Multimodal Biometric System using Iris and Inner-Knuckle Print

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ABSTRACT
Multimodal biometrics system becomes an inexorable trend in future. Multimodal biometrics overcomes many drawbacks over unimodal biometrics. Some of the drawbacks are non-universality, noisy data and spoof attack. Multimodal biometric is more efficient and accurate than unimodal system. In this paper we present a multimodal biometric recognition system using Iris and finger Inner-knuckle print. This system will give excellent result over performance.

Keywords
Iris, Inner-knuckle print, Biometric Fusion, Matching score, Multibiometrics.

1. INTRODUCTION
A biometric system is usually used for recognition based on physiological or behavioral characteristics of an individual. Biometrics system becomes robust method for authentication [1]. Finger print, Knuckle print, face, palm print, Iris are comes under physiological characteristics. While Gait, writing style and voice are comes under behavioral characteristics. Uniqueness, universality and permanence are the three important aspects in biometrics system. Biometrics authentication system were used in various fields like airports, railways stations and etc. Biometrics systems are divided into two categories namely unimodal or monomodal systems and multimodal systems. Unimodal systems uses only one trait whereas the multimodal systems uses more than two traits for identification and verification. Through multimodal biometric system excellent security can be achieved besides enhancing matching accuracy, multimodal biometrics has more advantages than monomodal biometrics [2]. In multimodal biometrics there are five categories under fusion ways [3.4]

- Single trait and multiple sensor.
- Multi biometric trait.
- Single trait and multiple units.
- Single trait and multiple classifier.
- Single trait and multiple instances.

Fusion can be done at any three possible levels namely feature extraction level, Matching score level, and decision levels [5.6]. Each levels of fusion has its own advantages and disadvantages. In Feature level fusion the main problem is the choice of best classifier for high dimensional joint feature vectors. In Matching score level fusion the biometric systems each act as a unimodal system. In Matching score level fusion in order to make two or more biometric score into similar domain we make use of Normalization techniques [7, 8]. Due to less complexity matching score level fusion is used widely by the researchers [9, 10, 11, 12]. In 1998, the first multimodal biometrics recognition system have been proposed by Fierrez-aguilar and Ortega-garaa, using face, minutiae-based finger and online signature, the fusion is done at matching score level[13]. In 2000, [14] A.k.Jain, Duin RPW, Mao j, proposed inner-knuckle print for personal authentication. In 2004, [15], Li Q, Qiu ZD, Sun et al proposed inner-knuckle print personal identification system. In 2007, [16] Luo RF, Lin TS, Wu T proposed line detection in Inner-knuckle print using Random transform and singular value decomposition. In 2008, [17] using finger, face and hand geometric modalities recognition is done, matching score is the fusion done and the method of fusion is Likelihood ratio. In 2010, [18] Goh Kah Ong Michael, Tee Connie, Andrew Teoh Beng Jin, proposed palm print and Inner-knuckle print biometric recognition system. In 2012. [19] Ramachandra and Abilash, proposed multimodal biometric system using face and finger print. In this paper we propose a new multimodal biometric authentication system using Iris and Inner-knuckle print. Fusion is done at score level. This paper is organized as follows section (2) describes proposed multimodal biometric system, section (3) consists of database used and the performance measure and section (4) consists of conclusion.

2. PROPOSED MULTIMODAL BIOMETRIC SYSTEM
Fig.1 show the proposed system diagram. In the proposed system first Region of interest is extracted by applying preprocessing. Then the feature of each biometric ROI is extracted and with the extracted features the matching score is found from the corresponding template. After finding the matching score they were fused to form unique matching score which is finally used for decision making either the user is accepted or imposter.

2.1 Monomodal Biom`etrics System Used in Proposed System
2.1.1 Iris Identification System
Iris recognition is well known and accurate biometric system for recognition. Each iris are different for twins like finger print [20]. The FAR and FRR are low in this recognition system. The recognition steps as follows

Step 1: Apply Linear Hough Transform to separate upper and the lower eyelids. For removal of eyelashes we used simple threshold.

Step 2: Localization and Segmentation are done through geometric calibration and direct least square ellipse algorithm.

Step 3: Normalization technique done using Daugman's algorithm [21].

Step 4: Applying Haar Wavelet decomposition and Neural networks (Neu Wave Networks) the feature extraction process is done by transforming the normalized image into different wavelet co-efficient which will form a bit patterns [22]. Fig. 2 shows the Neu Wave Networks.

Step 5: Finally matching is done using calculated Hamming distance (HD) [23].

$$HD_I=1/n(\sum_{i=1}^{n} pi \oplus qi)$$

2.1.2 Inner Knuckle Print Identification System

For personal recognition Inner knuckle print plays a vital role and generate more interests in biometrics [24]. The IKP are unique among the persons. The IKP recognition has two stages namely Region of interest extraction and line feature extraction based on guided image filtering.

2.1.2.1 Region of Interest Extraction

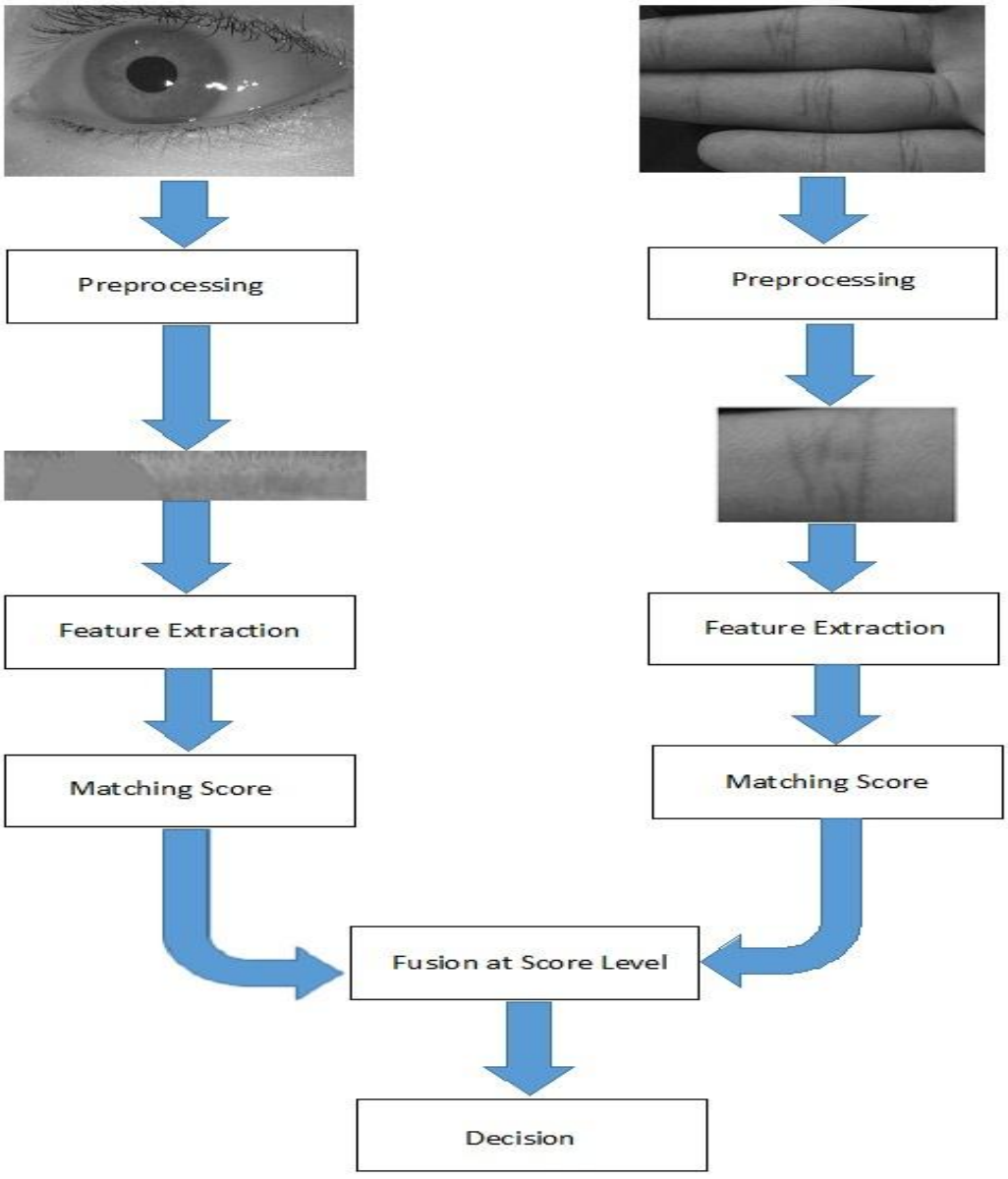
Three fingers are captured (middle finger, ring finger, little finger) using high resolution camera. Segmentation is done in single finger to extract the ROI.

Algorithm for ROI extraction follows:

Step 1: Gray image is obtained from original image.

Step 2: Horizontal lines are extracted using Gabor filter.

Fig. 1 Proposed System Block Diagram



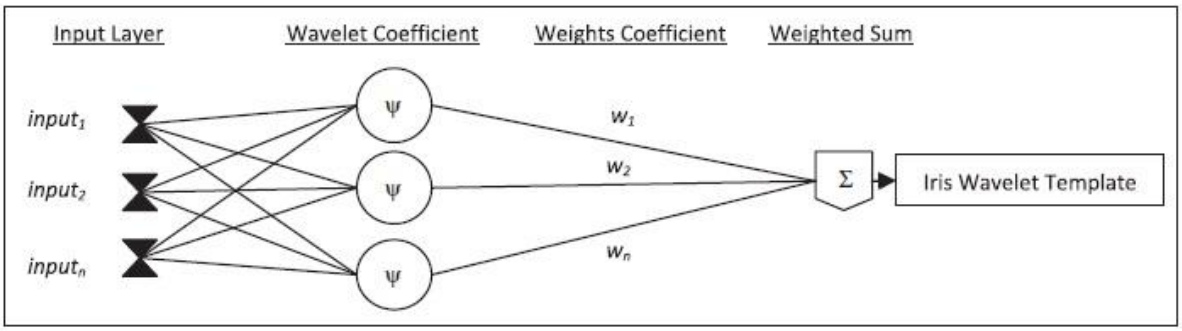


Fig. 2 Neu Wave Networks

Step3: Horizontal projection histogram is produced to segment the middle finger region from the original image.

2.1.2.2 Line Feature Extracted Based On Guided Image Filtering

In this section we discuss about guided image filtering method and derivative line detection method. The guided filter has least edge produce of properties like popular preserving properties like the popular bilateral filter [25]. Using guided image filtering will remove noise and keeps no change to the edge features. After this process the lines of IKP are detected using derivative line detection method [26]. At last the hamming distance is calculated using

$$HD_{IKP}=1/n(\sum_{i=1}^{n} pi \oplus qi)$$

2.2 Score Level Fusion

The two scores of the biometric traits are combined for fusion. This matching score level fusion is commonly used approaches in multimodal biometric recognition. It provides more effectiveness, ease implementation and conceptual simplicity. This is the dominant option in many published papers [27].

Before the fusion approach the normalization technique is applied. Many normalization techniques are there namely Min-Max, TanH and Z-score [27].In this paper we used Min-Max rule

S'=(S-Min)/(Max-Min)

Where Min and Max denotes the minimum and maximum score range.

After the normalization technique the fusion of two traits are done by Weighted Sum Rule

Weighted Sum Rule= $\sum_{i=1}^{n}(w_i s_i)$

Where n= number of match score needed to be fused,

S=matching score,

W_i= weight for each score.

3. DATABASES AND PERFORMANCE MEASURE

3.1 Databases

For Iris we can use CASIA Iris Image Database [28]. In this all Iris image are 8 bit gray level in format of JPEG Sample Iris image of CASIA Iris Database are shown in fig. 3.

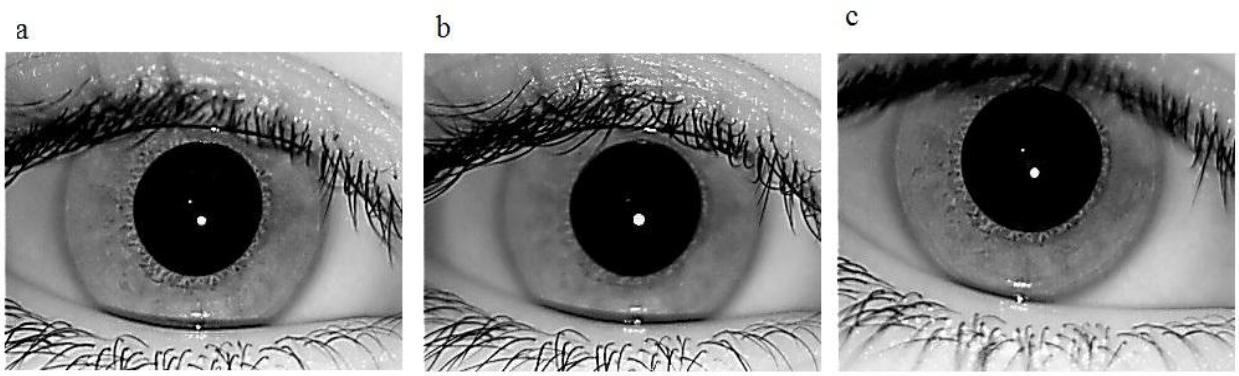


Fig. 3 Sample Iris images

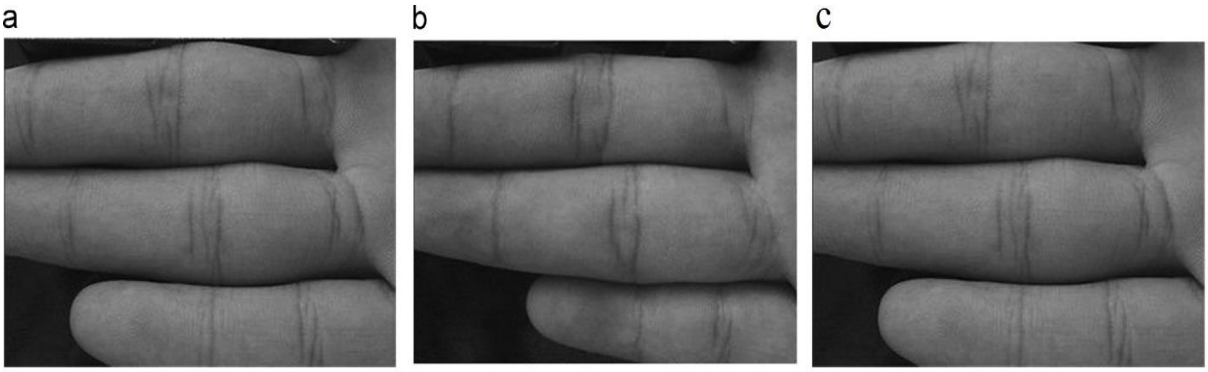


Fig. 4 Sample IKP images

For Inner-knuckle print the images are acquired using camera on which users finger are captured. Sample images of IKP are shown in fig. 4.

3.2 Performance Measure

The performance measure of the biometric system are by False Acceptance Rate (FAR), False Rejecting Rate (FRR) and Genuine Acceptance Rate (GAR) [29, 30].

$$\textbf{FAR}\ (\%) = \frac{\text{no. of accepted imposter}}{\text{total no. of imposter test}} X\ 100\%$$

$$\textbf{FRR}\ (\%) = \frac{\text{no. of accepted imposter}}{\text{total no.of imposter test}} X\ 100\%$$

$$\textbf{GAR}\ (\%) = 100\text{-FRR}\ (\%)$$

4. CONCLUSION

In this paper, we proposed the multimodal biometric recognition system by combining the Iris and Inner-Knuckle Print which gives high security with less computational complexity. The fusion is carried out at Matching score level. Our proposed system will show the best performance in accuracy and effectiveness. This multimodal biometric system can be implemented in any commercial purpose to acquire high security. Our future work investigated to combine the multimodal technique with the optimization algorithms to improve the efficiency of feature extraction and the fusion method.

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