Ameliorating the Accuracy and Mitigating the Error rate of Multimodal biometrics using Minimum Cost Matcher and Autoencoder

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ABSTRACT*—In present era, enhancing the fast and accurate recognition of an individual is becoming the prominent role. Multimodal biometrics addresses different vulnerabilities of single modal biometrics and achieves the better recognition accuracy. Multimodal biometrics gains the attention of fusion of two or more traits for accurate recognition of an individual. Intruders face the difficult situation in hacking the multimodal biometric template as it gives the hard time for intruders to gain the information simultaneously. This fusion helps to enhance recognition rate of an individual and also achieves the safe strategy. Eye biometric is adaptable for providing security in large scale applications. This paper focuses on enhancing fast and accurate recognition of an individual by mitigating the recognition error rate. This paper addresses the feature level fusion of retina and iris of an individual. These biometric features are extracted through Gray level co-occurrence matrix and the deep learners of unsupervised technique Autoencoder. Minimum Cost Matching method enhances the accuracy rate of individual with a minimal error rate. MCM achieves the high matching scores when it is compared with the various traditional similarity and dissimilarity measures.*

Keywords*--Autoencoder, fusion, Gray Level Co-occurrence Matrix (GLCM), Iris recognition, Multimodal biometrics, Retina recognition.*

I. INTRODUCTION

In present world, Security is gained through biometrics, that is a science of measuring different physical and behavioral traits of an individual like Finger, Face, Iris, Retina, Voice, DNA. As unimodal biometric system is facing different vulnerabilities due to lack of universality, lack of distinctiveness ability, lack of security for biometric template and trouble with sensors. The above issues are overcome by the multimodal biometrics as the information cannot get hacked by the intruder simultaneously. Among all the physical traits iris and retinal blood vessel structure have the unique identification features to identify the authorized individual. The fusion of biometric traits resists towards spoofing that cannot get compromised by the intruders so easily, gains high level flexibility and also enhances the authentication rate of an individual. Since for this reason many of researchers gained attention to this respective field.

Moderrasi and Oveisi[1] proposed a multimodal biometrics by fusion of iris and retina features using the contourlet transform. Ching-Han Chen and Chia Te Chu [2] fused the iris and face biometric traits for multimodal biometrics. Kavitha and Radha[3] integrated the iris and retina using rank level fusion. Mohana prakash.et.al [4]

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has developed a system of multimodal biometric using feature and score level fusion. Ryszard S. Choras[5] made the fusion of iris and retinal images for multimodal personal authentication. Meenakshi and padmavathi[6] proposed a multimodal biometric modal using the fuzzy vault. Nouar LARBI and Nasreddine TALEB [7] developed a new method called Phase-based Gabor Fisher Classifier (PBGFC) for feature extraction of iris and face to build a robust multimodal biometric system. FardinMirzapouret.al [8] performed classification on PAN images. Yulin Si et.al[9] enhanced the overall performance of the system through minimizing the effect of eye edge. Darabkh et.al[10] innovated the new strategies for iris recognition patterns Nath et.al[11] protected template of iris using stenography.

The inspiration driving the current work is a direct result to enhance solidness through disparity with few basic biometric traits. Incorporating the deep learning techniques and MCM enhance the accuracy of the current work with a low error. In this paper, we proposed the reconstruct able combined element guide for the feature level fusion of retina and iris traits using similarity matcher and deep learning methods [12]. The paper is sorted out as pursues. Category 2 elaborates the current work. Category 3 shows the arrangement of examinations did on retina and iris datasets, at long last, Category 4 results in conclusion.

II. METHODOLOGY

Multimodal biometrics apprehends distinct traits as a uni feature to perform the accurate recognition of an individual. The proposed system illustrates the feature level amalgam of iris and retina traits. The process carried out in the following steps.

Step 1: Image Acquisition and Preprocessing

The images are apprehended from DRIVE and CASIA datasets and converted into grayscale images. In preprocessing the unwanted area around the iris such as eyelashes and eyelids are removed for localization using Gabor technique. The krish operator is applied on the retina images to remove the noisy data and highlight the blood vessels edges.

Step 2: Feature Extraction

An indistinguishable structure is shaped at whatever point light goes into eye. The standardized retinal picture for vigorous extraction of features and achieves deeper representation of the picture with error reduction. Retina's profound highlights are remade with autoencoder. The deeper neuron structure is obtained using the autoencoder. Iris extraction helps in identifying the individual in an effective way. Iris for accurate texture extraction is done through gray level co-occurrence matrix. As it relays on the neighborhood gray level values .(r,s)th component within the grid investigates the likelihood as concerns moving r gray level value to s gray level value an incentive beneath of foreordained edge and separation and derives the feature vectors. "Mathematical statement (1)" represents the energy, "(2)" results in entropy, relationship coefficient are estimated for productive shape depiction, neighborhood change and investigating the shadow intensity through "(3)", displaying the unpredictability along with the level of relationship of factors defined by " (4)". Finally, the texture of iris is obtained by " (5) and (6.)"

$$A=\sum_{r=1}\sum_{s=1}(f(r,s))^2 \qquad (1)$$

$$R=\sum\sum(b-c)^2 f(b,c) \quad (2)$$

$$S=\sum_b\sum_c f(b,c)\log f(b,c) \quad (3)$$

$$Q=\sum\sum((B-\mu B)(C-\mu C)f(B,C)/\sigma_B\sigma_C \quad (4)$$

$$D= B+B^T \quad (5)$$

$$E= d(m,n)/ sum(d) \quad (6)$$

where m, n=0,1,2,3…. l

Step 3: Fusion and Dimensionality reduction

Horizontal concatenation is applied on the iris and retina traits in the feature level. Autoencoder is employed on the fused template for dimensionality reduction.

Step 4: Matching

Minimum Cost Matcher(MCM) is a exact matcher that employed on registered and query fused templates of iris and retina for evaluating the high level accuracy of an individual.

III. IMPLEMENTATION RESULTS

The proposed multimodal biometric traits i.e. iris and retina of an individual accuracy is determined by accepting CASIA and DRIVE datasets with 500 picture tests of iris and 500 pictures of the retina. Procured picture of jpg sizes of iris 310*260 pixels and retina of tif format of size 455* 464 group. Iris texture and retina blood vessel are extracted through GLCM and autoencoder techniques. After fusion, autoencoder is applied for the dimensionality reduction. Finally, the encoded template is stored into the database. Minimum Cost Matching is performed for obtaining the accurate matching scores. Here we considered the column wise elimination. Opt the least value of the column and allocate the maximum value of the area calculated for each cell correspondent to each column's minimal value. At that point the designated segment is disposed of. Finally, every one of the qualities in the last section are dispensed by relating to the minimum supply or demand. Continue this procedure with all segments in the network till different sources get fulfilled to different separations that achieves minimal cost. MCM is raised from Monge separation technique.

"Equation (7)" results the distance matrix from fused query matrix and enrolled matrix.

$$s_{p,q}=|e_p - r_q| \quad (7)$$

$s_{p,q}$ refers to distance between the enrolled and tested fused matrices, "e_p", "r_q"are the normalized feature vectors. To authenticate the user set the threshold value with low cost and minimum repetitions and accuracy is measured through calculating the in Equal Error Rate(EER) by equalizing the False Acceptance Rate (FAR) and False Rejection Rate(FRR) formulated in "(8) and (9)". "Fig 1 and 2" depicts the False Matching Rate and False Rejection Rate curves of fusion iris and retina images. Equal Error Rate is represented by the "Fig 3". "Fig 4" illustrates the accuracy of the current work.MCM is related with the various traditional similar and dissimilarity matching techniques and gained high level accuracy depicted in "Fig5".

$$EER= \frac{FAR+FRR}{2} \quad (8)$$

$$Accuracy=100-EER \quad (9)$$

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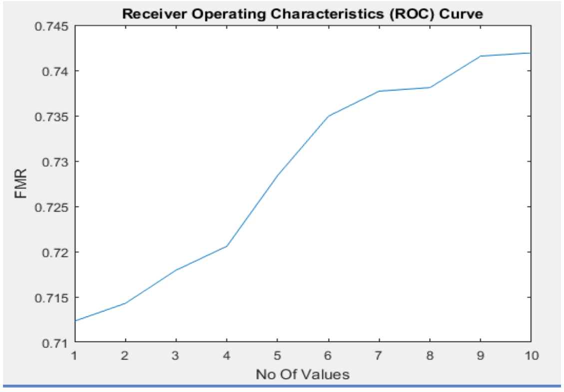

Figure 1: False Matching Rate of current system when MCM is operated

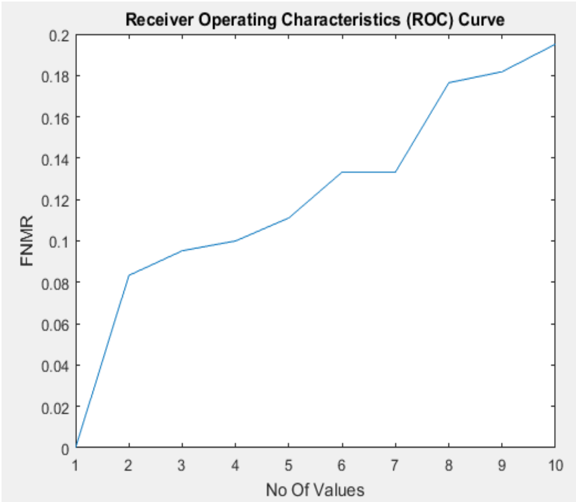

Figure 2: False Rejection Rate of current system when MCM is operated

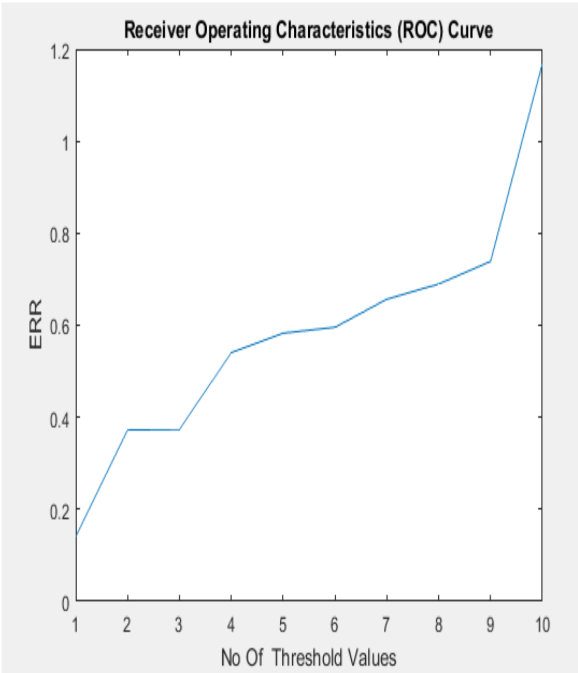

Figure 3: Equal Error Rate of current system when MCM is operated

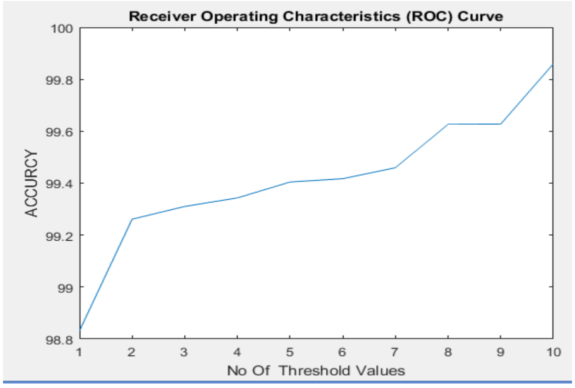

Figure 4: Roc curve for accuracy of fused iris and retina recognition system

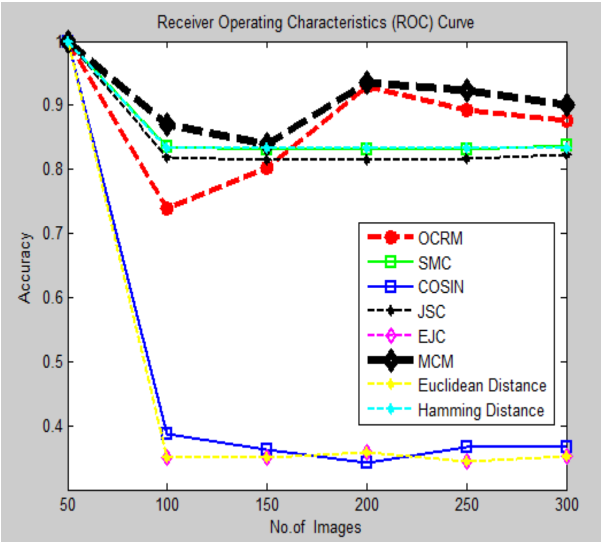

Figure 5: High accuracy of current system when MCM is compared to traditional methods

IV. CONCLUSION

Iris and retina biometric traits have the high uniqueness contrasted with various attributes of biometrics. The current work represents the fusion of iris and retina traits of an individual that mitigates the error rate and enhances the accuracy of recognition. GLCM (Gray Level Co-Event Matrix) and Autoencoder(AE) are applied for retrieving the features of retina and iris. Profound representations of the retinal blood vessels are extracted through autoencoder and also help in dimensionality reduction when it is employed on fused iris and retina biometric traits. Minimum Cost Matcher (MCM) enhances the accuracy of the recognition rate with minimum no of iterations and requiring little effort. Finally, the proposed system deals with the mocking assaults with minimal error.

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