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DEVELOPING A MULTI MODAL BIOMETRIC FRAMEWORK EMPLOYING THE PRINCIPLE COMPONENT ANALYSIS (PCA) IN CONJUNCTION WITH EDGE DETECTION TECHNIQUE TO ENHANCE THE EFFICACY OF SECURITY FEATURES.

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ABSTRACT

Biometrics is the ever growing field of development that has rendered itself useful in various businesses and human identity recognition. The occasional lapse in the security over the recent years has even more necessitated the work in this field. The biometric device is defined as an object that can essentially distinguish one individual from other on the basis of his or her distinctive characteristic trait, that can be behavioural like walking, speaking or aesthetic or physical trait like eyes, fingerprints, tongue prints to name a few. The existent works depend on what are called uni-modal biometric frameworks which rely on just one trait. Here in this paper we are trying to evolve from the existing framework onto a multi-modal bio-metric frameworkand further delineate the advantages of implementing such a multi-dimensional and integrated platform. Additionally, the works of scholars are reviewed and presented with much more fine-tuning. Lastly, the paper concludes with the implementation of Principal Component Analysis and Edge Detection, as the methodologies for the detection of iris and ears.

I. INTRODUCTION

Biometrics is the area of scientific development, deployed for evaluating and analysing at the personal data. In information progression, Biometrics from time to time refers to for assessing and researching human body characteristics, for instance, eye retinas and irises, fingerprints, facial models, voice plans and hand estimations, especially for ratification purposes. Biometrics is used for expelling a rundown of capacities from the obtained data, and contrasting out this set from the intelligent irregularity of the model set, in the database. The biometric blend can be portrayed, as the execution of various sorts of biometric data for improving the presentation of biometric systems. An ideal Biometric should be comprehensive, unique, and reliable, after some time that is not hard to evaluate, in like manner low in costs, and have excellent customer affirmation. However, with the current state of the art technology and progress, no single Biometric can fulfil all of these necessities

all together, at once. As an example, retina and fingerprints are known to be unique, yet they require committed sensors and are challenging to get at. Of course, voice and facemask geometry are holistic on their own per se, yet they require only an inexpensive receptor (for voice) or a camera (for facial detection) as a sensor, and they are inconspicuous. In like manner, an adequate blend of a couple of complementary Biometrics can give higher affirmation precision than any individual biometric alone. Multimodal biometric systems, hence are the need of the generation as they are perceived to perform better than uni-secluded biometric structures as it overcomes the shortcomings of a single biometric system. The most employed remarkable authentication technology is in criminology, which is used to recognize criminals. The individual ID makes it possible to intercept the crooks accurately. Describing the unmistakable evidence, of a criminal individual is inconvenient. The biometric structure has now been used in the distinctive business and quantifiable applications. These Biometrics are exceedingly reliant on the speech, signals, fingerprints, ear, hand geometry, iris, retina, face to name a few body structures. Previously, most of the systems in place were uni-modal. The authentications systems based on iris recognition are irrefutable the most consistent systems in the world. The chances of finding two people with similar iris is practically zero. The peculiarity of each individual iris, is even astonishing, to the extent that the left and right iris of a single person is different. Iris, differs from fingerprint in the senses that its protected by eyelids from external effects. Hence in this paper we plan to explore these advantages of iris to develop a reliable bio-metric authentication system.

1. Biometric System

Usually, the following features are an integral incumbency of any confirmation Biometric system:

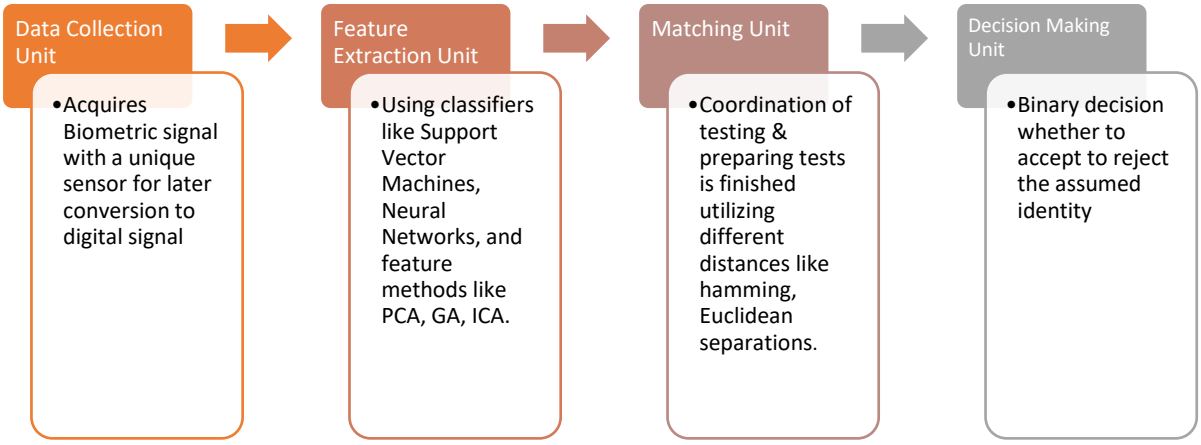

Fig. (a) Biometric System

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2. Mutli-Modal System

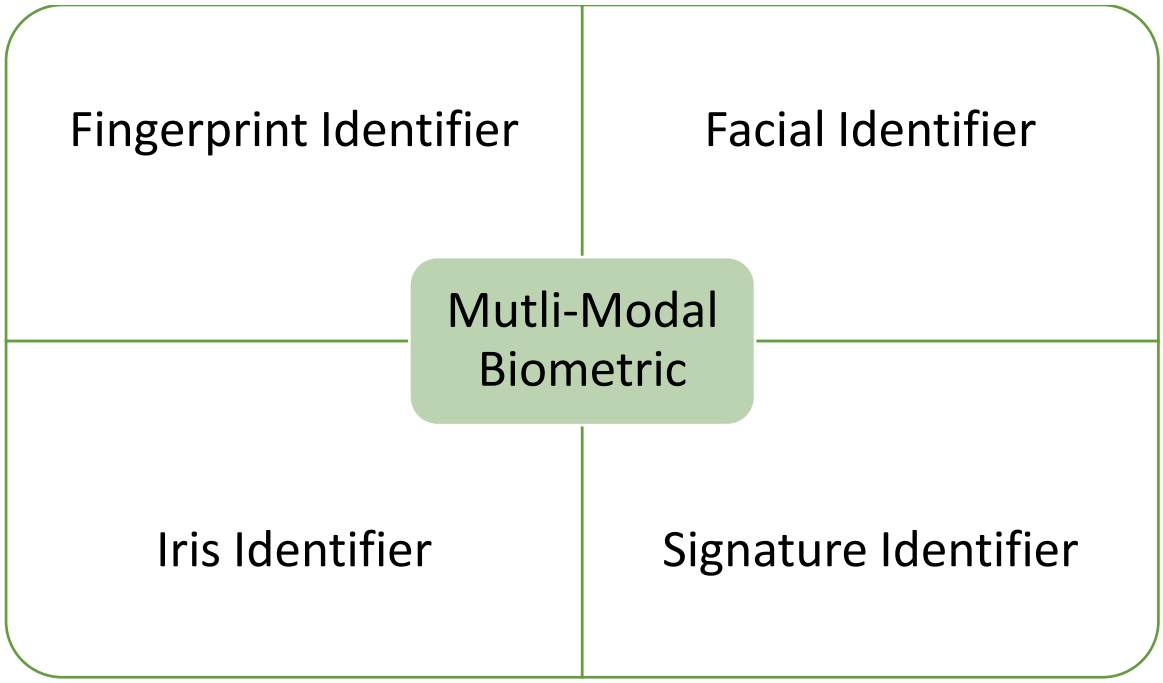


Fig (b): Multi-modal Recognition System

Use of various bio-measurements markers for recognizing individuals is known as multi-modular bio-metrics. In the multi-modular bio-metric systems, at first, the solitary bio-measurement structures are run, then the resulting mix is made using various counts to improve the potential of the structure. Two parameters FRR (False Rejection Rate, probability that the system rejects the print given the identity is true) & FAR (False Acceptance Rate, the probability that the system accepts the identity given it is false) are peculiar to this process, both of which are very much reliant on the biometric factor that is in place and its technical implementation.

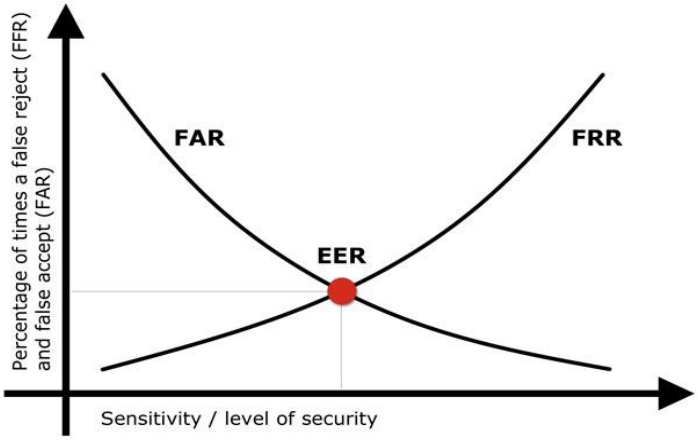
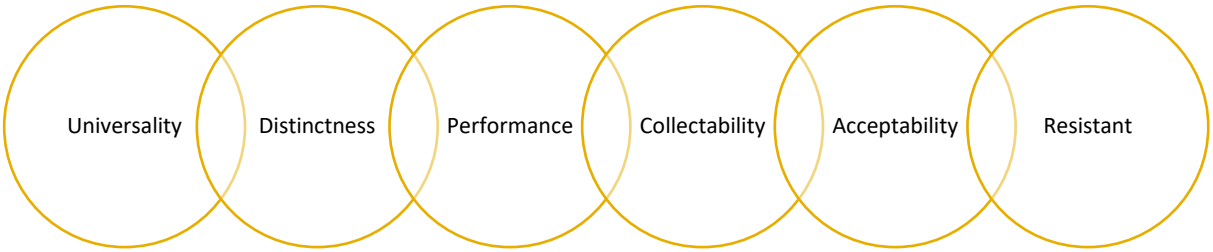


Figure (c) FAR versus FRR

If negative results outweigh the positive results, the system might be insufficient and incorrect. There are various levels where blend happens, like decision level, sensor level, organizing score level and extraction level. Bio-metric features are portrayed into two areas like physiological (hands, iris, face, veins) and social (forming style, speech, step, unique features). If blend of physiological and social features is utilized, by then execution rate can be improved. They can be used as long as the bio-metrics can encapsulate and satisfy the going with essential features like:



The association of bio-metric qualities prompts the progression of the presentations by diminishing the negative results. For instance, blend of ear and iris is progressively more genuine in deployment together than the use of just ear or iris model. Principal circumstances favouring the use multi modular structures are decline in cost and unpredictability. This is a result of the going with traits:

- Blend of modalities must occur in coherent way.
- Quick Response time technique is implemented
- Idiosyncrasy of various modals
- Varying measure for accurate judjement
- Expense is relabibily measure in monetary (currency), time (like hours, seconds) or any other unit

II. RELATED WORK

Kumar et. al. (2012)determined a fresh procedure using tweaked identity of a human by applying two dimensional ear-imaging. Herein, they showed a completely autonomous system suggested for the sturdy reduction into smaller parts of the circular region including the Fourier. descriptors. They furthermore, scrutinized a different component extraction approach prepared for ear ID, by applying constrained bearing data, similarly as in like manner, (image processing filters)Gabor filters implementation to detect localized grey-level stage data. Their assessment work led to a computationally adroit plus an amazing extra to

conclude the quickly summoned ear pictures utilizing a couple of Log-Gabor channels. Their results achieved a precision of ninety-five point nine three & ninety-six point two seven percentages on a database of one hundred twenty-five and two hundred twenty-one subjects, respectively. Their preliminary results, began the affirmation tests and negative confidence identification versus the actual negative identification lionized the planned technique over and above the feature removal method.

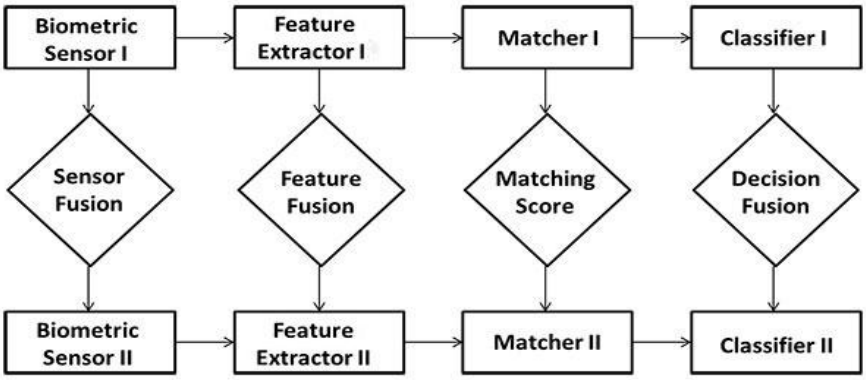


Figure (c) Multimodal versus Unimodal

Ashraf Aboshoshaet. al. (2015) portrayed that there were various issues in single bio metric system, for instance, fake attacks, no comprehensiveness as well as inconsistency of data and uproarious data. To handle these sorts of issues multiple bio-metric system was called forward. Multi- modular bio-metric structure uses, in any event, two specific modalities. They used three different properties namely-face, iris and fingerprints. The scores obtained from classifiers were normalized using min-max normalization process. A Product and weighted sum were used to obtain the final sum. The conclusion championed multi-modal bio-metric systems over the uni-modal ones and that the sum/product method was naive compared to that given by weighted sum method.

D. Garje1 et. al. (2012) showed that bio-metric identity structures that encapsulated aesthetic features and characteristics to perceive someone'sbehaviour, maintains a much higher standard of security rather than just pure reliance on complex number or alpha-numeric systems. Multi-modal bio-metric structure in all things considered, sensibly should be deployed on a quite a larger scale, as they trump, with respect to the uni-modal bio-metric, in terms of their reduced failure rate and can encompass a bigger population i.e. scan through it really quickly. Multi-bio-metric distinctive verification structure, intends to interweaved iris and other interesting imprint characteristics. A separate template is generated each for iris and a fingerprint which can be easily retrieved from a database. Reasoning proposed here is, for one of a kind imprint confirmation, to allow subtleties from finger impression pictures. It allowed to accomplish fantastically high quality and exceptional finger impression affirmation, even for low-quality fingerprints. Over the range of iris recognition, pictures are

institutionalized, traits are as remarkably segmented as the segments themselves, via the Log-Gabor filter. Lastly the hamming distance completed the matching process. The recognition of each and individual, fingerprint and iris templates led to the summation via an internally defined algorithm, which can potentially raise the overall rate and accuracy of prediction. It is imperative that it this system when used will lead be reliable as well as to the point

Anikaet. al. (2012) have clarified the arrangement and compactness approaches to manage ear revelation and affirmation in two dimensional and three dimensional pictures. By then, they gave a perspective over possible future research in the field of ear affirmation, in the setting of insightful perception and quantifiable picture examination, which they viewed as the most basic utilization of ear affirmation trademark within the near future.

III. COMMON TECHNIQUES

A. Feature Extraction using Principle Component Analysis

The unbiased estimator of sample variance is given by:

$$\begin{aligned}\sigma_x^2 &= \frac{1}{N-1}\sum_{i=1}^{N}(x_i-\mu)^2 \\ &= \mathbb{E}[(x-\mathbb{E}(x))(x-\mathbb{E}(x))] \\ &= \sigma(x,x)\end{aligned}$$

The explain the correlation between variance between orthogonal axis (x and y) we need a correlation that can be captured by extending this notion to find their ‘covarince’:

$$\sigma(x,y) = \mathbb{E}[(x-\mathbb{E}(x))(y-\mathbb{E}(y))]$$

The matrix obtained as such is called the covarince matrix:

$$\Sigma = \begin{bmatrix}\sigma(x,x) & \sigma(x,y)\\ \sigma(y,x) & \sigma(y,y)\end{bmatrix}$$

The covarince matrix obtained as such represented by its eigenvectors and eigenvalues is given by:

$$\Sigma\vec{v} = \lambda\vec{v}$$

where $\vec{v}$ is the eigen vector of Σ and λ is the corresponding eigenvalue

For PCA:

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1. The eigendecomposition extracts the transformation matrices: eigenvectors give the rotation matrix and eigen values are corresponding scalar values. So, to apply PCA, the exisiting shift already present in data must be accounted for by subtracting the mean of data from each point. This corresponds to centering the data around its mean. We each image vector contributed to mean image vector.
2. Normalizing the data, i.e. converting the data by dividing by its standard deviation. The resultant data will be scale-independent. The 2-dimensional iris region data is converted to a vector by joininh each row (or column) into a long vector.
3. The eigendecomposition is obtained in order to reduce the dimensionality. The effiecient method to do so is Singular Value Decomposition, which is the factorization of a real or complex matrix.
4. To reduce the dimensionality, the data is projected to the largest eigenvectors.

V = Matix with columns that have largest eigenvectors

D = orignal data with different observations

Then,

$D' = V^\intercal D$, represents the projected data

If we keep only N eigenvectors then $e_1 \cdots e_N$ correspond to their eigenvalues, the left over variance after projecting the orignal Dimensional data d is given by:

$$s = \frac{\sum_{i=0}^{N} e_i}{\sum_{j=0}^{d} e_j}$$

B. Edge Detection

It is strategy of detecting and locating the discontinuities in the picture. Edges in pictures are zones with solid power contrasts – a hop in fixation from one pixel to the next. Edge distinguishing a picture essentially lessens the measure of information and sift through pointless data, while defends the basic auxiliary properties in a picture. Earlier, there are numerous strategies like 2-D Filter, in which slopes are developed to get the edges of a picture. Variable can be improved to get slant, vertical and level edges. Canny Edge Detector is the epitome of all tools used in image processing and is considered to be robust and optimal.

The procedure is:

1. Blur the image to smoothen it and remove unnecessary noise.
2. The derivatives are computed in each direction $D_x = d[f(x,y)]/dx$ and $D_y = d[f(x,y)]/dy$ for the image on both the axis.
   The angle of the magnitude and its magnitude is given by:

$D = \sqrt{(Dx) * (Dx) + (Dy) * (Dy)}$ *and* $\emptyset = \tan^{-1}(\frac{Dy}{Dx})$

3. Retaining the pixel with highest gradient magnitude as the edge. The local maxima are quantified as the 'edge' and the gradient steeply reduces as we navigate towards the centre of the image.
4. Threshold values delineate the edges of the image.
5. The graph, *G(V, E)* in which the Edges *E* don't appear to be strongly connected are suppressed. Canny operator basically is a good method to use even for noisy images as it considers weak edges in the final output if and only if it has a significance connectedness to a strong edge.

IV. IMPLEMENTATION PROBLEMS AND FUTURE WORK

Humans continuously evolve over time, which can lead to aesthetic variations. This calls for a consistent 'feedback' system that can acknowledge these changes of human body and correspondingly substitute these new recognized identities, for the older and obsolete identities. There are a few restrictions that are overwhelmed by the multi modal bio metric frameworks. However, the multi-modal bio-metric frameworks are costlier than the uni-modular bio-metric frameworks. This is the main disservice, that depends primarily on the multi modal frameworks. Likewise, in the event that appropriate combination does not happen of various qualities, at that point, it can likewise prompt more terrible bio metric framework. The design impediments include budget, efficiency, robustness, integration and overhead constraints. It's imperative to determine the number of features to be included in the system (to determine a unique identity) as well as how to work them together.

V. CONCLUSION

We have efficiently championed the advantages of multi-modal and unimodal biometric systems and described various tools and techniques that can be put to use for the implementation of iris and ears as the unique identifiers for the recognition of different human beings. Also, the hindrance caused for by the eyelashes and eyelid stands unaccounted for.

The paper sets the base for the future implementation of much more advanced tools and techniques, that apply even more intricate and advanced procedures like using Particle Swarm Optimization and various Genetic Algorithms like Cat Swarm, Firefly, Flower Pollination Algorithms which are powerful when the number of variables taken into account are large. For multivariate data, we can turn to ICA or Independent Component Analysis, that can get hidden values of random variables.