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# HUMAN IDENTIFICATION WITH PALM PRINT BASED ON LOCAL BINARY PATTERN AND CO-OCCURRENCE MATRIX

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## *ABSTRACT*

*In this paper an efficient method based on local binary and co-occurrence matrix implemented on palm print images. Combination methods in the features level are divided into four categories: series combination, parallel combination, weight combination, and core-based combination. In order to identification by a person's palm lines, the lines must be properly extracted. One-way to define these lines are using different methods of edge detection. Sobel edge detection and Morphological operation are used in. In this paper, for the complete extraction of useful features from an appearance, a simple but powerful method a uniform local binary pattern to the identification of palms are expressed because this method can pull out all the useful information of an appearance.*

***KEYWORDS:*** *Series Combination, Parallel Combination, Weight Combination and Core-Based Combination*

## INTRODUCTION

Biometrics is a unique and measurable feature for identification. Biometric systems are divided into two categories: identification and verification. The first category's aim is recognizing the identification of the individual among the others in the database. In such systems, to the question "who am I?" will answer. In the second, the person offers his identity and the aim of the system is the confirming this identification and in such systems, to the question "do what I say I am?" will answer [1]. It is clear that any biometric identification system is not the absolutely best solution for identification. By international biometric Group, an interesting comparison is done between different systems based on four parametric, distinctiveness, and cost of the identification system, time and spending effort by the user in the identification and the rate of user's comfort during identification [2]. An ideal biometric system is a system in which contains all four enumerated parameters in the farthest place according to the center of the diagram [3]. In another study has gained the highest percentage compatibility by taking six biometric techniques (face, fingerprint, hand geometry, voice, eyes, and signature) with machine-readable travel documents (MRTD), facial features. In this study, parameters such as registration, refreshment, hardware requirement, and public acceptance are considered. The palm recognition system is a biometric system using intelligent automatic methods to identify or verify the identification of a person based on physiological characteristics. In the past two decades, the matter of identifying of palms is the extensive research field of machine's vision and pattern recognition. One of the extensive applications for recognition of palm lines is the field of security and verification.

In controlling the high population areas, such as airports, railway stations, subway and …., this method is more effective than other methods of surveillance. So several photographs have taken from the lines in the palms of people and the device must be able to identify these people at different times, in different orientations of light.

Current methods of identifying palms use of four types of palm's features: texture, lines, appearance, and orientation. According to the extracted features are divided into five categories [4]:

- Texture-based methods which using the filters such as Gabor, discrete Fourier, Wavelet, and Rydan.
- Line based methods are like the identifier of palm's directed lines, sober performance, multi-resolution filters, and Rydan filter.
- Appearance-based methods are that uses from the analyzing of principal component, analysis of the linear distinct appearance of the local guard and analyzing of kernel principal component.
- Orientation based methods which usually uses the Gabor filters.
- Multi feature-based method, such as the combination of features of palm's lines and filed in the same vector. Typically combinations are done in four levels, data feature, matching, and the decision.

Combination methods in the features level are divided into four categories: series combination, parallel combination, weight combination, and core-based combination [5].

In order to identification by a person's palm lines, the lines must be properly extracted. One way to define these lines is using different methods of edge detection. Sobel edge detection and Morphological operation are used in [6].

In this paper, for the complete extraction of useful features from an appearance, a simple but powerful method a uniform local binary pattern to the identification of palms are expressed because this method can pull out all the useful information of an appearance.

The rest of the paper is organized as follows: in section 2, a local binary pattern is generally offered. A histogram will be explained in section 3. The co-occurrence matrix will be presented in section 4. In section 5, Appearance database will be described. Results of the implementation are given in Section 6. The final section of the paper is the conclusion.

**Local Binary Pattern (LBP)**

The first step in constructing the LBP texture descriptor is to convert the image to grayscale. For each pixel in the grayscale image, we select a neighborhood of size *r* surrounding the center pixel. An LBP value is then calculated for this center pixel and stored in the output 2D array with the same width and height as the input image. The local binary pattern working by getting the 3*3 surrounding values of the picture. After that, we find the difference between them [7].

The comparing function $\boldsymbol{f}(\boldsymbol{I}(\boldsymbol{Z_0}), \boldsymbol{I}(\boldsymbol{Z_i}))$:

Where $\boldsymbol{Z_i}$ ,, i = 1,2,...,8 is all the points which they are surrounding $\boldsymbol{Z_0}$ from one to eight. If the intensity of the center pixel is greater-than-or-equal to its neighbor, then we set the value to *1*; otherwise, we set it to *0*. This value is stored in the output LBP 2D array, which we can then visualize below. Finally, local binary pattern (LBP) method has shown an excellent result due to its straightforward strategy and simple feature extraction operation [7]. This show a good efficiency

in face detection that results from its high correction of a lot of things.

**Description of the Local Binary Pattern**

The local binary pattern is considered as a strong approach to texture analysis. For the first time, it was proposed as a square operator 3×3 by Ojala and his co-workers [7].

The operation of this method is like which 8-neighborhood on operator are comparing with the central pixel. If each of the eight neighboring pixels will be greater or equal to the amount of the central pixel will be replaced by 1 and otherwise, their amount will be zero. At last, the central pixel is replaced by summing weighted binary neighboring pixels and 3 × 3 windows will pass to the next pixel. By getting the histogram of these amounts, a descriptor for appearance texture is obtained. Figure 1 demonstrates the local binary pattern operator.

| | | |
|---|---|---|
| 1 | 0 | 4 |
| 128 | 149 | 0 |
| 0 | 0 | 16 |

(a)

| | | |
|---|---|---|
| 1 | 0 | 1 |
| 1 | | 0 |
| 0 | 0 | 1 |

(b)

| | | |
|---|---|---|
| 7 | 3 | 5 |
| 6 | 5 | 1 |
| 2 | 3 | 8 |

(c)

**Figure 1: Demonstrates the Local Binary Pattern Operator**

LBP = 1+4+16+128 = 149

And the equation (1) shows the composing relationship of local binary pattern in each pixel:

$$LBP_{P,R(x,y)} = \sum_{p=0}^{P-1} s(g_p - g_c)2^P \quad (1)$$

Which S denotes the sign 1, $g_p$ and $g_c$, denotes the amount of the gray levels of neighboring and central pixels. Also, 2P is a required factor for each neighbor because LBP method contains tissues with different ratios.

**The Uniform Local Binary Pattern**

The first improvement of the LBP was introduced as a uniform pattern in 2000 [8].

If a local binary pattern consists of a maximum of 2-bit transition from 0 to 1 or vice versa is called a uniform. For example, 0000000000 patterns (0 transitions) and 11001001(4 transitions) are respectively the uniforms and non-uniform. It has been shown that using the neighborhood (1, 8) and (16, 2) respectively are about 90% and 70% of the entire pattern. The overall pattern of binary with P bits consists of P+2(P-1) of the monotone model. From $\mathrm{LBP}\binom{u2}{P,R}$ notations has been using for LBD uniform which below script express use of neighborhood (P,R) and the superscript indicates the using of a uniform pattern. A uniform binary model according to equation (2) is calculated.

$$\mathrm{LBP}_{\mathrm{P,R}}^{\mathrm{U2}}(\mathrm{x,y}) = \begin{cases} \mathrm{I}\left(\mathrm{LBP}_{\mathrm{P,R}}(\mathrm{x,y})\right) & \text{if } \mathrm{U}\left(\mathrm{LBP}_{\mathrm{P,R}}\right) \le 2, \mathrm{I(z)} \in [0, (\mathrm{P}-1)\mathrm{P}+2) \\ (\mathrm{P}-1)\mathrm{P}+2 & \text{otherwise} \end{cases} \quad (2)$$

That U(x) is the detonator of the number of transitions between bits, and is defined like equation (3)

$$\mathrm{U}\left(\mathrm{LBP}_{\mathrm{P,R}}\right) = |\mathrm{s}(\mathrm{g}_{\mathrm{P}-1} - \mathrm{g_c}) - \mathrm{s}(\mathrm{g}_0 - \mathrm{g_c})| + \sum_{\mathrm{p}=1}^{\mathrm{P}} |\mathrm{s}(\mathrm{g_p} - \mathrm{g_c}) - \mathrm{s}(\mathrm{g}_{\mathrm{P}-1} - \mathrm{g_c})| \quad (3)$$

If U(x) is smaller than 2 pixels, the currently pixels labeled with an indicator function I(z), otherwise, the (P-1) P+2 will assigned to it. Indicator function index I(z) which includes the (P-1) P+2 which is applied for specific index for to each of the uniform patterns.

**Co-Occurrence Matrix**

Second-order histogram which in some references known as co-occurrence matrix, express the event rates of gray values of the two pixels which depend on the distance of image and special direction of each other.

For the first time, the co-occurrence matrix has been used to extract textural features of the image in order to troubleshoot of grapefruit by Harlyk [9]. A co-occurrence matrix is the description of the frequency of $P_{ij}$ which the two separated neighboring pixels by a fixed distance d that one of them with gray intensity i and other with gray intensity j occurs in the image. So the co-occurrence matrix from a square matrix whose size depends on the maximum pixel intensity in a gray image is to be formed. Each element of $P_{ij}$ representative of the number of occurrences pixel size I of the pixel distance from pixel size j, and usually is equal to 1(d=1), and the angle between two pixels may represent by 0,45,90,135 degrees [10]. Figure 2 illustrates the desired pixel with the desired angle and 1 distance.

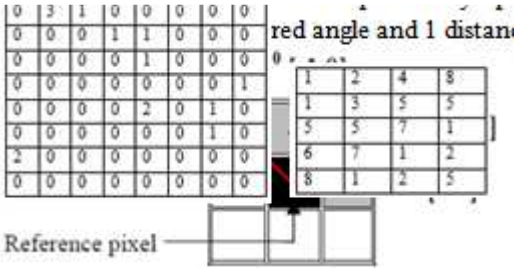



**Figure 2: Co-Occurrence Matrix Representation**

The result of the co-occurrence matrix shows how the pixel values of the image are closer to each other, the larger diameter of the core matrix of aggregate. The advantage of using this matrix on the simple histogram of the image with compared to a simple histogram is in which the spatial information of pixels has destroyed and just amount of gray pixels are calculated in this matrix location of pixels. So that the distribution of gray values is larger, there is more variance in the matrix.

In the mathematical definition of a co-occurrence matrix $C_d$ for the matrix with a distance (Δx, Δy) is defined as an equation 4.

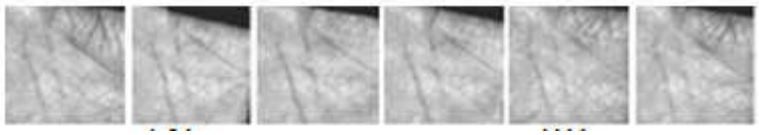
$$C_k(i,j) = \sum_{p=1}^{n} \sum_{q=1}^{m} \begin{cases} 1, if\ I(p,q) = i\ and\ I(p+\Delta x, q+\Delta y) = j \\ 0, \qquad\qquad otherwise \end{cases} \quad (4)$$

The (i, j) elements of $C_d$ matrix are the number of appearance of i and j which have distinct in size (Δx, Δy) with each other. In fact, the co-occurrence matrix is based on the estimation of the second rate which is conditional of the density function 1. Second-order statistical properties define the overall picture as well [11].

For example, figure 3 A, shows the co-occurrence matrix to the matrix dates' in figure 3 B that is calculated in the direction of zero and with a neighborhood of 1.

Since natural images usually have low-pass features and adjacent pixels are highly correlated, co-occurrences matrix of pixels or their diagonal coefficients are distributed.

In other words, the values are large amounts of numbers on the main diagonal and gradually will reduce minor diameters. After insertion due to the loss of correlation, the focus on the main diagonal of the co-occurrence matrix is reduced and cause distribution.



**(a)** **(b)**

**Figure 3: a) Shows the Co-occurrence Matrix to the Matrix Dates', b) That is Calculated in the Direction of Zero and with a Neighborhood of 1**

**Appearance Database**

The databases of images used in this article, is part of the image database which is collected at Hong Kong Polytechnic University. A device that is used for taking pictures is a scanner which is based on the CCD camera. The size of images is 384 ×284 pixels with 750 dpi resolution. Figure 4 shows the image acquisition device and the sample images which is captured by it [12].

**Figure 4: Image Acquisition Device and the Sample Images which is Captured by it**

To evaluate the proposed method, a number of the image from this databases are selected these image due to skin pigmentation and the small difference between levels of gray lines and other areas; they have different levels of brightness. The size of the original images is 384*284. After preprocessing, the central part of the image (size is 128*128), is cropped for feature extraction and matching.

**The Simulation Results**

Evaluations were done on a standard database of palms of Polytechnic University of Hong Kong Poly U Palm print. Dataset included the 600 picture of palms of 500 people which is included in the approximately there are 12 available images from per person.

**Evaluating and Choosing a Distance Function in System Performance**

There are two solutions for calculating the similarity between feature vectors. Ones calculate the distance between two feature vectors, and second, calculate the similarity. These two measurements are against each other. There are different criteria to evaluate the distance and similarity, that in this paper, the similarity between test image S and the training image T we used chi-square distance [13].

It is expressed as Eq. 5.

$$D(S,T)=\sum_{n=1}^{N}\frac{(S_n-T_n)^2}{(S_n+T_n)} \qquad (5)$$

Minimum 1 and maximum of 4 images in the palm of our test subjects got used to the training.

Experiments were performed on the database; Table 1 shows the obtained results.

As it is clear, the PCA method among other methods has the worst result, and LBP standard method has higher accuracy than other remaining methods. The proposed method has higher accuracy than the LBP standard.

Performance-based approaches which appear strongly have been influenced by the number of training images. So in the third experiment, we investigated the influence of this parameter on our method. In this experiment, we used a minimum and maximum of 4 images of per person to train ourselves. Experiments were performed on the database, and the results are presented on different algorithms. In table 1, the results show that the proposed method among the other training sample methods has better performance.

**Table 1: Comparing the Results of the Proposed System with Other Procedures Performed on the Database**

| Number of Training Image | Type of Identification Method | | | | |
|---|---|---|---|---|---|
| | PCA | $Lbp^{u2}$ (R=1,P=8) | $Lbp^{riu2}$ (R=2,P=16) | Proposed Method, (R=1,P=8) | Proposed Method with, (R=1,P=8) |
| image1 | 50 | 58 | 60 | 73 | 75 |
| image2 | 54 | 67 | 68 | 84 | 85 |
| image3 | 60 | 80 | 83 | 87 | 88 |
| image4 | 64 | 85 | 87 | 91 | 92 |

In our experiments, the number of training images for one of the database has changed from 1 to 4, and the last photo is selected for testing. This experiment was performed 20 times in each stage.

The obtained average values are recorded. In table 1, the change in accuracy percentage terms of the training number images is shown.

As can be seen in this table, the proposed method is highly dependent on the number of training images and accuracy of about a few percent increases in the number of images increases from 1 to 4 are visible.

## CONCLUSIONS

More recognizing machines from the brightness intensity of the pixels are used as input data. Brightness intensity dates' from the palm were under the influence of rotation and changing of environment brightness. In our proposed method, the local binary pattern is used which was strong in the state, light changes. Additionally, most of the palm recognition systems which based on binary pattern use for identifying, just from a steady LBP form and only with a certain scale. Obtained characteristics by using LBP single-scale methods gain structure of the image at a particular resolution is not useful for diagnosis of overall image texture and by this method with many discriminate models to obtain useful properties are excluded. A multi-scale approach can provide more features under different settings. So to achieve more discriminate features with less waste, we used from a combination of uniform local binary pattern with a different radius R= (1…….10).the proposed method is proposed to identify palms in this paper which is based on the combination of co-occurrence matrix according to the local binary pattern. The results show that the proposed method has also been stated that the accuracy of all methods is higher and its speed is like a similar algorithm.

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