SURVEY PROCESS MODEL ON PALM PRINT AND PALM VEIN USING BIOMETRIC SYSTEM

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ABSTRACT

In today’s world, security is the most important aspect in every field. This paper proposes a high level security system using biometrics to recognize a person. It is shown that single biometric modality recognition is not able to meet high performances. We propose a fusion of both palm vein and palm print modalities using multimodal biometric system. Instead of taking the entire image of palm, using ROI method, only a part of palm image is taken in order to overcome the hardware defects in fixing the ROI and to reduce the storage space, and to increase the security, the image is encrypted and stored.

KEYWORDS: Multimodal biometric, Modality, ROI Extraction, near infrared, bio code, encryption.

1. INTRODUCTION

Biometrics is the study of physical or behavioural characteristics of a person, in order to establish unique identity of an individual. There are many features such as face, iris, finger print, vein, hand geometry, voice etc. that are used in biometrics. When a single feature alone is used to create an identity, then the system is called as unimodal biometric system. There are certain disadvantage in using unimodal system, like forging, creating fake identity etc. In order to avoid this, a multimodal biometric system can be used, in which instead of using a single modality, the fusion of multiple features are used to create identity, which enhances the security. The multimodal system’s performance are more efficient than unimodal system in terms of accuracy, noise resistance etc.

We propose a fusion of two palm features, palm vein and palm print using multimodal biometric system. The palm vein and palm print images are acquired using web camera with visible and near infrared light sources. Then ROI extraction is carried out on the images. And from the ROI extracted image, the features are extracted, fused, encrypted and finally stored for matching process. ROI extraction process on the image helps us to concentrate on a particular part of the image alone, instead of processing the entire palm image, which in turn eliminates the time consumption of storage and matching process.

2. RELATED WORKS

Many research works have been carried out on palm print [1–4] and palm vein [5, 6] identification. Even though unimodal system shows some advantage, it still has some disadvantages due to various problems such as noisy data, intra-class variations, restricted degrees of freedom, non-universality, spoof attacks, and unacceptable error rates[19]. A multimodal identification system may require fusion of several modalities and hence shows better performance than individual identification system. A main advantage of our fusion approach against single modality is that it gives better protection against spoof attacks and both palm print and palm vein...
images can be taken simultaneously by the system. A fusion approach based on score-level, triangular norm with four finger biometric modalities, finger vein, fingerprint, finger shape and finger knuckle print features of a person’s single finger is proposed by Jialiang Peng et al [8]. A comparison on multi-algorithmic approach on single biometric trait and a multimodal on hand vein and palm print is done by Raghavendra R et al. [9]. David Zhang proposed a palm print acquisition device which operates under visible light and can take three different features such as principal lines (three dominant lines on the palm), wrinkles (weaker and more irregular lines) and ridges (patterns of raised skin) [7]. Although palm print recognition has been a success, it has some weaknesses. This problem can be overcome by multimodal biometric systems, by fusing palm print and palm vein modality.

3. PROPOSED SYSTEM

This figure explains the stepwise procedure involved in the proposed biometric system. The elaborated details in each step is given below.

3.1. IMAGE ACQUISITION

The palm print and palm vein images are captured using only one image sensor, but dual spectrum illumination [10]. Palm vein image is obtained using the near infrared (NIR) spectrum, and at the same time the images of palm print structure is obtained by the visible light spectrum. The property of absorption of near infrared light by palm vein is used here. Depending on oxygen concentration, Haemoglobin absorbs light of 760nm and 850nm [10]. The palm vein appears darker because they absorb NIR light and the rest of tissue around it, appears lighter as they reflect the light [10].

3.2. ROI EXTRACTION

ROI Extraction is done using Harris Corner Detection algorithm. The proposed Harris corner detection algorithm uses change in intensity shift and Eigen value method to find the corner points of the entire palm from the given image [16].

Intensity change in shifting window: eigenvalue analysis

\[
M = \sum_{x,y} w(x,y) \begin{bmatrix} I_x^2 & I_x I_y \\ I_x I_y & I_y^2 \end{bmatrix} \quad \lambda_1, \lambda_2 \text{ - eigenvalues of } M
\]

Measure of corner response:

\[
R = \det M - k (\text{trace } M)^2
\]

\[
\det M = \lambda_1 \lambda_2 \\
\text{trace } M = \lambda_1 + \lambda_2
\]

[16]

The result shows that,

1) R depends on eigen values of M
2) R is large for a corner
3) R is negative with large magnitude for an edge
4) |R| is small for a flat region [16].

The properties which makes this algorithm, a most efficient corner detection algorithm are,
• Average intensity change in direction \([u, v]\) can be expressed as a bilinear form:

\[
E(u, v) = [u \quad v]M[u \quad v]^{T} \quad [16]
\]

• Describe a point in terms of Eigen values of \(M\), measure of corner response.

\[
R = \text{det } M - k(\text{trace } M)^{2} \quad [16]
\]

• A good (corner) point should have a large intensity change in all directions, i.e. \(R\) should be large positive.
• Rotation Invariance property of the algorithm.

After detecting the corner points in the full image, the region of palm from the background gets separated.

**Fig. 1:** Corner points separating the palm from background (using mat lab).

Connect two main corner points using a line \(A\), one point lies between index finger and middle finger and the other point lies between little finger and third finger. Then draw a perpendicular line \(B\) from the midpoint of line \(A\) of length, 2A. Then from the other end draw perpendicular lines of length half of \(A\), on both sides, which forms line \(C\) of length \(A\) and with length of \(A\), draw a square using \(C\).

**Fig. 2:** After drawing the lines \(A\), \(B\) and \(C\) in the image.

**Fig. 3:** Final image

After removing the intermediate lines, the final Figure 3, gives the ROI (Region Of Interest) that is the area within the box is needed for further processing. Similarly the ROI for palm vein image is calculated and both the images are taken for further processing.

#### 3.3. FEATURE EXTRACTION

After ROI Extraction, features like wrinkles from palm print and vein pattern from palm vein are extracted.

##### 3.3.1. PALM PRINT

As discussed by Rihrads Fuksis in bio hashing paper, the palm print ridge has a sharp intensity changes. First derivative and gradient method are used to detect this sharp intensity change [10].

\[
\nabla g \equiv \text{grad}(g) = \begin{bmatrix}
\frac{\partial g}{\partial x} \\
\frac{\partial g}{\partial y}
\end{bmatrix} \quad [10]
\]
where $d$ is the half of the distance between taken neighbourhood pixels. In order to reduce rapid intensity spikes that are initiated by noise, the image smoothening techniques like Gaussian filter is used,

$$g[x, y] = f[x, y] \otimes e^{-\frac{x^2+y^2}{2\sigma^2}} [10]$$

where $\sigma$ is the smoothing rate, and $\otimes$ is the convolution operator.

Then the obtained data is converted into complex notation and which in turn helps us to change it into vector form,

$$F[x_0, y_0] = (g[x_0+y_0-d] - g[x_0+y_0+d]) + j(g[x_0+d, y_0] - g[x_0-d, y_0])$$

3.3.2. PALM VEIN

CMF (Complex 2D Matched Filtering) method is used to extract palm vein features. It performs faster than MF because only two convolution operations with the CMF kernel are required [10]. Along with extracting the selected features from the images, CMF also provides the information about the direction of the extracted features of the image. The principles of Matched Filtering with the Gaussian 2D function $G(x, y)$ determines the nature of CMF which was discussed by Rihards Fuksis [10].

$$G(x, y) = \begin{cases} -\exp\left(-\frac{y^2}{2\sigma^2}\right), & |x| \leq \frac{D}{2} \\ 0, & |x| > \frac{D}{2} \end{cases} [10]$$

where $D$ is the length of the filter kernel in direction $x$. The filter mask is scaled and rotated in different directions, to detect blood vessels. And the Gaussian 2D kernel is referred to as:

$$G[x, y; \phi, c] = G\left(\frac{x \cos \phi - y \sin \phi}{c}, \frac{x \sin \phi + y \cos \phi}{c}\right) [10]$$

CMF filters image only with one complex mask, which incorporates all the angles and scales. The complex matched filter (CMF) kernel is given by the following expression:

$$M[x, y] = \sum_{n=1}^{L-1} \sum_{l=0}^{N-1} \exp(j2\pi l)[G[x, y; \phi, c]] [10]$$

where $N$ - total number of used scales, $L$ - total number of used angles, $\phi_1 = \frac{\pi}{L}$. CMF kernel is used to filter the image:

$$C[x, y] = f[x, y] \otimes M[x, y] [10]$$

Then in order to obtain the final CMF result, additional operation of the angle decrement is performed to $C$:

$$F[x_0, y_0] = |C[x_0, y_0]| \exp\left(\frac{j \text{Arg}(C[x_0, y_0])}{2}\right) [10]$$

The result of CMF is a matrix of vectors, where in each input image pixel the vector is constructed. Vectors represent the similarity between image and filtering mask in certain region.

3.4. FUSION AND ENCRYPTION PROCESS

The obtained vector images of palm print and palm vein are combined using any of the methods proposed by B.Ragavendra Reddy [18] and encrypted using RSA algorithm or Blowfish algorithm [17] or fuzzy vault method [10], in order to increase the security. Then the resultant bio code is stored in database for future matching process.

3.5. MATCHING PROCESS

The entire process of image acquisition, ROI extraction, feature extraction, fusion and encryption is done and the resultant encrypted code is compared with the
encrypted code in the database using Euclidean distance method in which the string at random index within the bio code is compared with the bio code in the database.

4. CONCLUSION

The ROI Extraction method in this paper, which is implemented before the feature extraction helps us in the following ways,

1) Minimize the time taken for feature extraction process on the image, which in turn minimize the time taken for vector generation.
2) Minimize the storage space required to store the bio code.
3) Comparing of two bio code also proves to minimize the time taken.

5. FUTURE ENHANCEMENTS

We can further decrease the time taken for this ROI extraction method by introducing further less complexity algorithm than Harris corner detection algorithm.

6. REFERENCES


