IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 12, Issue 6, Ver. I (Nov.- Dec. 2017), PP 34-40
www.iosrjournals.org

Performance Analysis of PCA & ANN for Recognize the IRIS & Fingerprint traits using SVM

Piyush G. Kale, Prof. Chhaya S. Khandelwal
(Department of Electronics & Tele-Communication, Jawaharlal Nehru Engineering College, Aurangabad. India)
(Department of Electronics & Tele-Communication, Jawaharlal Nehru Engineering College, Aurangabad. India)

Abstract : *The Biometric system is of one the essential pattern recognition system that are used for identifying individuals using different biometric traits. The authentication system design on only one biometric modality may not satisfy the requirement of demanding applications in term of properties such as accuracy, sensitivity & precision. In this paper, we used minutiae& gabour wavelet for the feature extraction of fingerprint & IRIS respectively. After extracting the feature we used ANN & PCA for classification of traits. After that we combine both the images which comes after the applying the ANN & PCA. On those resulting images we apply SVM for developing authentication system which uses the IRIS and Fingerprint of a person for recognizing a person. It is observed that developed algorithm that has best performance parameters as compared existing algorithms.*

Keywords: *Fingerprint, IRIS, Minutiae, Gabour wavelet analysis, ANN, PCA, SVM*

Date of Submission: 11-11-2017 Date of acceptance: 25-11-2017

I. Introduction

The biometric authentication has seen considerable improved in reliability and accuracy, with some biometrics offering reasonably good overall performance. In biometric based systems for identity verification, static and/or dynamic biometric measures may be used as personal passwords. However, even the most advanced biometric identification systems are still facing numerous problems, some inherent to the type of data and some to the methodology itself. In particular, biometric authentication systems generally suffer from imprecision and difficulties in person recognition due to noisy input data, limited degrees of freedom, intraclass variability, non universality, and other factors that affect the performance, security and convenience of using such systems. Each biometric system must perform four basic tasks i.e. acquisition, feature extraction, matching and decision making [9]. Multi biometric systems can significantly improve the recognition performance in addition to improving population coverage, deterring spoof attacks, increasing the degrees of freedom, and reducing the failure-to-enroll rate. Physiological biometric identifiers include fingerprints, hand geometry, ear patterns, eye patterns (iris and retina), facial features, and other physical characteristics. Behavioral identifiers include voice, signature, typing patterns, and others. The major focus is to implement the multimodal system that provides accuracy at limited cost in terms of acquisition time. There are other reasons to combine two or more biometrics like different applications and customer preference. So the limitations of unimodal biometric system can be overcome by multi modal biometric systems. The Biometric authentication technology certifies recognition of human on the basis of some unique characteristics owned by him. IRIS and Finger print recognition are one of the techniques used for biometric authentication. In development of this system we have used two types of authentication traits of biometric systems i.e. IRIS and Fingerprint using that we checked the accuracy, sensitivity & performance of the system. So this system can be helpful in privacy also. Multimodal biometric systems are those that use more than one physiological or behavioral characteristic for enrolment, verification & identification. An overview of multimodal biometrics contained various levels of fusions, various possible scenarios, the different kind's modes of operation, integration methods and design issues [9].These systems are also able to meet the stringent performance requirements imposed by various applications. Multimodal biometric systems address the problem of non-universality since multiple traits ensure sufficient population coverage. Further, multimodal biometric systems provide anti-spoofing measures by making it difficult for an intruder to simultaneously spoof the multiple biometric traits of a legitimate user [11].Thus, a challenge response type of authentication can be facilitated using multimodal biometric systems. In applications such as boundary entry & exit, access control, civil identification network surveillance, multi-modal biometric systems are looked to as a means of reducing false non-match and false match rates providing a secondary means of enlistment, verification, and recognition if sufficient data cannot be acquired from a given biometric samples & combating attempts to fool biometric systems through fraudulent data sources such as fake fingers [1].

II. Methodology To Iris & Finger Print Classification

This section present the proposed methodology for classification of IRIS & finger print using ANN & PCA. The effectiveness of classification is achieved by combining the feature extracted of IRIS & Fingerprint using gabour wavelet analysis & minutiae feature extraction. In this approach of IRIS & Finger Print Recognition using Principle Component Analysis even though various classifiers are specified already but less accuracy are matched in available Data Set & Real Image. So this is the challenging part when we think about designing this application [9].

The overall different steps of proposed methodology are given as follow.
1) Select data set from database of IRIS & fingerprint.
2) Extract the feature using gabour wavelet analysis & minutiae feature extraction.
3) Train Neural Network on both traits.
4) Classification using PCA for IRIS trait.
5) Combine both images of IRIS & Fingerprint for result
6) Apply SVM for recognizing person.

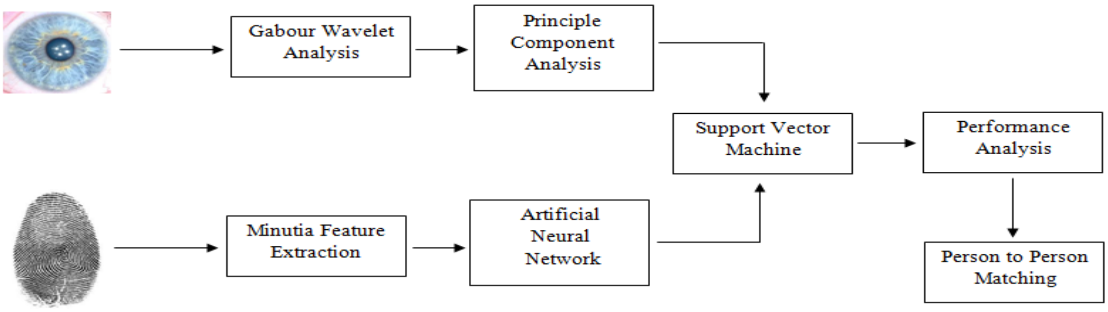


Fig.1. flow diagram of the proposed methodology

2.1 Feature Extraction Technique

2.1.1 Gabour Wavelet & Minutiae Feature Extraction

A Gabor filter is a linear filter whose response of impulse is defined by a harmonic function multiplied by a Gaussian function. Because of the multiplication convolution property (Convolution theorem), the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function. A 2-D Gabor filter is an oriented complex sinusoidal grating modulated by 2-D Gaussian function. GEF's were first defined by Gabor and later extended to 2-D by Daugman

$$h(x, y) = g(x', y') \exp[j2\pi(U_x + V_y)] \qquad (1)$$

Where $(x', y') = (x \cos\theta + y \sin\theta, -x \sin\theta + y \cos\theta)$ represent rotated spatial-domain rectilinear coordinates. Let (u,v) denote frequency-domain rectilinear coordinates, (U,V) represents a particular 2-D frequency. The complex exponential is a 2-D complex sinusoid at frequency [8].

On the skeleton image the minutiae feature extraction technique algorithm can be performed. The approach involves using 3 *x* 3 windows to examine the local neighboring pixels of each ridge pixel in the image. A pixel is then bifurcated as a ridge ending if it has only one neighboring ridge pixel in the skeleton image window, and classified as a bifurcation if it has three neighboring ridge pixels [4].

The main steps in the proposed algorithm include:

1. Segmentation 2. Binaryzation 3. Orientation estimation 4. Frequency estimation 5. Covariancy estimation

2.1.2 Principle Component Analysis (PCA)

It is the generalized technique which uses sophisticated underlying mathematical conventions and results to transforms a number of possibly correlated data points into a smaller number of data points which is called as Principal Components. The PCA is mostly used as a tool in exploratory data analysis and for predictive model making purposes. It can be done by eigen value decomposition of a data correlation (or covariance) matrix or singular value decomposition of a data matrix, usually after mean centering (and normalizing or using Z-scores) the data matrix for each attribute [9][1].Assume that we initialize with a data set that is arranged in terms of an m by n matrix, where the n columns are the samples (e.g. observations) and the m rows are the data points. We wish to linearly transform this matrix, X into another matrix, Y, also of dimension m × n, so that for some m × m matrix, P,

$$Y = PX \quad (2)$$

This equation represents a change of basis. If we consider the rows of P to be the row vectors p1, p2, . . . , pm, and the columns of X to be the column vectors x1, x2, . . . , xn then can be interpreted in the following way.

$$\mathbf{PX} = \begin{pmatrix} \mathbf{Px_1} & \mathbf{Px_2} & \dots & \mathbf{Px_n} \end{pmatrix} = \begin{pmatrix} \mathbf{p_1 \cdot x_1} & \mathbf{p_1 \cdot x_2} & \cdots & \mathbf{p_1 \cdot x_n} \\ \mathbf{p_2 \cdot x_1} & \mathbf{p_2 \cdot x_2} & \cdots & \mathbf{p_2 \cdot x_n} \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{p_m \cdot x_1} & \mathbf{p_m \cdot x_2} & \cdots & \mathbf{p_m \cdot x_n} \end{pmatrix} = \mathbf{Y} \quad (3)$$

2.1.3 Artificial Neural Network (ANN)

An ANN is a computational structure that is inspired by observed process in natural networks of biological neurons in the brain. It consists of easy computational units called neurons, which are highly connected with each other. ANNs have become focus the much attention, largely because of their large range of applicability and the ease with which they can treat difficult problems ANNs are now being increasingly recognized in the area of classification and prediction, where regression model and other related mathematical techniques have traditionally been employed.

One of the simplest feed forward neural networks (FFNN), such as in Fig.2, consists of three different layers: an input layer, hidden layer and output layer. In each layer there are one or more processing elements (PEs). PEs is meant to simulate the neurons in the brain and this is why they are often referred to as neurons or nodes. A PE receives inputs from either the outside world or the previous layer. There are connections between the PEs in each layer that have a weight (parameter) associated with them. This weight is adjusted during training. Information only travels in the forward direction through the network - there are no feedback loops [7].

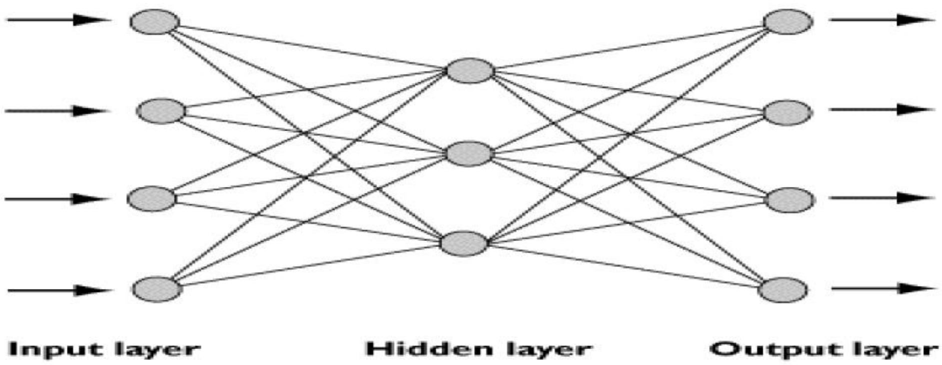


Fig.2. feedforward neural network layer diagram

2.1.4 Support Vector Machine (SVM)

The SVM will refer to both classification and regression methods and the terms Support Vector Classification (SVC) and Support Vector Regression (SVR) will be used for specification. This part will continue with a complete introduction to the structural risk [9]. The SVM is introduced in the setting of classification, being both historical and more usable. This leads onto mapping the input into a higher dimensional feature space by a require choice of kernel function. The report then considers to the problem of regression. SVM has successful application in Bioinformatics, Text & Image Recognition. A classification task usually involves separating data into training and testing sets. Each instance in the training set contains one "target value" (i.e. the class labels) and several "attributes" (i.e. the features or observed variables). The goal of SVM is to produce a model (based on the training data) which predicts the target values of the test data given only the test data attributes. Given a training set of instance label pairs (Xi ,Yi), i = 1,……, l where Xi ϵ Rn and

Y ϵ {1,-1}l, the support vector machines (SVM) (Boser et al., 1992; Cortes and Vapnik, 1995) require the solution of the following optimization problem

$$\begin{aligned} \min_{\mathbf{w},b,\boldsymbol{\xi}} \quad & \frac{1}{2}\mathbf{w}^T\mathbf{w} + C\sum_{i=1}^{l}\xi_i \\ \text{subject to} \quad & y_i(\mathbf{w}^T\phi(\mathbf{x}_i) + b) \geq 1 - \xi_i, \\ & \xi_i \geq 0. \end{aligned} \tag{4}$$

III. Result Analysis

This section presents experimental results & detailed analysis of proposed system with different parameter. Section A discusses the data set & section B discusses the experimental out come in visualize format and performance analysis was given in section C.

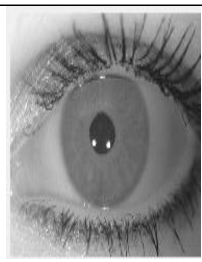
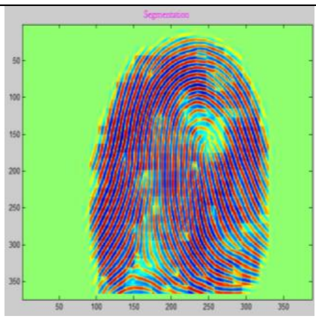
A. Data base / set description

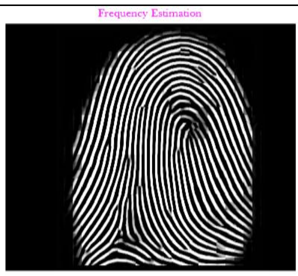
For this project we used multiple images of finger & IRIS for recognize the particular person to enhance security. For finger print recognization we create our own data base by using biometric module / hardware. We take multiple images of fingers with different angles of different people. On those images we can apply different feature extraction and classification technique to achieve maximum accuracy. For IRIS recognization we used IIT Delhi Iris database (Version 1.0).

B. Experimental results

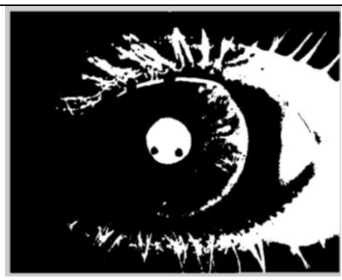
After applying the different feature extraction technique on IRIS and finger print respectively i.e. gabour wavelet, minutiae; the resulting image used as a input to PCA and ANN for classification. The combined images of both traits are used as an input to SVM for getting the final results. The final output generated by PCA, ANN and SVM given below.

Table.1. Result analysis

Experimental result of fingerprint	Experimental result of IRIS
 Input image	 Input image
 Segmentation	 Noise reduction



Frequency Estimation



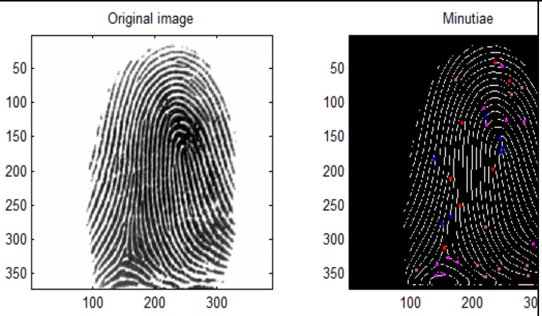
Pupil detection

Binaryzation

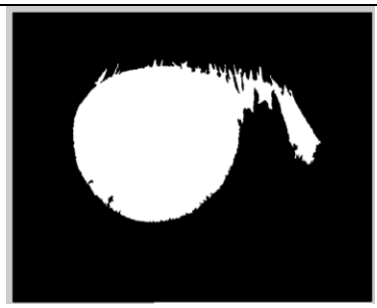
Center Eye ball detection

Covariancy estimation

Eyelash detection



Minutiae feature extracted



Eye ball structure

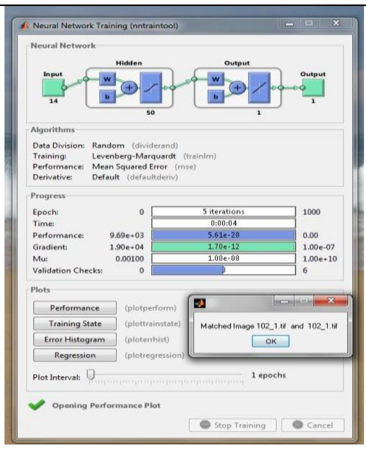


Image matching

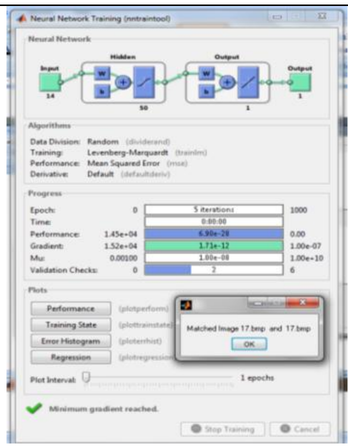
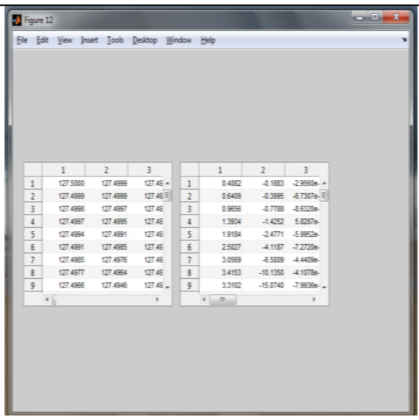
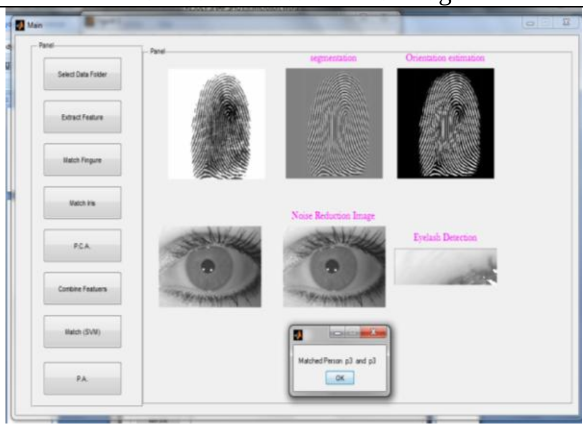


Image matching



PCA coordinates of IRIS image



Person to person matching

C. Performance Analysis

Table.2. Performance parameter

Traits	Accuracy	Sensitivity	Precision	Specificity	F Score
IRIS	86.32 %	85.77 %	86.18 %	85.77 %	85.95 %
Finger	92.37 %	91.83 %	92.24 %	91.83 %	92.00 %
Combined	99.61 %	99.06 %	99.47 %	99.06 %	99.24 %

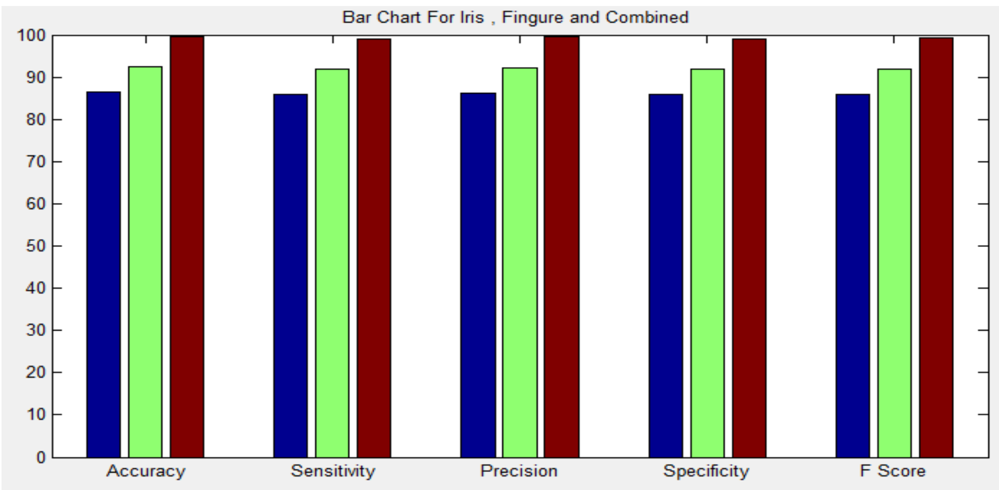


Fig.3. graph of performance paramters

IV. Conclusion

The unimodal biometric system was less accurate in various parameters to fulfill authentication, security & privacy problem. To overcome the drawbacks of unimodal system we are moving towards the bi-modal biometric system. In which we used IRIS & fingerprint images to develop highly secure & accurate system. For that purpose in our project we use feature extraction technique such as minutiae & gabour wavelet analysis those are best feature extraction technique. After extracting the feature we used principal component analysis and artificial neural network for classification purpose. We merged that both classified images & given as an input to support vector machine, which gives more accuracy for identification of the particular person by traits. The accuracy which we got individually for IRIS it is 86.32% & for fingerprint 92.37% and after merging these images we got accuracy 99.61%. In future the research can be done with the multiple modal such as a IRIS, fingerprint, palm and face by using such different model we can achieve higher level of presided parameters.

Acknowledgements

We are sincerely thankful to our institute Jawaharlal Nehru Engineering College for providing us the world class infrastructure for the developing of the project. We express our sincere thanks to our respected Principal Dr. Shinde H.H., Head of Department Prof. Rana J.G., Prof. Khandelwal C.S., Prof. Patil B.A. and Dr. Patil B.M. for permitting us to present this paper and also to all staff members & our colleagues for their continuous encouragement, suggestions and support during the tenure of the paper & project. We are also thankful of IIT Delhi for freely available of IRIS database for the research work. We hereby also acknowledge the literature which helped us directly or indirectly in the preparation of this paper & project.

References

Journal Papers:

[1] S. Anu H Nair, P.Aruna & M. Vadivukarassi "PCA BASED Image Fusion And Biometric Features" IJACTE ISSN (Print):2319–2526, Volume-1, Issue-2, 2013

[2] J.Daugman, "High confidence visual recognition of person by a test of statistical independence" IEEE transaction, Pattern Analysis and Machine intelligence, vol. 15, pp. 1148-1161, Nov 1993.

[3] Nazmeen Bibi Boodoo, R K Subramanian, 2009. Robust multi-biometric Recognition Using Face and Ear Images. International Journal of Computer Science and Information Security, Vol. 6, No. 2.

[4] Feng Zhao, Xiaoou Tang, "Preprocessing and postprocessing for skeleton-based fingerprint minutiae extraction" ELSEVIER, Received 4 June 2005; received in revised form 17 June 2006; accepted 6 September 2006

[5] X. Jing, Y. Yao, D. Zhang, M. Li, Face and palmprint pixel level fusion and Kernel DCV- RBF classifier for small sample biometrics recognition, Pattern Recognition 40 (11),2007, pp. 3209-3224

[6] K. Chang, K. W. Bowyer, S. Sarkar, and B. Victor, "Comparison and combination of ear and face images in appearance- based biometrics," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 25 no. 9 , pp. 1160 - 1165 , Sept. 2003 .

[7] Dr. Yashpal Singh, Alok Singh Chauhan, "NEURAL NETWORKS IN DATA MINING" ,Proceedings of

[8] Journal of Theoretical and Applied Information Technology,2009

[9] Mayur Ingale, K. S. Bhagat & P. M. Mahajan, "Image Segmentation Using Gabor Filter And Wavelet Transform", International Journal Of Electrical And Electronics Engineering Research (IJEEER) ISSN 2250-155x Vol. 3, Issue 4, Oct 2013, 25-28

Proceedings Papers:

[10] Dinkardas CN, Dr.S.Perumal Sankar, Nisha George "A Multimodal Performance Evaluation On Two Different Models Based On Face, Fingerprint AndIris Templates" IEEE Paper 2013.

[11] Qazi Emadul Haq , Muhammad Younus Javed ,Qazi Sami ulHaq"Efficient and Robust Approach of Iris Recognition through Fisher Linear Discriminant Analysis Method and Principal Component Analysis Method" IEEE 2008.

[12] Hariprasath.S, Prabakar.T.N "Multimodal Biometric Recognition Using Iris Feature Extraction and Palmprint Features" IEEE Paper 2012.

[13] Sheetal Chaudhary, and Rajender Nath, A Multimodal Biometric Recognition System Based on Fusion of Palmprint, Fingerprint and

[14] Face,Proceedings of TCART in Communication and Computing,2009

[15] Lye Wil Liam, Ali Chekima, Liau Chung Fan, "Iris recognition using self-organizing neural network", IEEE 2002.

IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) is UGC approved Journal with Sl. No. 5016, Journal no. 49082.

Piyush G. Kale Performance Analysis of PCA & ANN for Recognize the IRIS & Fingerprint traits using SVM." IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), vol. 12, no. 6, 2017, pp. 34-40.