MULTIMODAL BIOMETRIC PERSONAL IDENTIFICATION USING WBCT AND WLD

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Abstract- **Unique identity for a particular person is essentially important. This unique identity could be thumb prints, palm prints, Iris, knuckle prints etc. A biometric System is needed to identify these variations among human beings. This paper proposed about Iris and palm print recognition in multimodal biometric approach based on the wavelet based contourlet transform (WBCT) and Weber local descriptor (WLD). There are many limitations in unimodal process such as noise, variations and non-universality etc. This could get overcome by multimodal technique. In order to eliminate poor direction selectivity of 2-D wavelet transform and the problem of redundancy in contourlet transform, a novel approach called wavelet-based contourlet transformation is proposed. Also, Weber local descriptor which is a simple yet very powerful and robust local descriptor is proposed for obtaining high quality features. The features of Iris and palm print were extracted using WBCT and WLD respectively and then combined for matching. Initially the Iris and palm print images are collected from people and get stored in a particular database. During recognition process the matching is performed between new input images and registered images then the identification is done by using hamming distance. This method could be implemented in various recognition systems for better identification with high security.**

Keywords- **Multimodal biometric, WBCT, WLD, Hamming Distance.**

I. INTRODUCTION

Biometrics is the science of using any biological data in technology. It is a technical system which uses the biological information of a person to identify that person. This biometric system focus exclusively on the identification of humans and it has been deployed because of its effective security and convenience than other personal recognition systems. The biometric system works on the process of storing and matching the biometric characteristics. For efficiency reasons, rather than using stored characteristics directly, it extracts identifying features from the samples and encode those features in a form that facilitates storage and comparison. When a human uses a biometric system for first time, their identifying features are get recognized and stored in the database for future reference. There are two modes of recognition such as verification and identification. Identification could be done without the knowledge of a person and verification could be done only with the physical access of a person. Multimodal biometric systems are those that utilize more than one physiological or behavioral characteristic for enrollment, verification, or identification .The systems use multiple sensors or biometrics to overcome the limitations of unimodal biometric systems.

The proposed project is about recognizing the Iris and Palm print and the identification/verification is done by extracting their features and matching them with the help of Hamming distance. The Iris is the colored portion of the eye. Even though its structure is complex it is used for recognition purpose because of its several superior properties such as physically not modifiable, immediate response to light, isolated from physical environment etc. Also the Palm is the inner structure of hand between wrist and fingers. It is used as a powerful tool for verification because of its flexibility and discriminating ability.

II. EXISTING METHODS

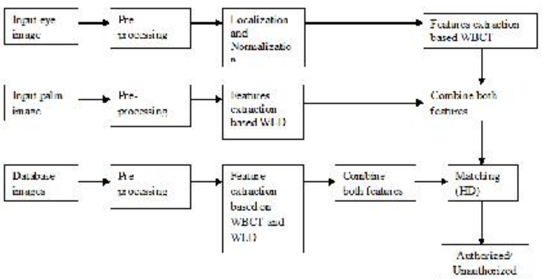
The first successful implementation of Iris recognition is done by J.Daughman. He extracted the image features using Gabor filter. Similarly, Fang-Li-et-al proposed an algorithm using Line edge map for feature extraction of Palm print. There are several other methods existed such as Wavelet transform, Curvelet transform, Contourlet transform, Haar wavelet based on DWT, Wavelet Packet transform using Haar Wavelet etc..

The feature extraction of the palm print is proposed by many methods. Which are Ajay Kumar and Helen C. Shen proposed by using the Gabor filter to extract the features of the palm print. Similarly Kong et al used the 2-d Gabor filter for the extraction of the features. Ke and Sukthankar proposed the PCA-SIFT Descriptor, which represents local appearance by Principal components of the normalized gradient field. There are other methods like Eigen palm feature, Fisher palm, 2-d Gabor wavelet, etc...

III. PROPOSED METHOD

This paper proposed the multimodal biometrics like iris and palm print for the identification using the WBCT and WLD.

Fig 1: Block Diagram of the Recognition System



(A) IRIS RECOGNITION SYSTEM

The eye image is given as the input. Then the input image is preprocessed by iris localization and normalization .From the preprocessed image the features are extracted using the wavelet based contourlet transform (WBCT).

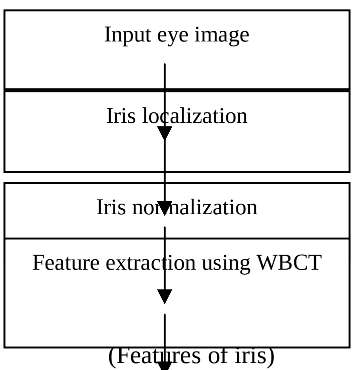


Fig 2: Flow of IRIS analysis

(a) IRIS LOCALIZATION:

Iris localization is found by using the Integro-Differential Operator (IDO).

$$max_{(r,x0,y0)} \left| G_\sigma * \frac{\partial}{\partial_r} \oint_{r,x0,y0} \left(\frac{I(x,y)}{2\pi r} \right) ds \right|$$

Where $I(x,y)$ is the input image. The IDO is found by J.Daughman, searches over the image domain (x,y) for the maximum in the blurred partial derivative with respect to increasing radius (r) of the normalized contour integral value of $I(x,y)$ along a circular arc ds of radius r and centre coordinates $(x0,y0)$ .The symbol * denotes convolution and $G_\sigma(r)$ is a smoothing function such as a Gaussian of scale (σ).This operator actually behaves as a circular edge detector, blurred at a scale (σ).It searches iteratively for the maximal contour integral derivative at successively finer scales of analysis through the

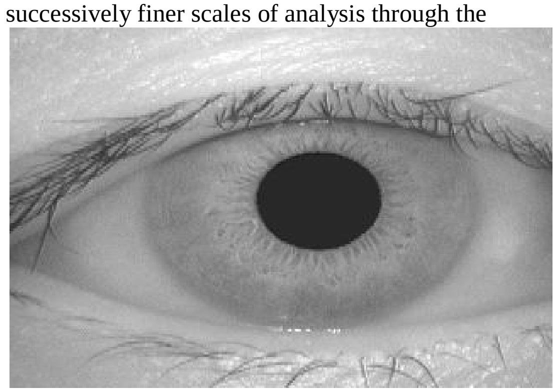


Fig 3: Input eye image

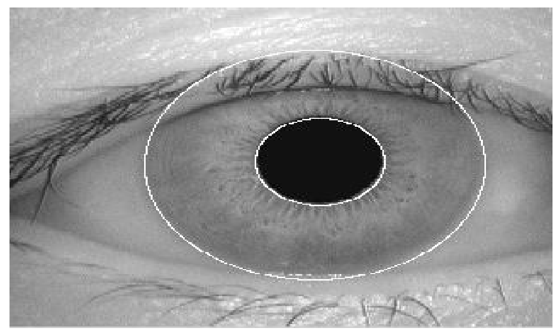


Fig 4: Localized eye image

three parameter $(r,x0,y0)$ defining the path of contour integration .It finds both the papillary boundary and the outer boundary of the iris.

(b) IRIS NORMALIZATION**:**

By using the iris normalization the iris data can be extracted. Different circles with increasing radius and angle are drawn starting from the pupil centre till it reaches near iris coordinates. By this, the information of the iris is extracted. The normalization of the localized iris is determined by the formula,

$$x = c(x) - r * \sin(\theta)$$
$$y = c(y) + r * \cos(\theta)$$

Where $c(x,y)$ denotes center coordinates. Here (x,y) denotes coordinates of the image,θ is the angle and r is the radius.

Fig 5: Normalized iris image

(c) WAVELET BASED CONTOURLET TRANSFORM (WBCT)

The WBCT is used to extract the features of the iris. Although the wavelet transform is an efficient way to extract the feature but it has a drawback of poor direction selectivity to capture the curves and edges. Similarly the contourlet transform is also used for the feature extraction. In the contourlet transform there are two stages, Laplacian pyramid and directional filter bank (DFB). Due to the redundancy occur in the laplacian pyramid, the contourlet transform has 4/3 redundancy factor, so it not chosen for image representation.

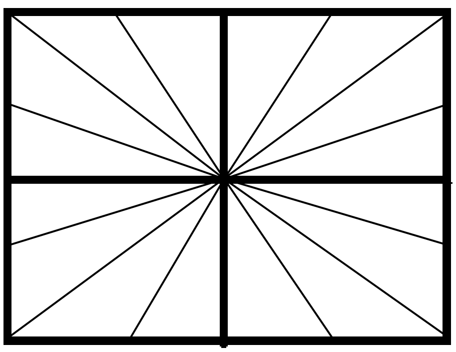


Fig 6: Image decomposition structure

To overcome this effects a non-redundancy technique called Wavelet based contourlet transform is used for iris feature extraction. Similar to the Contourlet transform the WBCT has two stages. In the first stage by using the wavelet transform the image is decomposed into sub-bands. In the second stage of the WBCT the directional filter banks is used, to capture the high frequency components of the images. In the first stage while applying the wavelet transform the decomposed image has four sub-bands are LH, HH, HL, LL.

Fig 7: Decomposed iris image

(B) PALM PRINT RECOGNITION SYSTEM:

Palm print image is given as the input. Then the input image is preprocessed for the features extraction. By using the Weber Local Descriptor which is a combination of the differential excitation and the gradient orientation from which the features can be extracted.

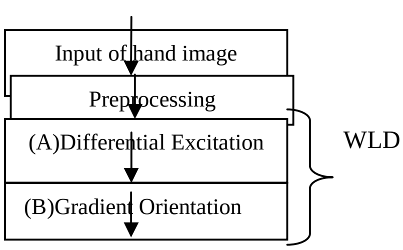


Fig 8: Flow of palm print analysis

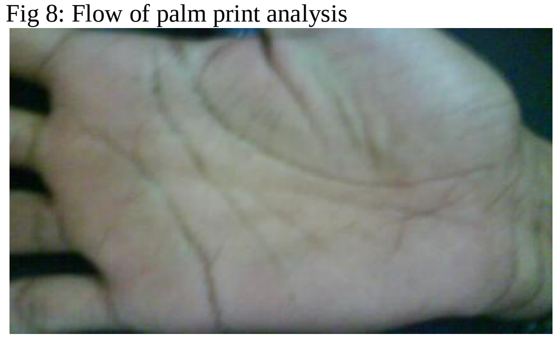


Fig 9: Input hand image

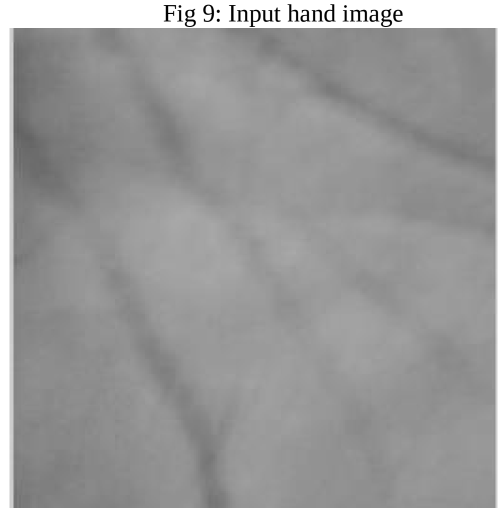


Fig 10: Preprocessed hand image

(a)Weber Local Descriptor:

Weber's Law:

Ernst Weber, an experimental psychologist discovered that the ratio of the increment threshold to the background intensity is a constant. This is known as Weber's law and it can be represented as,

$$\frac{\Delta I}{I} = k$$

Where ΔI represents the increment threshold of noticeable difference, I represent the intensity, and k represents the left side of the equation remains constant despite variations in the I term.the fraction $\frac{\Delta I}{I}$ is known as the Weber fraction.

WLD has two main components; they are (1) differential excitation (ε) (2) orientation (θ).

I: Differential Excitation:

Differential excitation is defined as the ratio between the sum of intensities differences of the centre pixel and the neighbor's pixel to the intensity of the centre pixel. It is calculated by using the formula,

$$\Delta I_i = I_i - I_c$$

Where i =0, 1, 2… p-1[p=8]. I_i is the intensity of neighboring pixel and I_c is the intensity of the current pixel.

$$\varepsilon(x_c) = \arctan\left[\sum_{i=0}^{p-1}\left(\frac{\Delta I_i}{I_c}\right)\right]$$

$\varepsilon(x_c)$ is the differential excitation of the current pixel x_c. Arctangent function is used as a filter to enhance the robustness of WLD against noise. The differential excitation $\varepsilon(x_c)$ may be positive or negative. The positive value denotes that the current pixel is darker than its surroundings and the negative value means that the current pixel is lighter than the surroundings.

x_0	x_1	x_2
x_7	x_c	x_3
x_6	x_5	x_4

Fig 11: Example of pixel formation

II: Gradient Orientation:

Gradient orientation is defined as the ratio of the intensity difference of two pixels.

It is found by the equation,

$$\theta(x_c) = \arctan\left[\frac{I_{73}}{I_{51}}\right]$$

Where $I_{73} = I_7 - I_3$ is the intensity difference of two pixels on the left and right of the current pixel, and $I_{51} = I_5 - I_1$ is the intensity difference of two pixels directly below and above the current pixel, $\theta \in \left|-\frac{\pi}{2}, \frac{\pi}{2}\right|$.

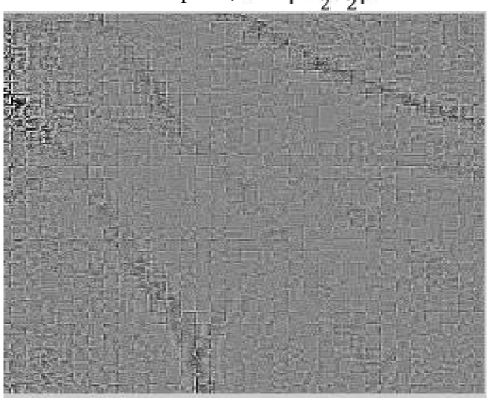


Fig 12: Weber palm image

From the Weber palm image the features are extracted for matching.

(C) Matching:

The features that are extracted from the iris and the palm print using the WBCT and WLD are combined to form a feature matrix. The same process is takes place in the database to create the feature matrix. These feature matrixes are comparing with each other using the Hamming Distance. If both features get matched he/she will be a Known person otherwise Unknown person.

IV. CONCLUSION

Thus the proposed method has overcome the limitations of the poor direction selectivity in wavelet transform for feature extraction. The high quality features are extracted by using the WBCT and WLD. As compared to the existing method the proposed method results better performance. Furthermore, by including the cryptosystem in the proposed method will result in more security.

V. ACKNOWLEDGEMENT

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