Finger Vein Recognition based on PCA Feature Using Artificial Neural Network

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Abstract- Personal recognition technology is developing rapidly as a security system. Traditional methods such as authentication key; password: card is not secure enough, because they could be stolen or easily forget. Biometrics has been applied to a wide range of systems. According to various researchers, vein biometrics was a good technique from other biometric authentication system used, such as fingerprints, hand geometry, voice, etc. of the DNA. Root Authentication systems can be designed in different ways. All methods include the matching stage. A neural network is an effective way of matching Personal identification authentication system. The finger vein pattern is unique biometric identity of the human beings. The finger vein recognition is a popular biometric technique which is used for authentication purposes in various applications. In the propose work an algorithm is proposed to find the accuracy, FRR and FAR of finger vein recognition. The performances of PCA, threshold segmentation, pre-processing and testing & training techniques has been validate and compared with each other in order to determine the most accurate results in terms of finger vein recognition.

Keywords: MATLAB, PCA, Threshold based segmentation, ANN and Edge detection Technique.

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I. INTRODUCTION

Different systems require reliable personal identification scheme to confirm the identity of the entity or decide to request him to their services. The reason for this program is to ensure rendering services only accessed by authorized users and not others [1]. Examples of such applications include secure access to building computer systems, laptop computers, cellular phones and ATMs. In the absence of strong personal identity program, the system is vulnerable to the threat of an imposter. Biometric is to to measure the human physical and behavioral characteristics. The technology used for identification and access control or personal identification for monitors. Biometric authentication basic premise is that each person is unique, the individual can be identified by its real physical or behavioral traits. (The term 'biometrics' comes from the Greek 'bio' means life and 'metric' means measurement). [2].

1.1TYPES OF VARIOUS BIOMETRICS

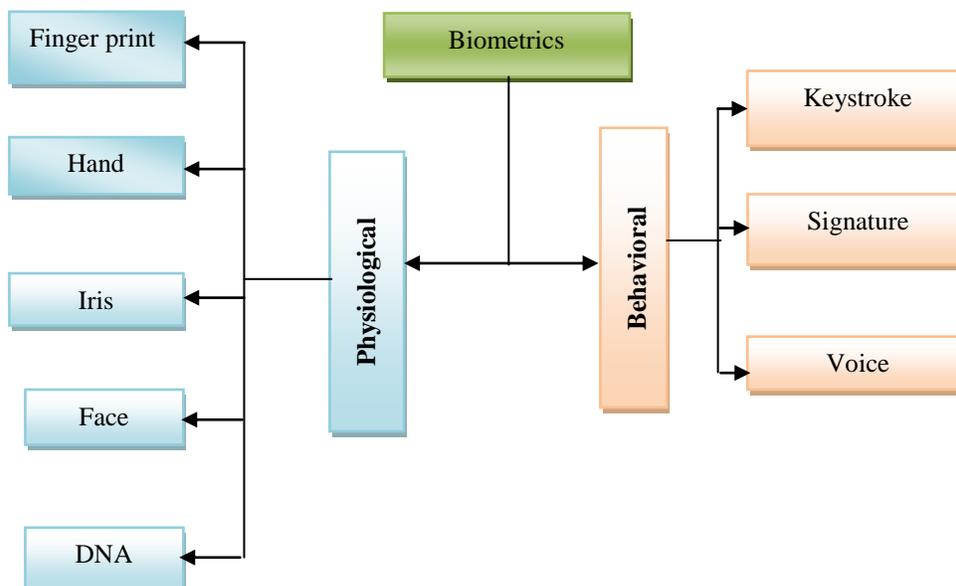Biometrics mainly divide into two parts :

1. Physiological
2. Behaviour

Fig. 1 Biometric traits

The physiological characteristic used in this paper is finger vein along with PCA as a feature extraction technique and artificial neural network as a classification technique.

1.1.1 Finger vein recognition

Like fingerprints, finger vein based blood vessel patterns are unique for each individual. Finger vein based blood vessel pattern have high security because the veins are located under the surface of the skin. The fingerprints can be cheated by dummy finger fitted with a copied fingerprint, but the finger vein based identification system is highly secure for authentication [3, 4].

1.2 FEATURE EXTRACTION USING PCA

Principle component analysis (PCA) is a statistical process, to set the value of a collection of observations conversion using orthogonal transformation related variables called principal component linear uncorrelated variables. . PCA can be done by eignvalue of decomposition of a data covariance (or correlation) matrix characteristic value decomposition or singular value decomposition of the data matrix to complete, usually in the middle of the averaging of the data matrix for each character (and normalized or Z score) . PCA defines a new orthogonal coordinate system, which is best described by single data set differences [5].

1.3 ANN in vein recognition

Artificial neural networks are used to identify the vein, because of their simplicity. Vein identification method can be obtained after a training match mode. The neural network is an intelligent system that provides to produce output on the basis of their training data in the form of vein [6,7].

II. RELATED WORK

S.M.Rajbhoj, and P.B.Mane, [8] proposed a novel multi-biometric system using two most used biometric traits fingerprint along with iris. Feature vector of every trait has been used removed from texture pattern of biometric images, using DWT and PCA method. Classification of these feature vectors is carried out using Euclidean distance. **Jinfeng Yang ,Yihua Shi et al.[9],** propose a novel Vein zone enhanced program and finger vein Network segmentation by using scattering method is intended Removal, vein directional filtering and misinformation to effectively enhance finger vein Image. **Sepehr Damavandinejadmonfared et al.[10]** propose a simple algorithm for Finger vein recognition. Principal Component

analysis (PCA), the main part of the kernel Analysis (KPCA) and kernel entropy component analysis (KECA) performances have been evaluated. Based on these results, KPCA has been matched and has been proved that KPCA method performed well for identifying finger vein. **Pedro Tome, et al.** [11] proposed an Open source finger vein framework. This system was vulnerable to the spoofing attacks having false acceptance rate is 86%. **Lu Yang et al. [12]** proposed a finger vein recognition system used for identifying the internal characteristics of the living body. **Masaki Watanabe et al. [13]** proposed a palm vein recognition system. Palm scanned three times during the registration, and then only one final scan is permitted to confirm authentication. This method is accurate and secure due to unique blood vessel pattern

III. PROPOSED WORK

In the propose work, vein recognition system using (PCA) principle component analysis with Artificial Neural Network (ANN) is presents. The parameters like FAR, FRR and Accuracy have been calculated.

False Acceptance rate (FAR)

$$(\text{Total Number of Samples} - \text{Number of Samples that falsely accepted}) / (\text{Total number of samples})$$

False Rejection Rate (FRR)

$$(\text{Total Number of Samples} - \text{Number of Samples that falsely rejected}) / (\text{Total number of samples})$$

Accuracy

$$100 - (FAR + FRR) \%$$

1.1 METHODOLOGY

Thus methodology includes various steps for the fingervein recognition using MATLAB, which are listed below:

Step 1: Develop and design a particular GUI for proposed vein recognition system

Step 2: Upload vein images for training and testing

Step 3: Apply pre-processing step.

Step 4: A code is developed for vein segmentation and localization. For vein recognition segmentation threshold based segmentation is used.

Step 5: After this code is developed using PCA principle component analysis for extracting feature .Now the proposed classifier with appropriate feature sets get trained.

Step 6: Initialized Artificial neural network with feature sets of segmented vein region of finger image as an input to artificial neural network.

Step 7: After the training of vein we can simulate the proposed work with the test image and check their performance metrics.

Step 8: After the classification of testing vein the performance metrics like FAR, FRR and Accuracy are computed.
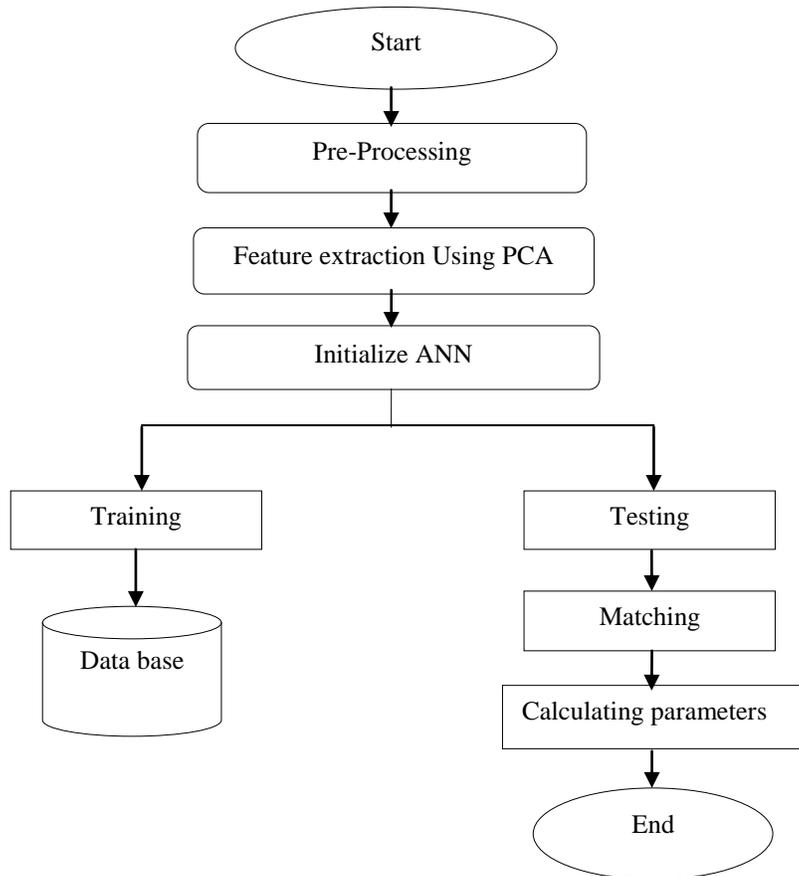
**Fig. 2 Flowchart of proposed work**

IV. SIMULATION RESULTS

The simulation has been carried out in an Intel Core 2 Duo CPU system with 2.10 GHz on a 32-bit Windows 7 Ultimate Operating System using MATLAB.CASIA Multi-Spectral finger vein image database contains different types images captured from different people using a self-designed multiple spectral imaging device for the research purpose. All finger vein images are 8 bit gray-level JPEG files without any compression. The parameters that have been calculated are given in the tabular form:


Fig. 3 Different stages of vein recognition

Table 1: Results of proposed work

Image No.	FAR	FRR	ACCURACY
1	6.75018	0.789046	92.460436
2	6.67017	0.778035	92.34671
3	5.67429	0.631904	93.21654
4	6.78992	0.660562	93.02471
5	7.45282	0.821064	94.21430
6	6.74522	0.882146	92.32561
7	5.67872	0.594201	94.15628
8	5.34310	0.557211	94.63876
9	6.76384	0.627653	93.76521
10	7.45379	0.792501	92.59401
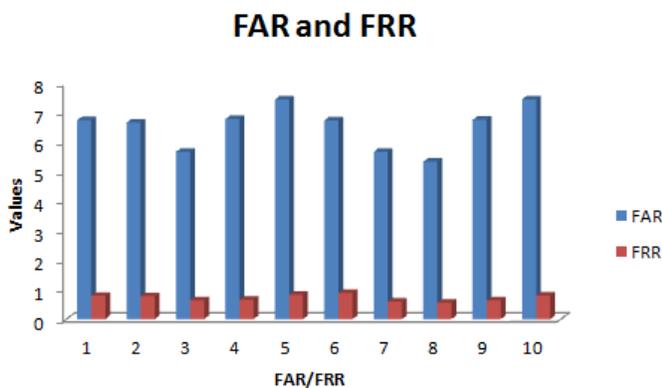
Fig.4 comparison bar graph between FAR and FRR

The above figure shows the graph between FAR/FRR and their values. In the figure 5.16 red lines indicates FRR results and blue lines indicate FAR result. The average value obtained for FAR is 6.532205 and the average value for FRR is 0.713432.
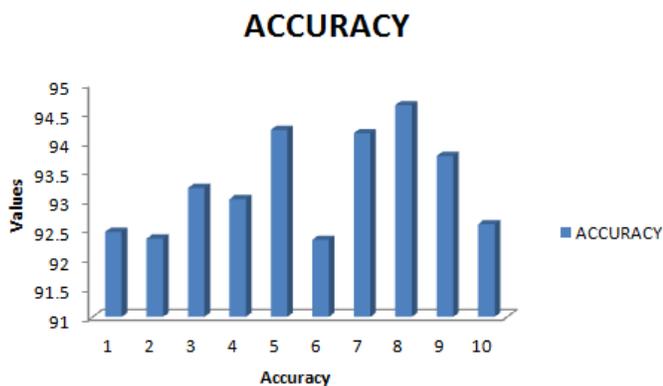
Fig.5 Graphical representation of Accuracy

Graphical representation of accuracy obtained for the proposed work is shown in the figure 5.17.The average value of the accuracy obtained for the proposed work is 93.27426.

V.   CONCLUSION

In the Proposed work finger vein recognition is done by using PCA, threshold based segmentation using Artificial neural network and Edge detection technique. In the finger vein recognition biometric parameters has been calculated like FAR, FRR and Accuracy using Human finger Vein pattern under the skin's surface. Finger vein recognition is used to identify the individual person and their identity. PCA technique is used to find principle feature of the uploaded vein image. Training panel will do one time simulation whereas testing panel will do it multiple times. Training and Testing is done for matching the biometric parameters like if parameters are matched the image get recognized otherwise not-recognized. Pre-processing is done for resizing and for color conversion of the loaded image. The average value of FAR is 6.532205, FRR is 0.713432 and for accuracy is 93.27426.In future we can use optimization technique for feature optimization. We can use like generic algorithm, PSO, ACO and BCO. Feature optimization gives us best optimal feature set. It gives best fitness results than the PCA which i have applied.

References

[1]   Tome, Pedro, Matthias Vanoni, and Sébastien Marcel,"On the vulnerability of finger vein recognition to spoofing,"Biometrics Special Interest Group (BIOSIG), 2014 International Conference of the. IEEE, 2014

[2]   He Zheng, Qiantong Xu, Yapeng Ye and Wenxin Li, "Effects of meteorological factors on finger vein recognition," *2017 IEEE International Conference on Identity, Security and Behavior Analysis (ISBA)*, New Delhi, 2017, pp. 1-8.

[3]   L. Yang; G. Yang; Y. Yin; X. Xi, "Finger Vein Recognition with Anatomy Structure Analysis," in *IEEE Transactions on Circuits and Systems for Video Technology* , vol.3 PP.99-105.

[4]   M. Sapkale and S. M. Rajbhoj, "A biometric authentication system based on finger vein recognition," *2016 International Conference on Inventive Computation Technologies (ICICT)*, Coimbatore, 2016, pp. 1-4.

[5]   T. S. Beng and B. A. Rosdi, "Finger-vein identification using pattern map and principal component analysis," *2011 IEEE International Conference on Signal and Image Processing Applications (ICSIPA)*, Kuala Lumpur, 2011, pp. 530-534.

[6]   Wu, Jian-Da, and Siou-Huan Ye. "Driver identification using finger-vein patterns with Radon transform and neural network." *Expert Systems with Applications* Vol.36, 2009,pp. 5793-5799.

[7]   Wu, Jian-Da, and Chiung-Tsiung Liu. "Finger-vein pattern identification using principal component analysis

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and the neural network technique." *Expert Systems with Applications* Vol. 38, 2011,pp. 5423-5427.

[8] S.M.Rajbhoj, and P.B.Mane, "Match score integration of iris and fingerprint in multi-biometrics system," in Electronics and Communication Systems (ICECS), 2014 International Conference on, vol.5, 2014, pp.1-5.

[9] Yang, Jinfeng, and Yihua Shi,"Finger-vein network enhancement and segmentation," *Pattern Analysis and Applications* Vol.17, 2014, pp. 783-797.

[10] Damavandinejadmonfared, Sepehr, et al,"Finger vein recognition using PCA-based methods," *World Academy of Science, Engineering and Technology* Vol. 6, 2012, pp. 1079-1081.

[11] Tome, Pedro, Matthias Vanoni, and Sébastien Marcel,"On the vulnerability of finger vein recognition to spoofing,"*Biometrics Special Interest Group (BIOSIG), 2014 International Conference of the*. IEEE, 2014.

[12] Yang, Jinfeng, and Xu Li,"Efficient finger vein localization and recognition," *Pattern Recognition (ICPR), 2010 20th International Conference on*. IEEE, 2010.

[13] Watanabe, Masaki, et al,"Palm vein authentication technology and its applications," *Proceedings of the biometric consortium conference*. 2005.