INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 5, Issue 3)
Available online at: www.ijariit.com

Iris recognition with GLDM and Gabor feature using Neural Network Classifier

Shishir Pratap Singh
singhshishir007@gmail.com
Uttam Group of Institutions, Agra, Uttar Pradesh

ABSTRACT

This research work presents a Neural Network (NN) architecture for a system of recognition of people through the biometric measurement of the human iris. In this system, a database of the human iris is processed by means of image processing methods. The coordinates of the center and radius of the iris are obtained and a cut of the area of interest is performed eliminating the noise around the iris. The inputs to the neural network architecture are the processed iris images and the output is the number of the person identified. This work proposes the hybridization of features like Gabor wavelet, Grey Level Difference Matrices (GLDM) and wavelet moments for extracting features from the images to train the neural network. The classification accuracy obtained with the hybrid approach on the images is98.6% with a 60:40 ratio of training and testing respectively.

Keywords— *Iris recognition, Hybridization, Neural Network, Wavelet, Biometric*

1. INTRODUCTION

The identification of people from the iris image is considered one of the best means of biometric-based recognition. This technology, compared to other biometric technologies, is based on the distinct properties of the iris. The texture of the iris is stable throughout the life of the person unlike the fingerprint, unique for each person, contrary to the characteristics of the voice. In addition to being an internal organ, the iris is well protected from the external environment but nevertheless measurable, in a rather minimal invasive way, by a simple acquisition of the image. So in order to recognize a person from the image of his eye, several processes are implemented. First, the image of the eye is segmented in order to extract the iris and to isolate it from all surrounding elements such as the pupil, the white of the eye, the eyelids and the eyelashes.

The segmented iris is then standardized to have a fixed size and thus compensate for the different intrinsic and extrinsic variations. Then, the most discriminating characteristics of the iris are extracted, in a process called encoding, in order to constitute a profile representing the biometric signature of the iris. Finally, a classification process uses the profile made of the iris and compares it with profiles

2. STATE OF ART

Biometrics is the quantitative study of living things, specifically in our context: it is the recognition and identification of individuals using information closely related to their characteristics. Biometric methods involve the use of fingerprints, face, voice, iris or DNA, etc. They each have their own advantages and limitations some methods are rigorous but are also very constraining (high cost, a collaboration of the indispensable person in the majority of cases, etc.) while others are more user-friendly but suffer from problems of precision. In order for the characteristics of each individual to be qualified as biometric modalities, they must be:

- Universal (exist in all individuals)
- Unique (possibility of differentiating one individual from another)
- Permanent (can evolve over time)
- Registrable (possibility of recording the characteristics of an individual with his consent)
- Measurable (possibility of future comparisons)
-

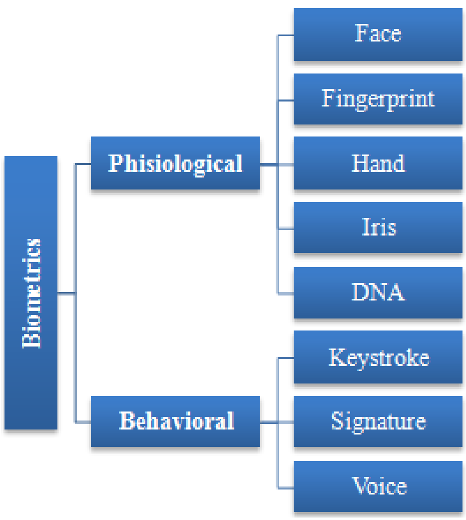


Fig. 1: Different modalities

3. GENERAL STRUCTURE OF A BIOMETRIC SYSTEM

A biometric system is a pattern recognition system which proceeds first by acquiring the biometric data of the individual to be recognized, then extracting a set of characteristics from the latter, and finally comparing these characteristics with the models of the database. Depending on the context of the application, a biometric system can operate either in verification or identification every biometric system consists of two processes that carry out the recording and testing operations:

(a) **Registration Process:** The purpose of this process is to record the characteristics of users in the database.

(b) **Testing Process (Identification/Verification):** This process performs the identification or verification of a person.

In each of the two previous processes, the system performs four operations fundamental principles, namely:

3.1 Acquisition

An acquisition system provided with a sensor is used to acquire a specific characteristic of the individual, for example, a microphone in the case of voice.

3.2 Extraction

After acquiring an image or a voice, the characteristic which the authentication process needs is extracted. For example: extract the face from the background of an image in the case of face recognition.

3.3 Classification

By looking at the models stored in the database, the system collects a number of templates that most closely resemble that of the person to be identified, and constitutes a limited list of candidates. This classification occurs only in the case of identification because the authentication retains only one model (that of the person proclaimed).

3.4 Decision

As far as authentication is concerned, the decision strategy allows us to between the following alternatives the identity of the user corresponds to the identity proclaimed or sought or it does not correspond. It is based on a predefined threshold. The estimation of the threshold of the decision constitutes the greatest difficulty of these techniques and can give rise to two types of errors, often taken as performance measures for these techniques of authentication: False Rejection (FR) which corresponds to rejecting one True user or valid identity, and False Acceptance (FA) that gives access to an impostor [4].

3.4.1 Mode of Operation: Any biometric system operates either in verification mode or in identification mode as mentioned above:

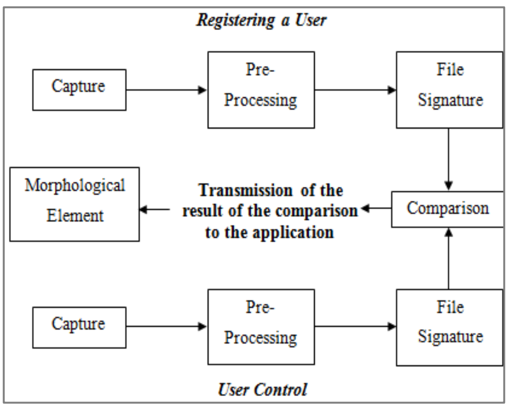


Fig. 2: Architecture of a biometric system

In verification mode, the system verifies the identity of a person by comparing the acquired biometric data with that stored in the database. In such a system, the person claims an identity, usually via a Personal Identification Number (PIN) code

4. ARCHITECTURE OF AN IRIS RECOGNITION SYSTEM

An iris recognition system is a biometric system whose function is to identify people from images of the iris. It is composed of a number of subsystems, which correspond to each step of the recognition of the iris [2]. Once the image of the eye is acquired, image processing techniques are used to extract the iris, construct the biometric signature representing the iris and finally find the identity of the iris (figure 3). Depending on their nature and function, all image processing operations are divided into 4 stages: segmentation, normalization, encoding and classification.

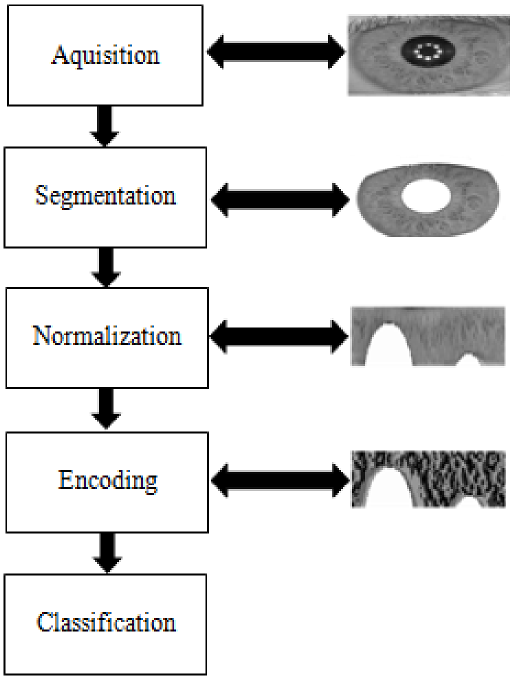


Fig. 3: Diagram of the different steps of an iris recognition system [8]

4.1 Segmentation

After the acquisition of the image, the iris must be isolated. In the first step, a series of image enhancement. These pre-processing operations are high-pass filtering, contrast enhancement and histogram equalization. Their goal is to enhance the overall quality of the image to then apply the operations of segmentation of the iris.

4.2 Normalization

The segmentation of the iris of the rest of the image produces, according to the images, irises of different sizes. The segmented iris can be a complete iris or a complete iris fraction, small or large. Thus a comparison between two irises of different sizes will be possible only from a consistent representation between all the images

5. PROPOSED METHOD

Motivated by the results obtained by and their flexibility for the fusion-based feature extraction in biometric recognition of the iris, it is proposed to represent the texture features of the iris. The figure represents the flow diagram of the new proposal. Obtaining coordinates of the center and radius of iris and pupil. To obtain the coordinates of the center and radius of the iris and the pupil of the images of the CASIA V1 database, the method developed by [8].

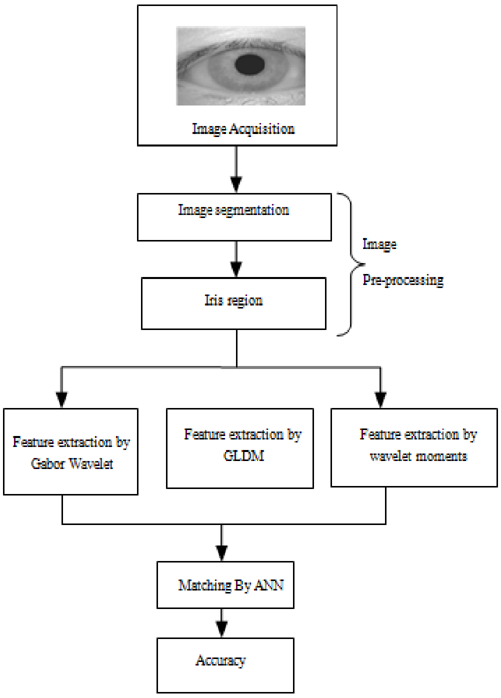


Fig. 4: Flow diagram of iris recognition

First, edge detection is applied with the canny method; then the process continues using a gamma adjustment of the image; to the resulting image obtained previously a non-maximum suppression is applied; subsequently, the threshold method is applied to the image.

Finally, the Hough transform is applied to find the maximum in the Hough space and, therefore, the parameters of the circle (row and column of the center of the iris and its radius).

In order to obtain the coordinates of the center and radius of the pupil, the same previous process is carried out, only taking into account at the end the coordinates of the center and radius of the iris to determine those of the pupil.

6. FEATURE EXTRACTION

6.1 Gabor wavelet

Gabor's Eye, developed by Dennis Gabor, is extensively used as a treatment of images because of the Gabor wavelets salient properties: the localization-frequency and selectivity in orientation. Frequency representations and orientation of Gabor are according to the biometric recognition system. The Gaussian envelope for iris recognition is represented as follows:

$$\psi_{u,v}(z) = \frac{\|K_{u,v}\|^2}{\sigma^2} e^{\frac{\|k_{u,v}\|^2 \|z\|^2}{2\sigma^2}} \left[e^{ik_{u,v}z} - e^{-\frac{\sigma^2}{2}}\right] \qquad (1)$$

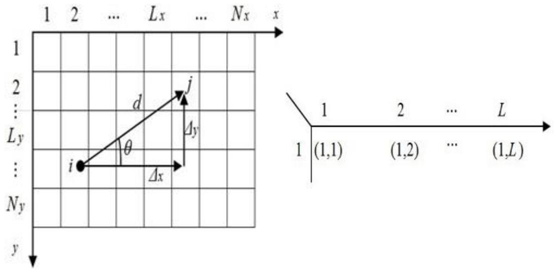
Where $z = (x; y)$the coordinate is the point$(x;\ y)$ Where u and$v$are orientation and frequency respectively for kernels of Gabor. $\|.\|$Is the standard operator and σ is the standard deviation of the Gaussian envelope?

The Gabor wavelet is the representation of the convolution product of frequency and orientation claimed from equation (1). The convolution of the image I and of a kernel of Gabor $\psi_{u,v}(z)$is defined by:

$$\boldsymbol{G_{u,v}(z) = I(z) * \psi_{u,v}(z)} \qquad (2)$$

6.2 Gray Level Difference Matrices (GLDM)

The texture is one of the most important characteristics for the identification of objects of interest in an image. The GLDM method is a texture analysis technique based on the absolute difference between pairs of gray levels or the average gray level of an image.



An example of the calculation of the GLDM matrix with a distance $d = 1$ and the angle $\theta = 0°$ is shown below:

$$I(x,y) = \begin{bmatrix} 11222 \\ 11222 \\ 13333 \\ 33444 \\ 33444 \end{bmatrix} \qquad GLDM = [15 \quad 4 \quad 1 \quad 0 \quad 0] \qquad (3)$$

6.3 Wavelet moments

6.3.1 Discrete Wavelet Transform (DWT)

The wavelet transform is used to decompose low frequency images so as to differentiate high frequency components, in view of its capacity to catch particular transformed information of the extracted image. The application of single-level DWT on an image M results in sub-groups given as:

$$M = M_a^1 + \{M_h^1 + M_v^1 + M_d^1\} \qquad (4)$$

To further reduce the dimension of input data, DWT can be applied N times to get N-level decomposition. Therefore at the end of four level DWT, the image can be represented as:

$$M = M_a^4 + \sum_{i=1}^{4}\{\{M_h^i + M_v^i + M_d^i\}\} \qquad (5)$$

At the end of 2-level DWT, input image with $m \times n$ is approximated to $\frac{m}{2} \times \frac{n}{2}$

DWT employees Fourier transform to convert time domain image into the frequency domain. The mathematical expression of DWT is given by:

$$\boldsymbol{DWT_{x(n)}} = \begin{cases} \boldsymbol{dd_{j,k} = \sum img(n) hh^*_s(n - 2^s r)} \\ \boldsymbol{ap_{j,k} = \sum img(n) ll^*_s(n - 2^s r)} \end{cases}$$

7. CLASSIFICATION BY NEURAL NETWORK

The above-extracted feature values can be combined to get an optimal dataset for neural network training.

7.1 Learning Process: Back Propagation

Back propagation neural network is a type of multi-layer feed forward network in which each layer is connected by transfer functions and can fulfil arbitrary nonlinear mapping.

The basic learning process of the back propagation neural network algorithm is as follows:

Step 1: Initialize the connection weightsw_{ij}, v_{jt} and threshold $\theta_j$in the back propagation neural network.

Step 2: Input the first learning sample couples to the back propagation neural network

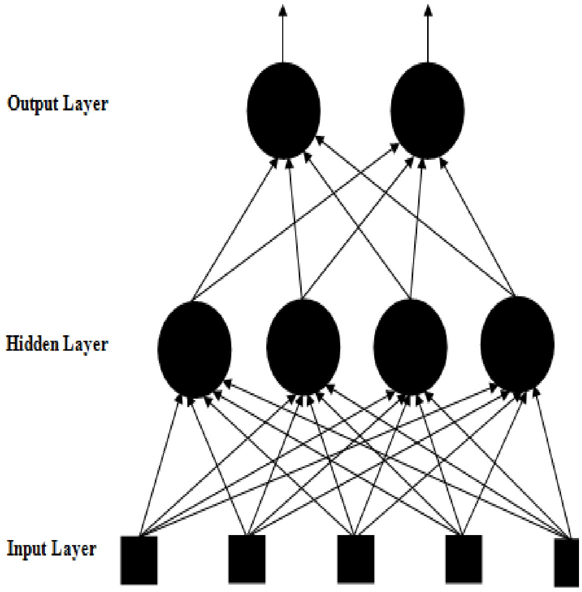


Fig. 5: Structure for back propagation neural network [9]

Step 3: Compute the input u_j of each neural unit and the output h_j in the hidden layer. The equation is:

$$u_j = \sum_{i=1}^{n} w_{ij}x_i - \theta_j$$

$$h_j = f(u_j) = \frac{1}{1+\exp(-u_j)}$$

Step 4: Compute the input l_t of each neural unit and the output y_t in the output layer. The equation is:

$$l_t = \sum v_{jt}h_j - \gamma_t \ (6)$$

$$y_t = \frac{1}{1+\exp(-l_t)}$$

Step 5: Compute the weights error δ_t which is connected to the neural unit t in the output layer.

$$\delta_t = (c_t - y_t)y_t(1-y_t) \quad (4.13)$$

In equation (4.13), c_t represents the expectation of the sample.

Step 6: Compute the weights error δ_j which is connected to the neural unit j in the hidden layer.

$$\delta_j = \sum_{t=1}^{q} \delta_t v_{jt} h_j (1-h_j)$$

7. SIMULATION RESULTS

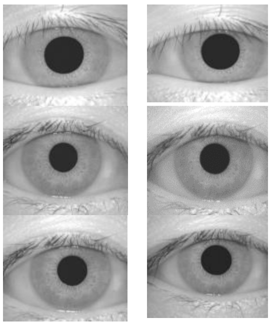


Fig. 6: IRIS database CASIA V1

The proposed scheme is validated for CASIA V1 databases. In the case of the CASIA V1 database, Fig7 to Fig 10 shows the accuracy of different methods proposed, only with the difference that the fusion process is shown as a step after obtaining the best set of accuracy.

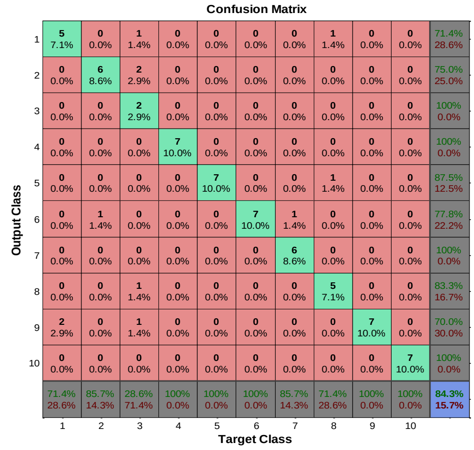


Fig. 7: Confusion matrix plot for wavelet moments

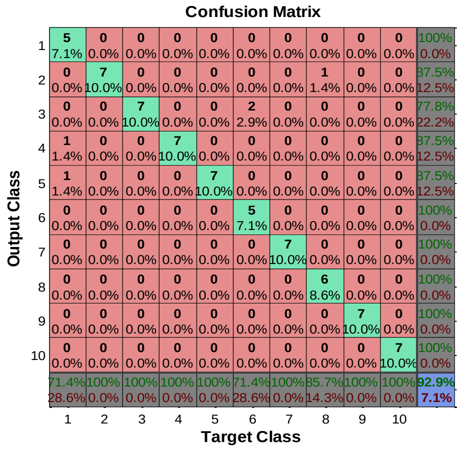


Fig. 8: Confusion matrix plot for Gabor wavelet + GLDM

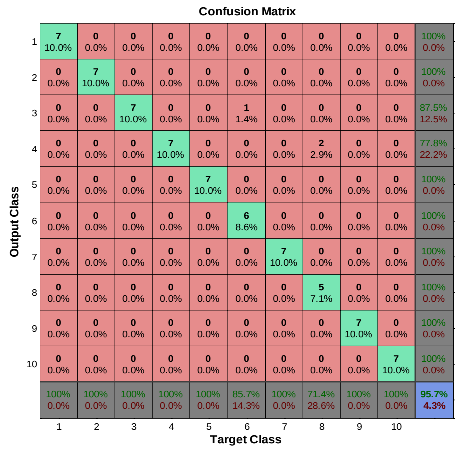


Fig. 9: Confusion matrix plot for Gabor wavelet

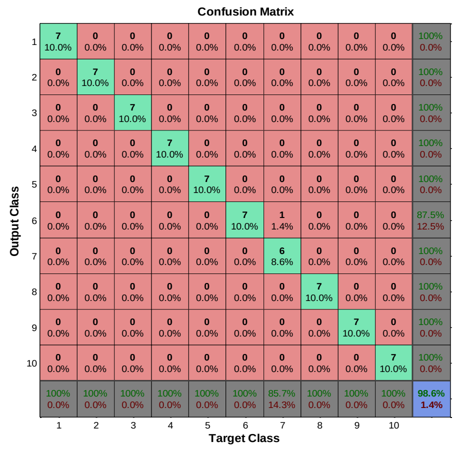


Fig. 10: Confusion matrix plot for Gabor wavelet + GLDM + wavelet moments

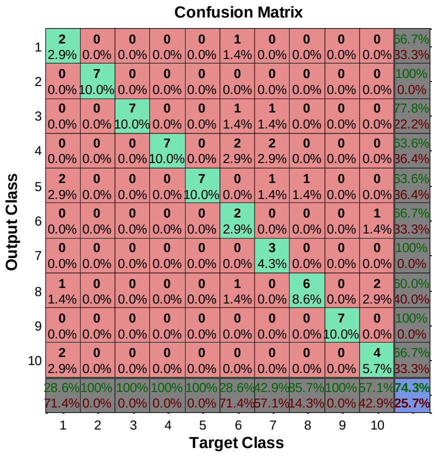


Fig. 11: Confusion matrix plot for GLDM

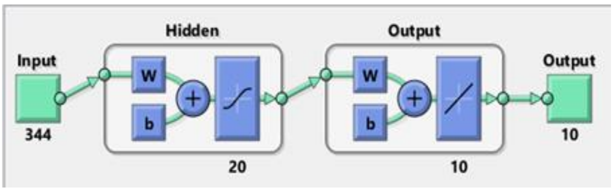


Fig. 12: Architecture of neural network

Table 1: Comparative studies of different methods

Method	Accuracy in percentage
GLDM	74.3%
Wavelet Moments	84.3%
Gabor Wavelet	95.7%
Gabor Wavelet+GLDM	92.9%
Hybrid approach by Gale et al. (2016) [38]	98%
Gabor Wavelet+GLDM+Wavelet Moments(Proposed)	98.6%

8. CONCLUSION

The recognition of iris is currently one of the most accurate biometric techniques. In an iris recognition system, pre-processing, especially iris segmentation, plays a very important role. The raw iris image is segmented with a canny edge detector. Further hybrid features (Gabor wavelet+GLCM+Wavelet moments) is used with neural network classifier, achieved accuracy is 98.6%. It is interesting to see the iris feature extraction in future, iris images obtained in less controlled environments, for example, under different lighting conditions

9. REFERENCES

[1] Galton, Francis. "Personal identification and description." Journal of Anthropological Institute of Great Britain and Ireland, pp. 177-191, 1989.
[2] http://www.galton.org/
[3] Newton, David E., "DNA evidence and forensic science", Infobase Publishing, 2008.
[4] Akrouf Samir, Sehili Mohamed El Amine, Chakhchoukh Abdesslam, Youssef Chahir and Messaoud Mostefai, "Face Recognition Using PCT and DCT", IEEE 5th International conference on MEMS Nano and Smart Systems (ICMENS 2009), Dubai, 2009.
[5] Akrouf, Samir, Abderraouf Bouziane, A. Hacine Gharbi, Messaoud Mostefai, and Youssef Chahir. "Towards an Intelligent Multimodal BiometricIdentification System." International Journal of Computer and Electrical Engineering 2, no. 6, 2010.
[6] A. K. Jain, A. Ross and S. Prabhakar, "An introduction to biometric recognition". IEEE arative studies of different methods Transactions on Circuits and Systems for Video Technology, vol. 14, pp. 4–20, Jan 2004
[7] Chander Kant, Rajender Nath, "Reducing Process-Time for Fingerprint Identification System", International Journals of Biometric and Bioinformatics, Vol. 3, Issue 1, pp.1-9, 2009.
[8] A. K. Jain and A. Ross. "Multibiometric systems". Communications of the ACM, special issue on multimodal interfaces, Vol. 47, No. 1, pp. 34–40, January 2004.
[9] L. Hong, A. K. Jain, and S. Pankanti. "Can Multi-biometrics Improve Performance?" IEEE Workshop on Automatic Identification Advanced Technologies, 1999.
[10] Vassilios Chatzis, Adrian G..Bors, and Ioannis Pitas, "Multimodal Decision-Level Fusion for Person Authentication", IEEE Trans. Systems. Man Cybernetics., vol. 29, no. 6, pp.674-680, April. 1999.

