



Research Article

Dual-nature biometric recognition epitome

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Abstract

All humans are born with unique physically identified body characteristics to other persons which remains unchanged throughout life. These characteristics are taken into account by the emerging technology to get recognized from person to person. The technology used by the traditional human identification system sometimes becomes inefficient when data or images received are not up to the acceptable quality mark or when a person has a face covered with mask-like during epidemic virus fistula. In order to overcome such human recognition challenges, a Multi-biometric sustainable approach (D-nb) has been proposed using two uniquely identified modalities like foot and iris. This approach shrewdly identifies and makes the bodacious recognition among humans and suggests the sagacious result which is foremost better than the traditional biometric system.

Introduction

Today a biometric recognition process is very popular from both physiological and behavioral points of view for identification and authentication of individuals. If both are the same as the decision, the test picture corresponds to the store picture and it is checked that it is a mapping operation [1]. In order to identify the test image with the saved database, the person is identified or does not decide whether it is only one to many mapping systems. Some prominent biometric identification features are being used as [2].

Face biometric: Face recognition is a technique in which a person is automatic identified and verified using digital image [3].

Ear biometrics: Ear biometrics uses features or characteristics of ear for matching. This is a stable and not changes with age [4].

Fingerprint biometrics: A fingerprint is one of the most popular biometrics used in last few decade for recognition of a person. Ink is used for taking an impression of finger and thumb images on paper [5].

Hand Geometry biometrics: Now palm print is also used as a biometric because each person has no changes in lines of palm print during the growth [6].

Voice biometrics: Voice biometric comes under the behavioral characteristics each person has different sound, pitch and speaking style [7].

Signature biometrics: The making of signature. Signature are measured as writing style of a person that means holding the pen, pressure on paper and the direction of letter is different each parson has its own style [8].

It accomplishes in two steps; one is the training process and the other is the testing process.

Training process

- o Input image is captured or acquired by camera.
- o An image is pre-processed means image resizing, reformatting.
- o Feature extraction is performed.
- o Prepared database.

Testing of image: It is close to the preparation phase, but balanced. The processes of training and testing are described in Figure 1

There are numerous challenges faced by the Uni-biometric system such as:

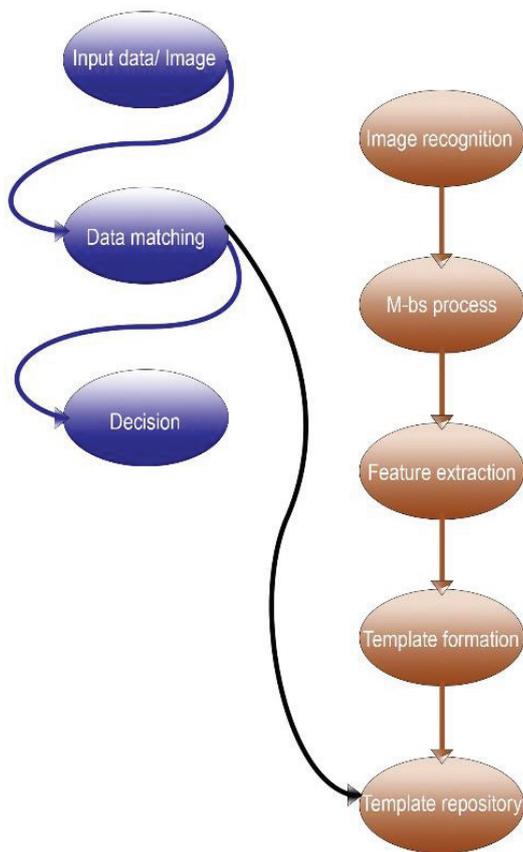


Figure 1: Information training flow process.

- Noise
- Intra-class variations
- Non-universality
- Spoof attacks

Multi-biometrics offer opportunity to take more than two biometric features, to combine them to overcome unimodal biometric system limitations and to achieve optimal results [9]. We've been using two biometric foot and iris for a multi-biometric device. Sprints have been developed, iris are special and not changed during a person's age as a reflective layer structure.

A critical comparative analysis of foot and iris modalities with other available practices have been epitome in Table 1.

The rest of the article is arranged as, Related work is addressed in section II, section III presents the proposed methodology, section IV demonstrates the performance obtained through results while concluding remarks are given in section V.

Related works

Many researchers have made significant contributions reported [10], that the biometrics is becoming more commonly used in several places through different biometric device such as bank, institute, airports. Multi-biometric is preferred in

authentication-based image processing applications. The authors [11], introduced a multi modal systems working on physiological and demography information for identification of person.

The author [12], links open overlay panel introduced a biometric system for person recognition that shown the improvement accuracy of the recognition system. Another research work on face and ear-based hybrid system has been presented by [13]. This system is used Iterated Function concept in which images are compression and indexed. Sarfraz, et al. [14], designed a multi-biometric system that combines face modalities and foot modalities using PCA [15], classifier for face and wavelet transformer for foot and concatenated after normalization process to obtain a matching score and take a decision. Another author Davrondzhon [16], proposed a system for multimodalities biometric that combines face, ear and iris using PCA, Eigen image [17] and hamming travers [18], classifier for feature extraction, sum rule method is used for fusion to calculate matching score. They introduced recognizing person utilizing multiple biometric traits and their advantages such as high accuracy and robustness, that increased recognition performance. Herbadji, et al. [19], developed a Multi-biometric system, which combined face and foot modalities at decision level using PCA classifier for face and wavelet transformer for foot and concatenated after normalization process to obtain matching score [20].

Methodology

The body parts can be paired with the other body elements in several potential ways, leading to very diverse machine architectures. Particularly in parallel or in cascade, the Iris footprint can be combined and therefore further findings are arranged as:

Iris biometrics

Iris recognition work on the colored part of eye that is isometrics surrounds by pupil known as iris. Iris image is captured using high quality camera every person has a unique iris. Process of calculating patterns are very complex it stored in bit format as a template illustrated in Figure 2. Hamming traverse method is used for calculating the distance between test image and stored template if the distance is zero that indicate the test image and training image is same otherwise, we can say both images are different.

Footprint biometrics

Identification of peoples by fingerprint is becoming a wonderful success. Measurement such features are not a complicated process some transformation such as furrer, haar are available [21]. Each parson has completely different footprint and it is easy to capturing without any special requirement both leg images can be used for recognition [22]. Captured foot image needs some additional approach such as cropping and resizing. Figure 3 displays the picture captured by high quality camera than the RGB image converted into gray scale after that resize them for preparing the database.

Table 1: Critical comparative analysis of biometric authentications with proposed technique.

Recognition method	Flexibility	Challenges	Working ground	Comparison with proposed technique (Iris and foot)
Face	Most favorable, works foremost better while identifying masses of people who spent just seconds before a camera or scanner	Age invariant, thermal imaging due to multi-feature extractions from small and large database, single face identification with occlusion, Facial expressions like (joy, sadness, anger, fear, disgust and surprise), poses	Analyzes the particular characteristics common to all faces such as the distance between the eyes, width of the nose, position of cheekbones, jaw line and chin etc.	Iris scanner uses safe and low energy visible infrared light and can recognize at least from 40 feet away. Iris scanners collect approximately 240 biometric features. Throughout one's life, iris patterns remain stable. It is protected by the mechanism of the body itself. For a footprint, the footprint pressure distribution is calculated by means of a pressure sensor pad. Footprint-based authentication is adequately reliable to focus on sensitive data provided by high-security applications without any downside.
Fingerprint	Most common and low cost, no two fingerprints were ever found to be the same in over 140 years of worldwide fingerprint comparison	Misrepresentations due to finger injuries and finger cuts. physical distortion.	The pattern of ridges and furrows on the fingertips, as well as the minutiae points of a specimen print with a database of prints on file.	
Hand Geometry	Can be useful in harsh environments, do not require clean conditions, requires very small database, environmental factors, such as dry weather causing drying of the skin, are not a problem	The hand size restricts the number of applications. At least two out of 100 randomly selected persons have the same hand geometry.	Based on the geometric shape of a hand-palm size, finger length and width, knuckle distance. Use in industrial environment	
Retina scan	Requires very small file size, can take place in less than two seconds	May be a health risk, Requires the highest level of end-user cooperation and motivation	It captures blood vessel pattern on the back of the eye, a standard in military and government installations.	
Voice	Non-intrusive. High social acceptability, provides quick and efficient authentication, natural input and does not demand any training	Having low accuracy, an illness like cold will alter a person's speech, rendering it difficult or impossible to recognize absolute	Spectrogram takes the voice sample then paired with stored voice data	
Signature	Not physically intrusive,	Due to insufficient resolution authentication may take longer, Sign issues differ from one cause to the next	Uses checksum mechanism, Cyclic Redundancy Check and private and public key	

Hamming distance method for iris

Hamming distance approach [23], is applied for a matching iris templates incorporate noise masking also. The distance between two iris templates is calculated in bits format and distance calculated between two iris templates if the distance is minimum that indicate the iris are same otherwise iris are not matched which confirms hamming distance is a reliable and accurate for iris recognition.

The iris recognition process completed in three stages

- a. Segmentation: Located the iris region
- b. Normalization: Created a consistency of data iris region
- c. Feature encoding: Produced templates as set of discriminated features of the iris.

Sequential modified Haar transform technique

The sequential modified haar wavelet [24], is based on the mapping technique in which integer-valued signals are mapped using the reconstruction of image technique. Wavelet coefficients represented by decimal numbers and each decimal value needed eight bytes for storing the haar value.

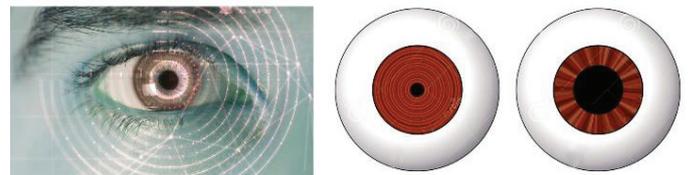


Figure 2: Iris selection initialization process.



Figure 3: Foot selection initialized stages.

Multi-biometric approach

The sample images of eye are being consider as input to the system and thereby iris templates are generated as

output. The discrete bits formation of the image has been obtained illustrated in Figure 4, showing segmentation and normalization stages [25].

Image segmentation

The control area on the 3-D floor is exposed to the pressure distribution of the person on the medium [26]. Because human physical presence defines the significant pressure surfaces, personality identification can be thus understood through the classification of high pressure surfaces and examination of their formal features [27]. When the scene footprint is compared to other templates, the public protection program can assess or reject the accused individual. The visible footprint arc travels away from the curved surface position and direction which has little to do with the curved surface parameter.

Image noise reduction

For identification of footprint patterns, edge detection is necessary. For the sake of the gradient of light intensity of a gray-scaled picture it is very difficult to distinguish corners via a Laplacian transformation [28]. Then for edge detection the entire picture must be binarized. To binarize the entire image, a certain threshold value is not adequate. The entire picture is then separated into several sections, and threshold values are autonomously determined for such a segment.

The proposed technique produces n number of iris codes out of n number of eyes tests performed at various time periods from the same person. Using majority voting scheme [29], a unique iris code x is built from the n number of iris code. The suggested framework operates on x and generates codewords, known as Error Corrected Iris Code (ECIC) [30]. These ECICs are composed of iris coding and parity regulation p . The hash h is also created from code x . Eventually, parity regulates p of the ECIC, matrix h of parity and hash- h render code that are embedded in digital images by transformation of the integrated wavelet and incorporation processing threshold illustrated in Figure 5.

The new and unique feature of the multi-biometric is the speed and precise segmentation of irises, the iris image being captured to reduce identifying errors, producing a vector with distinguishing texture characteristics and a proper dimension to improve the detection and computational efficiency [31]. The sagacious edge detection and circular Hough transforms are used for the segmentation process. The segmented iris is normalized and phase data is extracted by applying Log-Grabor filter [32] and encoded shrewdly to produce the refined vector feature through phase quantization method [33]. The iris from real eye object has been extracted after undergoing segmentation, normalization and quantization process as shown in Figure 6. Unless the iris area has been effectively segmented from the eye object, the next step is to turn the iris region in such a manner that it has set measurements to enable comparisons [34]. Dimensional incoherence [35], between eye images are mainly because of the iris stretching caused by the dilation of pupils from different luminance levels. Other sources of inconsistency include varying imaging distance,

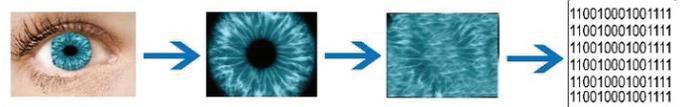


Figure 4: Segmented and Normalization discrete bit formation.

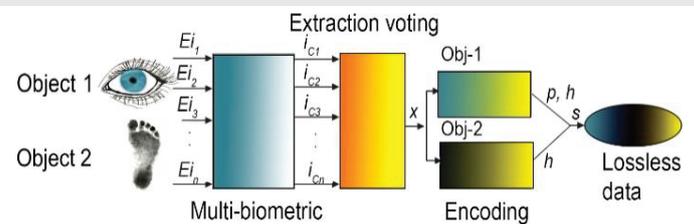


Figure 5: Proposed multi-biometric object processing mechanism.

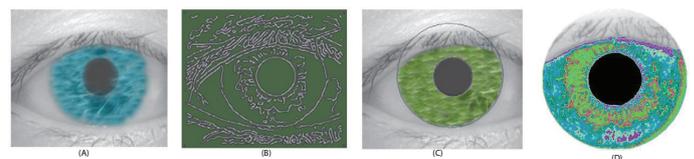


Figure 6: Extracting iris from eye object after segmentation, normalization and quantization processes phases.

- (a) The real object.
- (b) Sagacious edge detection.
- (c) Hough transform results.
- (d) multi biometric extracted iris.

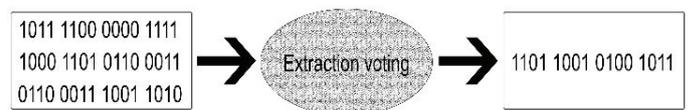


Figure 7: Extracting voting mechanism.

camera rotation, head tilt and eye rotation within the socket of the eye. Construction outcomes of individual iris code x from n number of iris code are achieved using a specific procedure named extraction vote. Figure 7, explains the fabrication of these unique iris x from three sample iris codes. The sparse parity test matrix is used to

describe multi-biometric codes. This small matrix is often generated at random, depending on the sparsity limitations [36]. Referring Figure 5, The valid message bits are processed by the multi-biometric phase when satisfy the condition thereby extraction voting occurs. After creating a specific iris code x , each column in iris code x is considered to be a message in multi-biometric encoding and encoded to render ECIC with the aid of generator values. The special iris code x is converted into hash h , often referred to as cancellable iris code. Table 2 shows factual score, imposter score and threshold value for object 1 and 2 respectively. The Iris and foot biometrics were

tested individually and Table 3 show False Accept Rate (FAR) [4], and False Reject Rate (FRR) [37], of Iris and foot. The weight of all individual iris and foot modalities was calculated, shown in Table 4. Iris recognition and foot recognition algorithms produced dissimilarity scores [38].



The Min-Max normalization technique [39], was used to convert all dissimilar data into similar data shown in Table 5.

Iris and foot fusion mechanism

By adopting weighted sum rule procedure, the matching scores generated for both modalities are fused and combined matching scores are generated as Equation 1.

$$S = (w_1 * I) + (w_2 * F) \tag{1}$$

Considering S as a final score obtained by averaging and then adding the scores of iris (I) and foot (F). If the results match successfully, person will eventually be verified, otherwise, depending on the matching score.

Table 6 shows the weight value of iris and foot after the fusion of two traits.

Matching score was calculated for two modalities using their weight Table 7 shows the matching score for combination of two traits iris and foot.

Performance and results

For getting performance results, nearabout 100 sampling objects (eye and foot) among 500 images were considered.

Table 2: The factual score, Imposter score and Threshold value for iris and foot images.

Traits	Genuine Score	Imposter Score	Threshold Value
Iris	1.7121E+04	1.9082E+04	1.7330E+04
Foot	2.2277E+04	2.6613E+04	2.2325E+04

Table 3: FAR and FRR for iris and foot images.

Traits	FAR	FRR
Iris	1.1010E+00	9.8793E-01
Foot	1.1921E+00	9.9785E-01

Table 4: Weight for all Modalities.

Traits	Weight
Iris	0.89
Foot	0.83

Table 5: Normalized Score.

Traits	Normalized Score
Iris	0.05
Foot	0.07

Table 6: Weight for each Trait in Fusion of two Traits.

Traits	Iris	Foot
Iris + Foot	0.517	0.482

Table 7: Matching Score for each Trait after fusion.

Traits	Score
Iris + Foot	0.292

For each iris object, the four samples were taken for multi-biometric process. The remainder of the iris representation in the repository is linked to the other iris in the authentication process. A total number of $(500 \times 499) / 2 = 124,750$ comparisons were made, out of which 345 intra-group matches were found and another 116,602 inter-group matches were recorded. Figure 8, exhibits a total intra-group and inter-group distribution. It has been observed that travers between intra-group and Inter-group is exorbitant and the portion occurring between the intra-class and the inter-class is quite trivial, thereby nearly 100% of the right identification levels are obtained. In-order to determine the error correction capacity of D-nb, Reed Solomon (RS) [40], code is being applied which eventually generate the results as illustrated in Figure 9. The selected RS and D-nb curves overlaid on top of the real and impostor normalized HD distributions. RS correction curves are also notably lower than the D-nb curves. In comparison, the RS encoding is often less granular than the D-nb. It leads in efficiency loss, with the False Rejection Rate (FRR) and the False Acceptance Rate (FAR) levels.

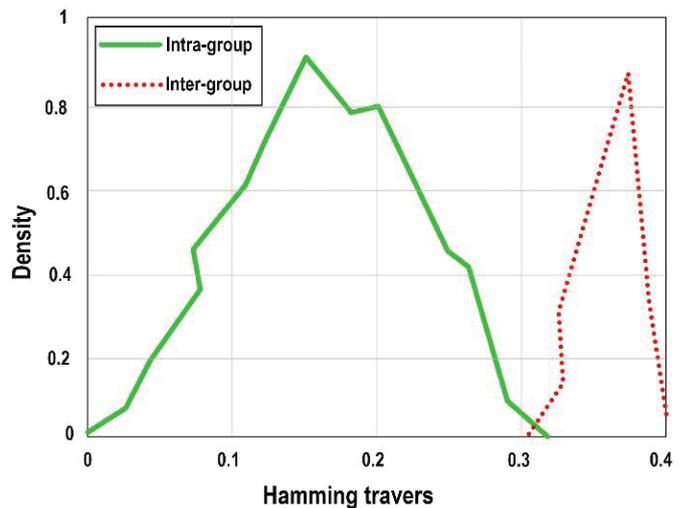


Figure 8: Intra and inter-group travers distribution.

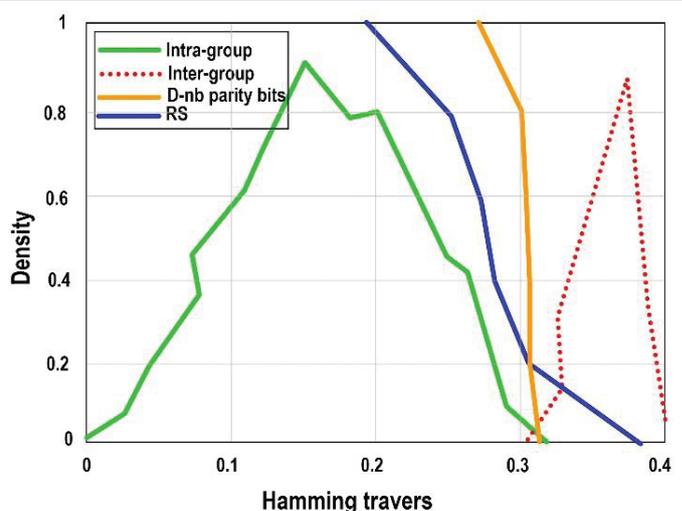


Figure 9: Determination if error correction mechanism.



Conclusion

The multi-biometric system employed biometric features of iris and foot. For hamming archways and sequential modified classifier approaches of haar transformation, weight was calculated of each biometric element. After normalization, the knowledge was combined. The Iris is divided into an easy and quick technique, based on the Sagacious edge detector and Hough transformation. For other approaches, the actual FRR and FAR are 2.0 and 0.38 %, while the FRR and FAR suggested by D-nb are 1.87 and 0.365 percent. Due to the improved steepness and granularity properties, D-nb codes have shown to result in better recognition performance than RS codes. The framework uses D-nb codes for lower FRR and FAR.

As a conclusion, it can be claimed that, compared to other reported technologies, the proposed system cam up with 98% accurate and shrewd performance in terms of reliability, accuracy and continuity.

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