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Novel Framework for Multimodal Biometric Person Authentication System: A Review

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Abstract: *Multimodal biometric system verifies a person's identity victimization additional than one physiological (face, fingerprint) or behavioral biometric traits (voice, signature). This kind of system aims to extend the irresponsibleness of the biometric system additionally and will increase the security level once compared to the systems developed victimization single biometric attribute. The fusion Uni- multimodal biometric system will take place at varied levels. The Multimodal systems that area unit already existing are face and ear, iris and fingerprint, palm prints and face, etc. Multimodal biometric system developed victimization fingerprint, hand pure mathematics needed the operator to form physical contact with a sensing device. This paper will reviews the two multimodal biometrics i.e. Iris and Ear biometrics in detail with features extraction method and also the recognition process.*

Keywords: *Iris, Ear, Recognition, Multimodal, Biometric System.*

I. INTRODUCTION

Individual character alludes to an arrangement of characteristics (e.g., name, government managed savings number, and so forth.) that are connected with a man. Character administration is the procedure of making, keeping up and differentiates personalities of people in a populace [1]. A solid character administration framework is earnestly required to battle the pandemic development in fraud and to meet the expanded security prerequisites in a mixed bag of utilizations going from global outskirt intersection to getting to individual data. Setting up (deciding or checking) the character of a man is called individual acknowledgment or validation and it is a discriminating errand in any personality administration framework. The three essential approaches to set up the personality of a man are "something you know" (e.g., secret key, individual ID number), "something you convey" (e.g., physical key, ID card) and "something you are".

Biometric authentication systems verify a person's claimed identity from behavioral traits (signature, voice) or physiological traits (face, iris, and ear). Multimodal biometric system overcomes the limitations of unimodal biometric systems such as non-universality, noise in sensed data, spoofing, intra-class variability, inter-class variability [2]. Multimodal biometric system can be constructed using more than one physiological or behavioral characteristic for identification and verification purposes. Most of the existing biometric systems developed were based on single biometric features (fingerprint, ear, face, iris and so on). Each biometric trait has its own strength and weakness.

Some of the problem with fingerprint recognition system is fingerprint images have been observed to have poor ridge details. Similarly, face recognition system fails due to variation in facial expression. Hence while developing biometric systems the choice of biometric traits is important in order to achieve better performance. Multimodal systems available are face and ear [3] face and fingerprint, palm print and face, etc. In this paper, two unique traits iris and ear are used to recognize a better performance and high security.

Any physiological or behavioral feature may be used as a biometric verifier as long as it satisfies the following requirements [4]:

- Universality – every person must own this characteristic.
- Distinctiveness – two persons possessing the same characteristic do not exist.
- Permanence – the characteristic must be invariant for a time period as long as possible.

- Collectability – indicates the fact that biometric may be quantitatively measured;
- Performance – which refers to the accuracy of the tangible recognition, speed, robustness, as well as the prerequisites for touching a certain level of performance;
- Acceptability – indicates the degree in which the given biometric characteristic is accepted by the users;
- Resistance to circumvention – indicates the facility through which a system can avoid fraud.

- **Iris Biometric**

Iris Recognition is the best way of recognition in today's world. There are some features that makes iris recognition high effective and accurate like: stable, unique, flexible, reliable, and non-invasive [5].

Figure.1: Iris Biometric [16]

- **Ear Biometric**

Application of ear recognition in the field of biometrics is a new method. The structure of the ear is robust because it does not change with the facial expressions. The external part of ear constitutes many unique factors like design, peculiarities. The other part of body has not this type of uniqueness [6].

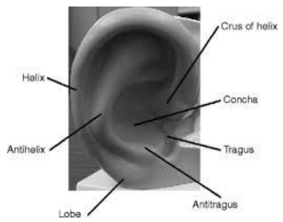

Figure.2 Ear Biometric [16]

II. FEATURE EXTRACTION USING PCA

Principal component analysis is a classic method used for compress higher dimensional data sets to lower dimensional ones for data analysis, apparition, feature extraction, or data compression. PCA involves the calculation of the Eigen value decomposition of a data covariance medium or singular value decay of a data matrix, usually after mean centering the data for each attribute [7].

Step 1: Get normalizes data from the iris regions. 2-D iris image is represent as 1-D Vector by concatenating each row (or Column) into a long vector

Step 2: Take away the mean image from each image vector.

Step 3: Compute the covariance matrix.

Step 4: Analyze the eigenvectors and Eigen values of the covariance matrix.

Step 5: The eigenvectors are sorted from high to low according to their corresponding Eigen values. Choose components and forming a feature vector

Step 6: Derive the new data set once we have chosen the components, we simply take the transpose of the vector and increase it on the left of the original data set, transposed.

Final Dataset = RowFeatureVector x Row Mean Adjust

Where RowFeatureVector is the matrix with the eigenvectors in the columns transposed so that the eigenvectors are now in the rows, with the most major eigenvector at the top, and RowMeanAdjust is the mean used to data transposed. The data items are in each editorial, with each row holding a split dimension. Principal components analysis is basically useful for dropping the number of variables that consists a dataset while retaining the contradiction in the data and to identify unknown patterns in the data and to classify them according to how much of the information, stored in the data, they report for.

PCA allows scheming a linear alteration that maps in order as of a high dimensional space to a lower dimensional space [8].

$$b_1 = t_{11}a_1 + \dots\dots\dots T_{1n}a_N$$

$$b_2 = t_{21}a_1 + \dots\dots\dots T_{2n}a_N$$

$$b_k = t_{K1}a_1 + \dots\dots\dots T_{13n}a_N$$

Linear transformation implied by PCA.

III. SCORE LEVEL FUSION

The match score is a measure of similarity between the input and template biometric component vectors. At the point when match scores given by distinctive biometric matchers are merged this is otherwise called fusion at the estimation level or certainty level [9]. Match score is define as the result of comparing two features set that are extracted from the same feature extractor. Two scores are generated one is similar score and other is distance score. Similar score tell the similarity between the two feature sets and distance score tell how different the two feature sets are.

Aside from the raw data and feature vectors, the match scores contain the richest data about the input pattern. Additionally, it is generally simple to get to and join the scores created by diverse biometric matchers [10]. Therefore, data combination at the match score level is the most generally utilized approach as a part of multi-biometric frameworks. In score level fusion the match score output by multiple biometric matchers are joined together to produce a new match score. This match score then further used for verification and identification modules for deliver a decision about identity of a person.

It must be noticed that the match scores created by the individual matchers may not be homogeneous [11]. For instance, one matcher may give a separation or difference measure (a littler separation shows a superior match) while another may yield a similitude measure (a bigger comparability worth demonstrates a superior match). Besides, the yields of the individual matchers require not be on the same numerical scale (range). At long last, the match scores may take after distinctive likelihood dispersions [12]. These three components make match score level combination a testing issue. Probability distributions [12]. These three factors make match score level fusion a challenging problem.

IV. EUCLIDEAN DISTANCE

The most of these image segmentation techniques are based on classical (e.g. Euclidean) metrics. Using a ”faster” distance function with lower threshold levels and a “slower” distance function with a higher one, similar results can be obtained. The Euclidean distance or Euclidean metric is the "ordinary" distance between two points in Euclidean space that one would measure with a ruler, and is given by the Pythagorean formula. By using this formula as distance, Euclidean space (or even any inner product space) becomes a metric space [13].

The Euclidean Distance between two points like P and Q is given by:

$Q - P = (Q_1 – P_1, Q2 - P2… Q_N – P_N)$

V. BFO OPTIMIZATION

Bacterial Foraging Optimization Algorithm is an optimization algorithm which reduces the noise, features selected, unnecessary data and gives the high accuracy. Kelvin M Passino invented the BFO algorithm. It is basically a feature selection algorithm that led to following objectives [14]:

- bound storage necessities, increase speed of processing
- Performance enhancement to achieve high correctness
- Exploitation of full resources.
- Improving identification rate

The BFO process can be divided into mainly three parts a. chemotaxis b. reproduction and c. elimination and dispersal.

a) **Chemotaxis**: It is the behavior of the bacteria in which it tries to avoid the deadly substance and then move forward to search nutrients by hiking towards high nutrient area. So it involves two steps:

1. Unidirectional movement
2. Topple

In the unidirectional movement it moves only in one direction whereas in topple step it moves in other direction rather than unidirectional direction. There is a limit in number of steps to survey entire search space. Suppose Q_0 (p, q, r) be the position of oth bacterium at pth chemotactic, qth reproductive and rth elimination.

Fitness function, denoted as P (o, p, q, r), will be evaluated for each step of run or topple in the chemotactic procedure.

b) **Reproduction:** The fitness of every bacterium is calculated as the computation of the step fitness throughout its time, namely,

$$P^o (Fitness) = \sum^{m+1} P(o, p, q, r)$$

Where m is amount of chemotactic steps.

c) **Elimination and dispersion:** Only Reproduction and chemotactic are not enough for universal optima exploration. Elimination and dispersion of reproductive steps are also required to move to another direction [15].

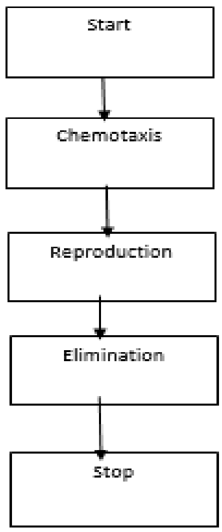

Figure.3 BFO Flowchart [15]

ALGORITHM

Step 1	**:**	Initialize parameters j, S, M, M_8, M_ed, J_ed, Z(o) (o=1,. . . ,S), Θ_o
Step 2	**:**	Elimination-dispersal loop: q=q+1
Step 3	**:**	Reproduction loop: r=r+1
Step 4	**:**	Chemotaxis loop: p=p+1

- For o =1,. . . ,S take a chemotactic step for bacterium o as follows.
- Compute fitness function, P (o, p, q, r):

P(o, p, q, r) = P(o, p, q, r) + P(Θ_o (p, q, r), T(p, q, r))

Let

P_{last} = P(o, p, q, r)

Compute P (o, p+1,q,r) and

let P(o, p, q, r) = P(o, p, q, r) + P(Θ_o (p, q, r), Z(p, q, r))

Swim

Let n=0 (offset for swim length).

While n < M (if have not climbed down too long)

i. Let, n = n + 1
ii. If P(o,p+1,q,r)< P_{last} (if doing better), let P_{last} = P(o, p + 1, q, r)
iii. Else, let This is the end of the while statement.

Step 5 : If p < M, go to step 4. In this case keep on chemotaxis because the life of the bacteria is not ended.

Step 6 : Reproduction

P^o (Fitness) $= \sum^{m+1}$ P(o, p, q, r)

Step 7 : If q < M, go to step 3

Step 8 : Elimination-dispersal: For o= 1. . . S with probability P_{ed}

VI. CONCLUSION AND FUTURE SCOPE

In this paper, the iris and ear recognition algorithm based on PCA (Principal Component Analysis) is first introduced and then, matching technique based on Euclidean distance is given. After this BFO optimization has been introduced in this paper. This paper gives the future work for implementation.

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