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Biometric Palm vein Recognition using Local Tetra Pattern

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ABSTRACT:
In today's world, authentication is become one of the most important security primitive. Biometrics has been widely used and gives a secure authentication method because it has advantages over some existing methods; there is minimum chance of losses incurred by theft of passwords and smart cards. Palm vein pattern is unique for every human even for the twins also. Palm vein authentication has a high level of authentication accuracy due to the uniqueness and complexity of vein patterns of the palm. Because the vein patterns of palm are internal to the body, they are an impossible to forge. To verify identity, Local Tetra Pattern(LTrP) method is developed in this paper. LTrP encodes the relationship between the centre pixel and its neighbors, according to the calculated vertical and horizontal directions. Local Binary Pattern (LBP) encodes the images with two distinct values and Local Ternary Pattern(LTP) encodes images with only three distinct values but the LTrP encoded the images with four distinct values as it is able to extract more detailed information. Image enhancement, feature extraction, similarity check are used for local tetra pattern

Keywords:
Biometric, Palm Vein, Authentication, Local Tetra Pattern (LTrP), Local Binary Pattern (LBP), Local Ternary Pattern.

I. INTRODUCTION

Our life has become easier with the development of science and technology. To verify the identity of a person and to provide authorization for access authentication systems are used. Traditional authentication system uses passwords, smart cards, Identification cards, PIN (personal identification numbers) and keys, which comes with few disadvantages. In recent years, most authentications systems use biometric authentication technology. Biometrics is the technology in which person is recognized on the basis of unique physiological characteristics such as fingerprints, vein, face, retinal, hand geometry, handwriting, iris and voice methods. Palm vein pattern authentication technology is emerging technology which uses vascular patterns as personal identification data[10]. This technology is highly secure and very accurate because authentication data is present inside the body which makes it impossible to forge. The system is robust as vascular images can only be taken in alive body. This technology can be used in many applications such as Offices, hospitals, banks, library, Air ports etc.

II. PREVIOUS WORK

In past few years numerous palm vein identification algorithms have been proposed. The local binary pattern (LBP) feature has emerged as new technique in the field of texture classification and retrieval [9]. T. Ahonen et al. proposed [2,3] LBP for face recognition where the face image is divided into smaller regions from which the LBP feature distributions are extracted and concatenated into an enhanced feature vector which is used as a face descriptor. LBP operator has been also proposed for Palm-print recognition[4] and finger vein recognition [5]. Zhang et al. proposed local derivative patterns (LDPs) for face recognition, they used LBP as non directional first-order local patterns collected from the first-order derivatives and extended the same approach for nth order LDPs [6]. The LDP operator has been also proposed for finger vein recognition[6].

Mirmohamadsadeghi L. et al. proposed Palm vein recognition using LBP and LDP, where they were adjusted based on discriminative features identified in vein texture to be used as image descriptors in the context of recognition with palm veins. These operators present computational simplicity and efficiency[8].

Murala S. et al.[1] proposed Local Tetra Pattern(LTrP), This method encodes the relationship between the referenced pixel and its surrounding neighbor pixels, based on the directions which are calculated using the first-order derivatives in vertical and horizontal directions. Local Tetra Pattern (LTP) has been proposed for face expression recognition[11], Object tracking[12] and face recognition[13].

The Local Binary Pattern, the Local Derivative Pattern, and the Local Ternary Pattern extracts the information which is based on the distribution of edges, which are coded using either positive direction or negative direction. Thus by differentiating the edges in more than two directions the performance of these methods can be improved. This observation has inspired us to propose the four direction code, referred to as local tetra patterns (LTrPs) for CBIR

III. PROPOSED METHOD

The goal of the proposed system is to compares the pattern of veins in the palm of a person which we have to authenticate with a pattern from the databases. In this paper, the LTrP includes direction pattern and Magnitude Pattern which are used to retrieve feature from the images. The LTrP describes the spatial structure of the local texture using the direction of the centre gray pixel.

A. Pre-processing

The raw images which are unsuitable for analysis because the various types of noises present in the images. Hence, appropriate pre-processing methodologies must be used to enhance the quality of the images. Pre-processing is used for reducing image noise, highlighting edges, etc.There are several techniques for preprocessing of images such as Laplacian of Gaussian (LoG), Canny edge detection, so on. In this proposed system the technique used for pre-processing is Image Resize. This method is used to improve the retrieval time.

B. Local Tetra Patterns

Murala et al. [1] proposed the LTrP, that describes the spatial structure of the local texture using the direction of the center gray pixel, g_c.

Given image I, the first order derivatives in 0^0 and 90^0 directions are denoted as $I^1_\theta(g_p)|_{\theta=0^\circ,90^\circ}$. Let g_c denote the center pixel in I, let and g_h and g_v denote the horizontal and vertical neighborhoods of, respectively. Then, the first-order derivatives at the center pixel g_c can be written as

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

And direction of centre pixel is calculated

$$I^1_{Dir.}(g_c) = \begin{cases} 1, & I^1_{0^\circ}(g_c) \geq 0 \text{ and } I^1_{90^\circ}(g_c) \geq 0 \\ 2, & I^1_{0^\circ}(g_c) < 0 \text{ and } I^1_{90^\circ}(g_c) \geq 0 \\ 3, & I^1_{0^\circ}(g_c) < 0 \text{ and } I^1_{90^\circ}(g_c) < 0 \\ 4, & I^1_{0^\circ}(g_c) \geq 0 \text{ and } I^1_{90^\circ}(g_c) < 0 \end{cases} \quad [1]$$

From above equation it is evident that the possible direction for each center pixel can be either 1, 2, 3, or 4, and eventually, the image is converted into four values, i.e., directions.

The second-order $LTrP^2(g_c)$ is defined as,

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

$f_3\ (I^1_{Dir.}(g_c),\ I^1_{Dir.}(g_p)\ )$

$= \{\quad 0, \qquad I^1_{Dir.}(g_c) = I^1_{Dir.}(g_p)$

$\{\quad I^1_{Dir.}(g_p) \qquad else$ [1]

From above equations, we get 8-bit tetra pattern for each center pixel. Then, we separate all patterns into four parts based on the direction of center pixel. Finally, the tetra patterns for each part(direction) are converted to three binary patterns.

Let the direction of center pixel $I^1_{Dir.}(g_c)$, obtained be "1"; then, $LTrP^2$ can be defined by segregating it into three binary patterns as follows:

$$LTrP^2|_{Direction=2,3,4} = \sum_{p=1}^{P} 2^{(p-1)} \times f_4\left(LTrP^2(g_c)\right)\Big|_{Direction=2,3,4}$$

$$f_4\left(LTrP^2(g_c)\right)\big|_{Direction=\phi} = \begin{cases} 1, & \text{if } LTrP^2(g_c) = \phi \\ 0, & \text{else} \end{cases}$$

Where ϕ =2, 3, 4

Similarly, the other three tetra patterns for remaining three directions (parts) of center pixels are converted to binary patterns. Thus, we get 12 (4× 3) binary patterns.

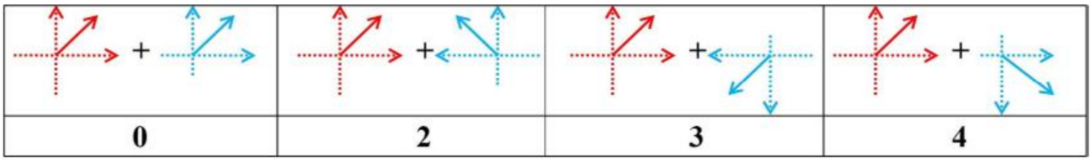

Figure 1: Calculation of tetra pattern bits for the center-pixel direction "1" using the direction of neighbors[1]

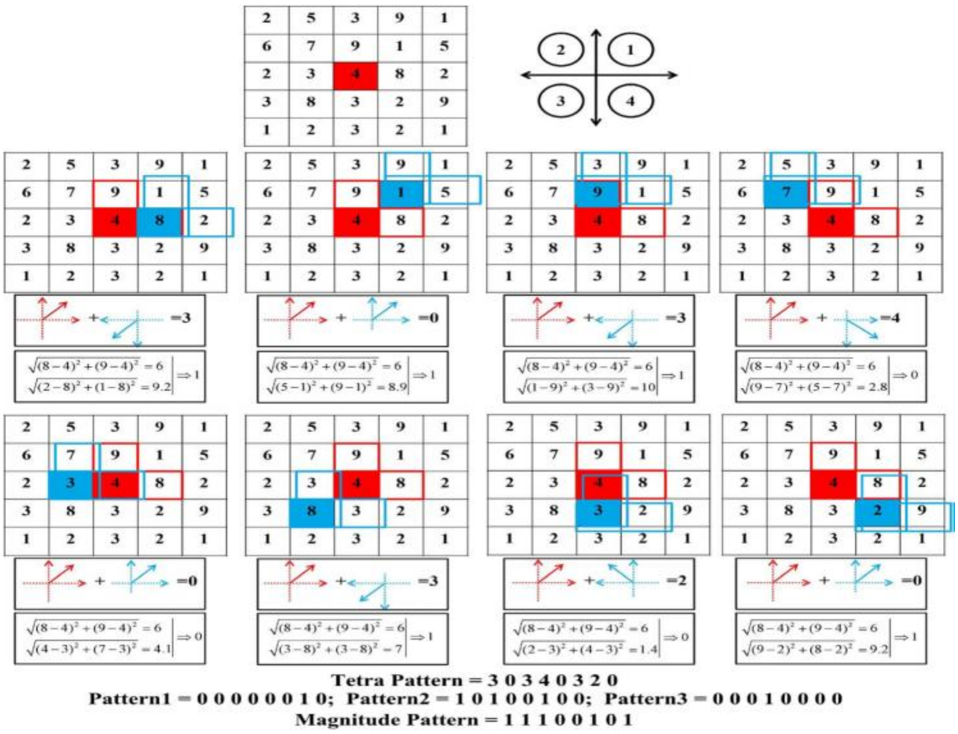

Figure 2: Example to obtain the tetra and magnitude patterns[1]

In Fig 3 shows the block diagram of proposed system. The objective of the proposed work is to authenticate the images from the stored database that matches the query image. Firstly, input image is resized to appropriate dimensions. This image is processed in local tetra pattern

LTrP works as:

1. Apply the first-order derivatives, in horizontal and vertical direction
2. For each and every pixel, calculate the direction.
3. Based on the direction of the centre pixel, divide the obtained patterns into four parts.
4. After that calculate the tetra patterns and then separate them into three binary patterns.
5. Then histograms of binary patterns will be calculated.
6. Calculate the magnitudes of centre pixels.
7. Calculate their histogram after constructing the binary patterns.
8. Combine the histograms calculated from steps 6 & 8.
9. Construct feature vector.

Comparison will be taken between the input image and the images in the database.

Retrieve the images based on the best matches which are similar to query image

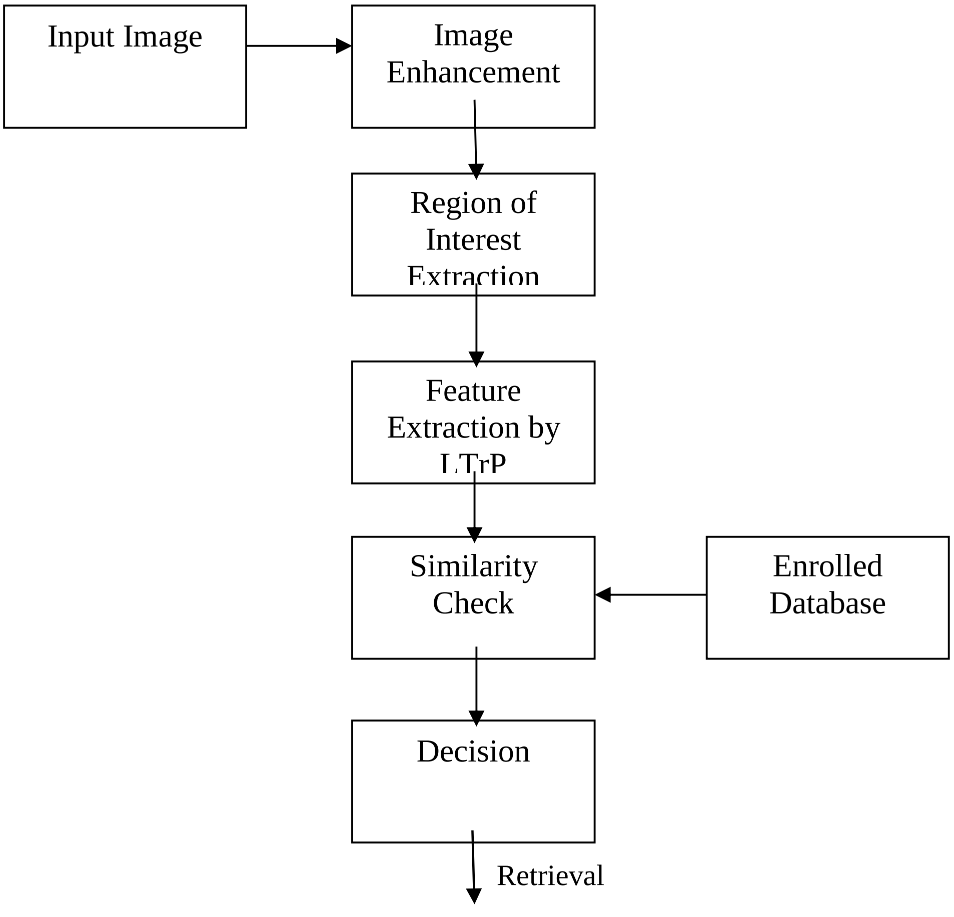

Figure 3: Block Diagram of Proposed System

IV. RESULT

Database: To evaluate the performance of proposed system, the most commonly used public dataset CIE Biometrics. This database consists of large number of images of left and right hand. These CIE Biometrics dataset set consists of palm vein images of 50 different people with left and right hand. The 4 query retrievals by the proposed method are shown in figure 4 with an average retrieval time as 20 sec.

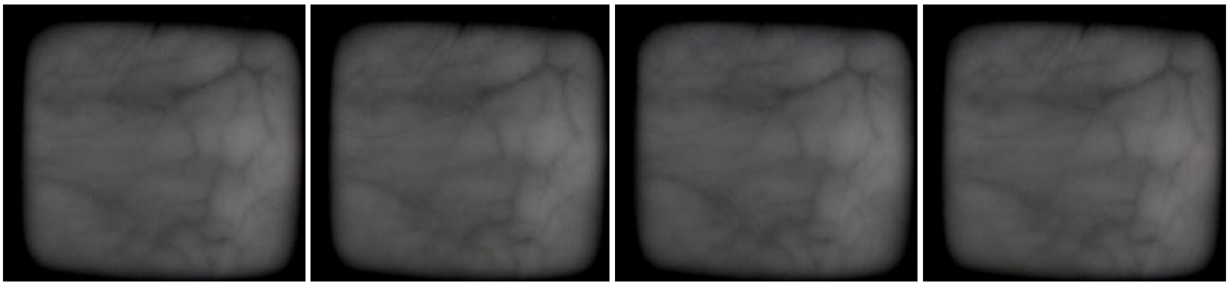

Figure 4: Sample images from database.

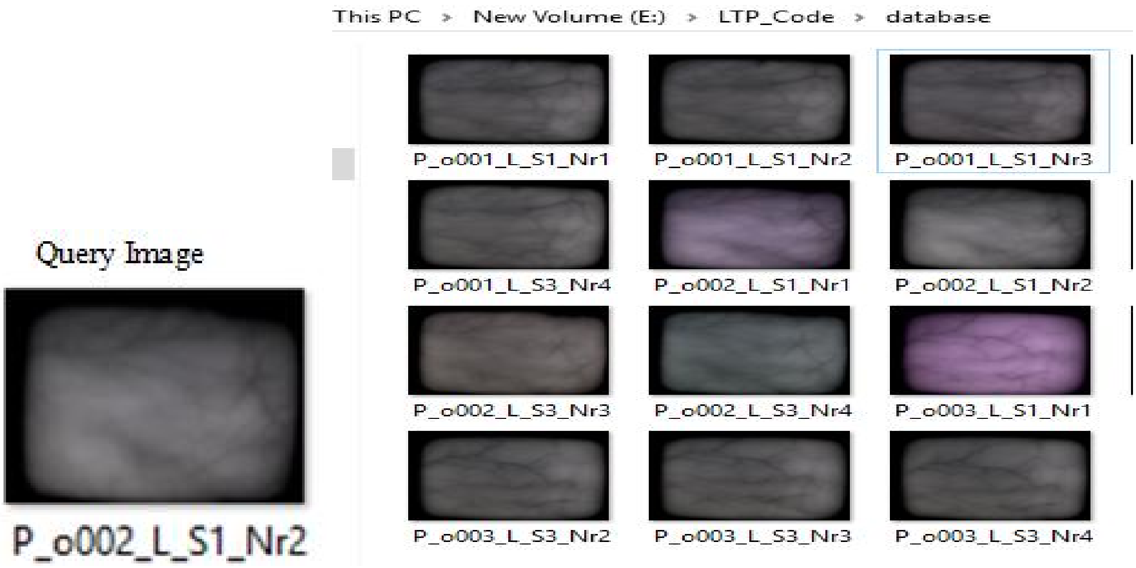

Figure 5: Sample retrieved results from database for given query image

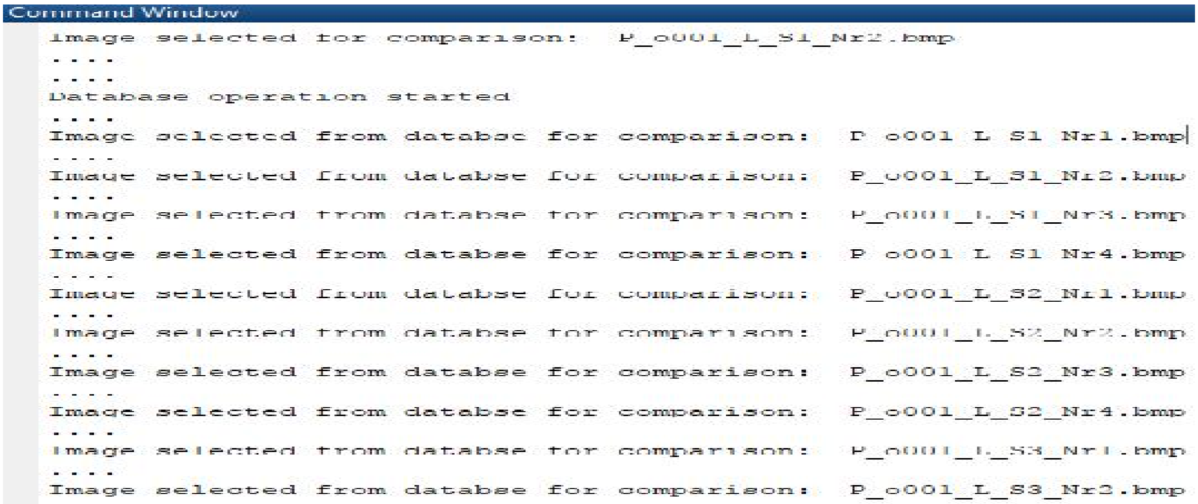

Figure 6: Image selected for comparison and database operation started

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GUI Operation:

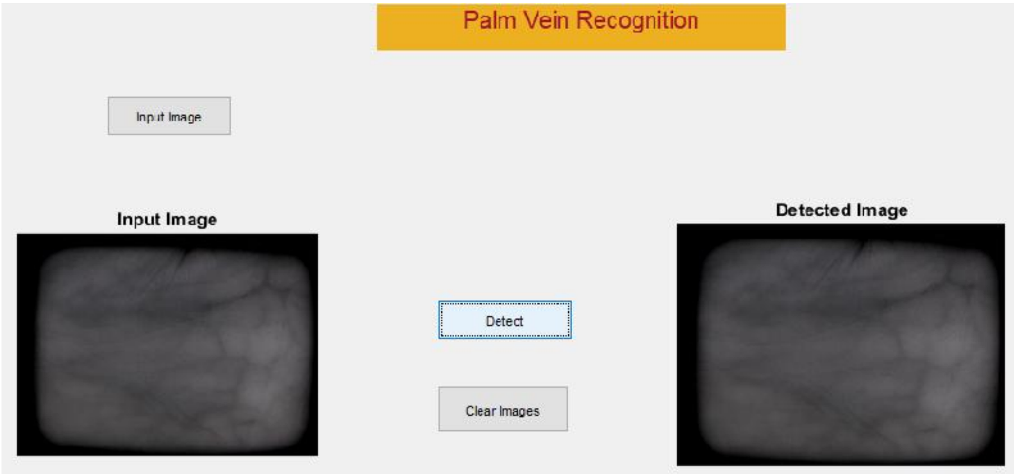

Fig 7: GUI operation for palm vein recognation

```
....
Image selected from databse for comparison:  P_0003_L_S1_Nr4.bmp
....
Image selected from databse for comparison:  P_0003_L_S2_Nr1.bmp
....
Image selected from databse for comparison:  P_0003_L_S2_Nr2.bmp
....
Image selected from databse for comparison:  P_0003_L_S2_Nr3.bmp
....
Image selected from databse for comparison:  P_0003_L_S2_Nr4.bmp
....
Image selected from databse for comparison:  P_0003_L_S3_Nr1.bmp
....
Image selected from databse for comparison:  P_0003_L_S3_Nr2.bmp
....
Image selected from databse for comparison:  P_0003_L_S3_Nr3.bmp
....
Image selected from databse for comparison:  P_0003_L_S3_Nr4.bmp
....
Database operation Ended
....
Match found for following:
1 >  P_0001_L_S1_Nr2.bmp
>>
```

Figure 8: Database operation ended and match found

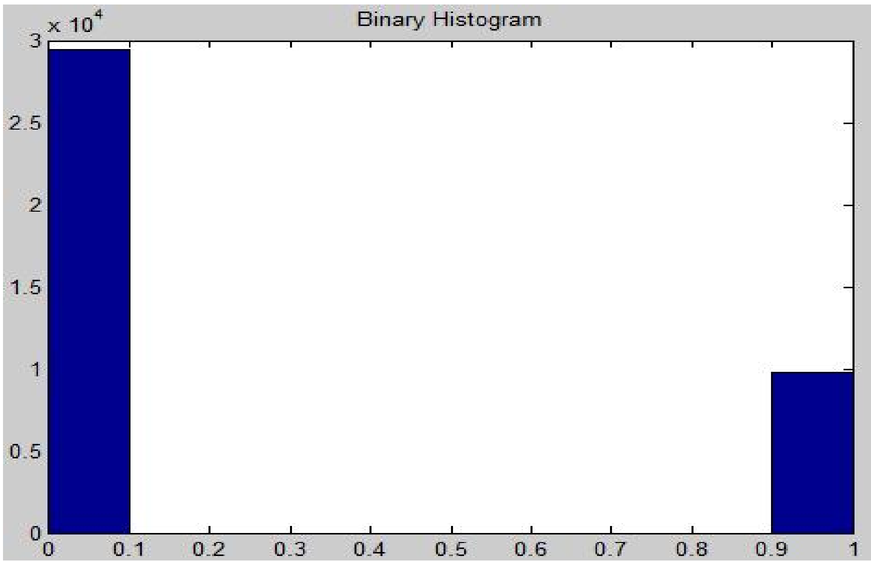

Figure 9: Binary histogram of matched image.

V. CONCLUSION

The proposed method has been implemented using Matlab and tested on CIE BIOMETRICS public database. It contains 1,200 images of the palm vein, in BMP format of size 1024x768 as shown in Figure 4. Database contains images of 50 people. We have followed the authentication technique, as described in the methodology.

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