrix. Due to this reason, it cannot calculate features in a large scale.

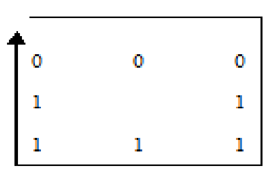


**Figure-4.** Generated binary value

**Local derivative pattern**

LDP is very simple concept but this pattern has 4 direction 0, 45, 90 and 135. First consider the 0 degree and it is shown in Figure-5.

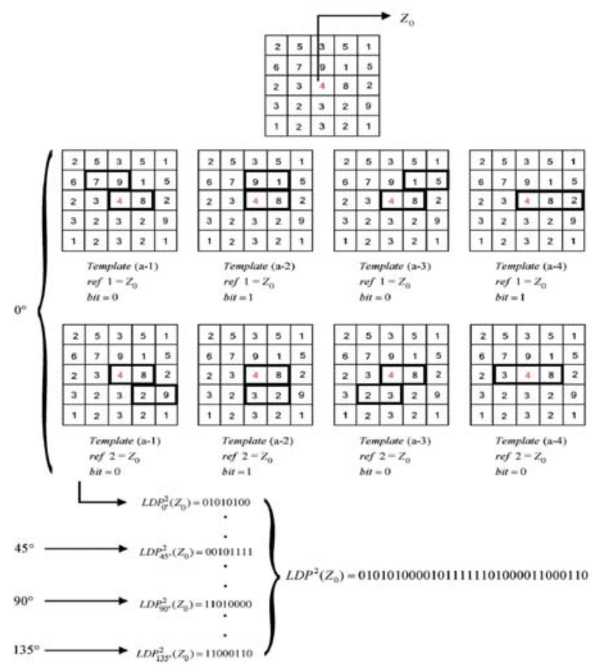


**Figure-5.** LDP method.

The below direction is common for the LDP. The first four pixel shows 0 degree direction. Now consider the matrix and denote the center pixel [6]. For example 4 is a center pixel. Take the first direction and find the value. The value is increase order then replace the bit is 0. Otherwise the bit value is 1 and it is shown in Figure-6.

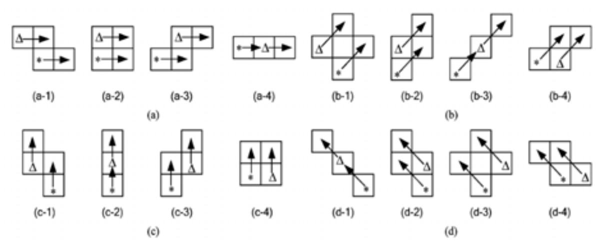


**Figure-6.** LDP with different angles.

For example 7 to 9 is increase order and 4 to 8 is increase order then the bit is 0. This way finds the pattern for 0 degree. Then change the direction as 45 and find the binary pattern using the same concept. This way to find all the binary patterns. And it is converted into decimal and generates the histogram. The reference and new input image histograms are compared. When new input image histogram is matched with the reference histogram, then the input image will be displayed as the output image.

**Local tetra pattern**

The LTrP describes the spatial structure of the local texture using the direction of the center gray pixel. Firstly, we find the directions (horizontal and vertical) of each pixel and then divide the patterns into four parts based on the direction of the center pixel. After that, calculation of the tetra patterns will be done and separate them into three binary patterns [7]. The next step is to construct the binary patterns and calculate their histogram and finally we construct the feature vector. Consider the below example. The image is divided into matrix. Consider the above example 4 is a center pixel. Then find the horizontal and vertical axis for the center pixel. For example 4 is center pixel the horizontal axis is 8 and the vertical axis is 9. Find the distance for above horizontal and vertical axis. It is shown in Figure-7.

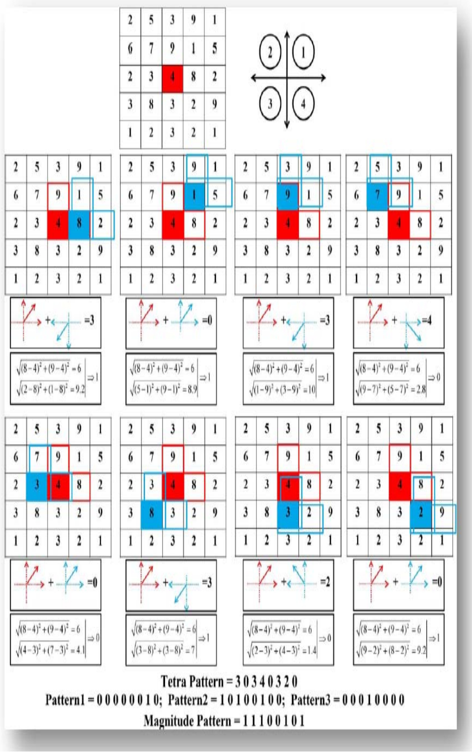


**Figure-7.** LTrP method.

Find the distance between two axis using the distance formula. The square root of 8-4 and the square root of 9-4. 8 is horizontal axis and 9 is a vertical axis. This is a one of the distance. Then find the magnitude distance for the matrix. Consider the pixel 8 then find the horizontal and vertical axis. 2 is a horizontal and 1 is vertical axis then find the distance in same way. Likewise to find the magnitude distance for all the surroundings pixel. To compare this two distance find the direction for the center's pixel. To find the tetra pattern to compare the horizontal and vertical value to center pixel. Two axis values are greater than 0 then the direction is 1. For example 8 and 9 are greater than center pixel 4. So the direction is 1.This way to find direction for all the pixels. Vertical value is less 0 and horizontal value is greater 0 then the direction is 2. Two values are less 0 the value is 3. Horizontal value is less 0 and vertical value is greater 0 then the direction is 4. This way to find the tetra pattern. For example the tetra pattern is 30340320 [6]. Then it is divided into 3 patterns. i.e. the value is converted into binary value. For example find the 2's then it is represents 1 others are 0 pattern 1 as 00000010, then next is 10100100 and then next is 00010000. Finally find the binary pattern and converted into decimal. And then histogram is generated. The reference and new input image histograms are compared. When new input image histogram is matched with the reference histogram, then the input image will be displayed as the output image. The disadvantage faced in LTrP is that the basic LTrP operator has lack of inclusion of spatial information. Due to the challenges faced in the existing methods, we opt Local Vector Pattern as the proposed method.

## PROPOSED METHOD

First consider the image as the matrix format. The center pixel and the first distance, second distance and third distance values are shown in the Figure-8.

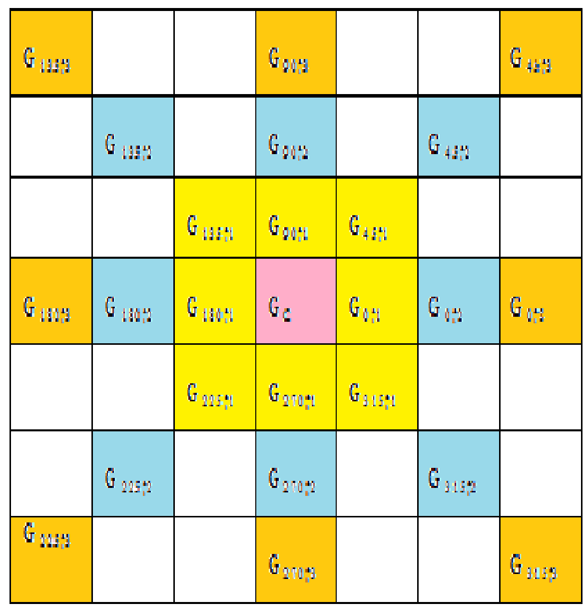

**Figure-8.** Neighborhood pixels of $G_c$ with different angle along each distance.

First calculate the binary value for $G_1$.By using the $G_1$ value $G_1{}^{'}$ is calculated.

$$G_1{}^{'} = G_1(45^0)-(G_c(45^0)/\ G_c(0^0)) \times G_1(0^0) \quad (1)$$

Equation (1) is used to find the binary value.

The input image when processed through this below flowchart the required binary format is achieved. And the binary value is converted into decimal. And then histogram is generated. The reference and new input image histograms are compared. When new input image histogram is matched with the reference histogram, then the input image will be displayed as the output image. The flowchart is shown in the Figure-9. It is mainly used to

VOL. 10, NO. 6, APRIL 2015 ISSN 1819-6608
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reduce the high redundancy and feature length increasing problem. By using this method the output image is clearly identified without any mistake.

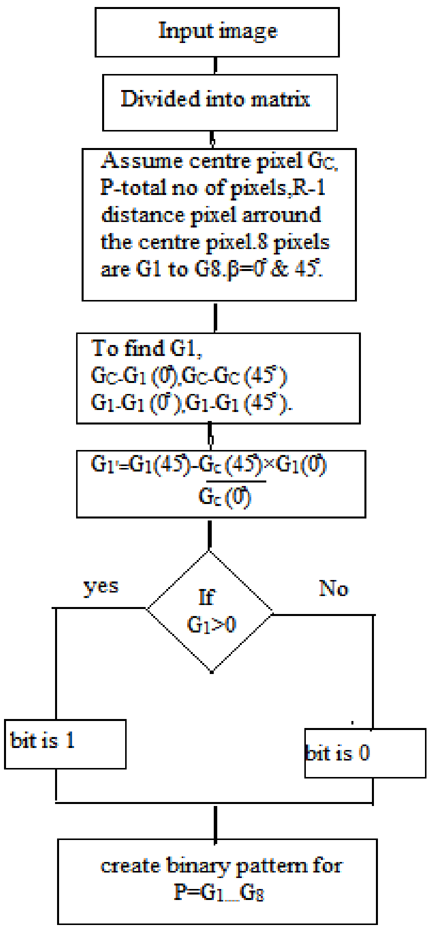
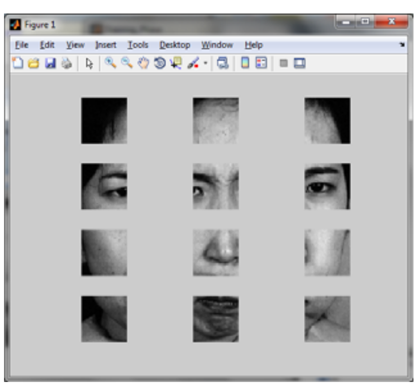


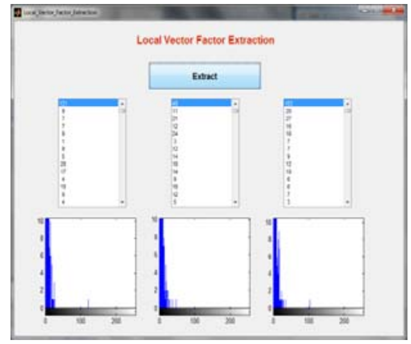

**Figure-9.** Flow chart of LVP method.

## SIMULATION RESULTS

The Figure-10 shows the extracted reference image in the training phase and its histogram diagram.



(a)

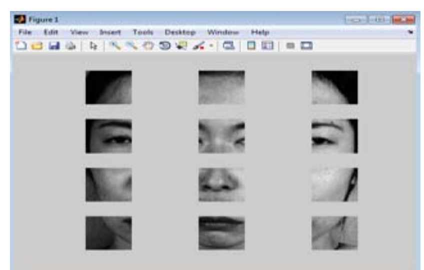



(b)

**Figure-10.** (a) Extracted reference image (b) histogram.

Figure-11 shows the testing image and its extracted image

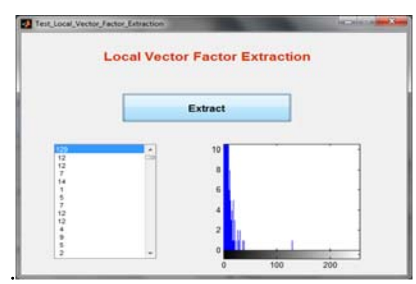

(a)



(b)

**Figure-11.** (a) Input image (b) extracted image

Figure-12 shows the histogram for the testing phase and by using this histogram the original face is recognized.




(a)

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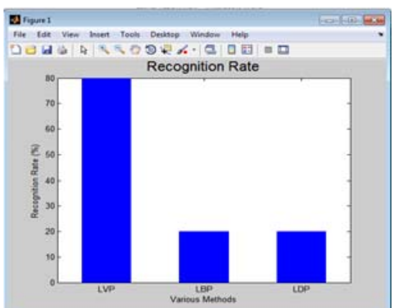
(b)

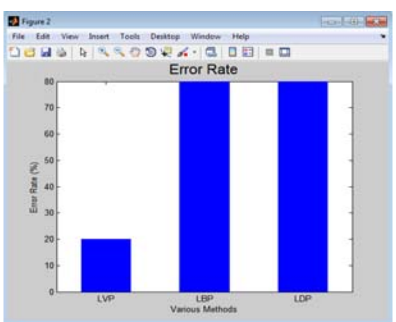
**Figure-12.** (a) Histogram (b) recognized face.

## PERFORMANCE ANALYSIS

Figure-13 shows that, Recognition Rate, Error Rate, LVP gives better performance when compared to LBP and LDP.




(a)




(b)

**Figure-13.** (a) Various Methods Vs Recognition Rate (b) Various Methods Vs Error Rate.

## CONCLUSION AND FUTURE WORK

Thus a local pattern descriptor is used to extract the features. This feature extractor is called lo LVP. The LVP used in this project extract the features in high-order derivative space for face recognition. The LVP is mainly used to reduce the high redundancy and feature length increasing problem. It is used to encode various spatial surrounding relationships between the referenced pixel and its neighborhood pixels. Thus, in the future enhancement the proposed LVP is implemented in the system generator.

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