Global Journal of Computer Science and Technology
Volume 11 Issue 7 Version 1.0 May 2011
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
ISSN: 0975-4172 & Print ISSN: 0975-4350

Future Biometric Passports and Neural Networks

By Kheder Durah, Omar Al Zoubi, Bilal Alzoubi, Emad Mohammed

Abstract- Due to the increase in the number of crimes and different ways they are perpetrated, demand has increased on the means that increase the level of security accuracy in the places that need special kind of protection, and places that require verifying the identity of those who demand access, such as computer networks, banks and home land security departments. There are many ways to identify people and grant them the required access; these methods include: What people have? (like an access card or key) and What people know? (like password); Moreover, there are physical biometric features such as (figure prints, retina, iris, DNA,etc) and behavioral biometric features such as (signature, voice, walking, etc). Recently, experience proved that using the iris is the best and more accurate than any other way and it will be the target of our research. There are several ways to increase the level of security that have been innovated, most important of which was using the biometrics. The most accurate biometric feature is the human eye iris, due to the characteristics it enjoys, and which make it possible to be used to identify people. The eye iris texture differs from one person to another; it even differs between identical twins, and the right and left eyes of the same person too. The aim of this research is to design an algorithm to recognize the iris for using it to identify people and create an international biometric passport for that person.

GJCST Classification: I.2.6

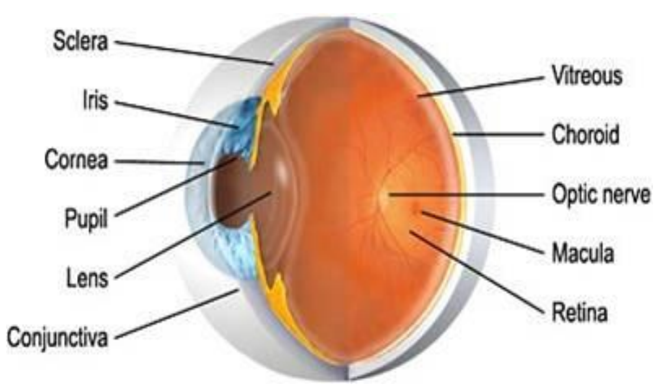
FUTURE BIOMETRIC PASSPORTS AND NEURAL NETWORKS

Strictly as per the compliance and regulations of:

Future Biometric Passports and Neural Networks

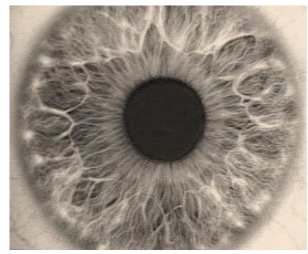
Kheder Durah, Omar Al Zoubi, Bilal Alzoubi, Emad Mohammed

Abstract– Due to the increase in the number of crimes and different ways they are perpetrated, demand has increased on the means that increase the level of security accuracy in the places that need special kind of protection, and places that require verifying the identity of those who demand access, such as computer networks, banks and home land security departments. There are many ways to identify people and grant them the required access; these methods include:
What people have? (like an access card or key) and What people know? (like password); Moreover, there are physical biometric features such as (figure prints, retina, iris, DNA,etc) and behavioral biometric features such as (signature, voice, walking, etc). Recently, experience proved that using the iris is the best and more accurate than any other way and it will be the target of our research. There are several ways to increase the level of security that have been innovated, most important of which was using the biometrics. The most accurate biometric feature is the human eye iris, due to the characteristics it enjoys, and which make it possible to be used to identify people. The eye iris texture differs from one person to another; it even differs between identical twins, and the right and left eyes of the same person too. The aim of this research is to design an algorithm to recognize the iris for using it to identify people and create an international biometric passport for that person.



I. Introduction

Several methodologies using the iris for identifying people have been used, most important was that applied by scientist J. Daugman. Generally speaking, all those are similar in their steps of operation; what is different in our research is the way of performing each, some were modified in one step while others were done in more than one step.



The process of identifying and recognizing people using the eye iris goes through the following steps:

1. Iris image acquisition
2. Processing
3. Post processing
4. Matching
5. Decision

We carried out few thousands lab tests and experiments and took several pictures of the eye iris by a special IRIS capture camera used for this purpose namely Panasonic Authenticam using Iridian technologies; We also developed a computer program using MATLAB language to code the iris and execute the matching process between one iris and another. In this research paper we developed new ways in many stages:

- We used a new method to locate inner and outer boundaries of the iris by considering that the iris is not a circle, it has an elliptical shape. We used a method to locate the iris boundaries by generating circles with different diameters and different centers, and then we measure the mean of the intensity for each circle.
- We used a new method t select a sector of the iris by locating the cross points of the eyelashes with the iris.
- We used neural networks based on simplex algorithm to verify the person who stand in front of the camera.

II. Why Choosing Eye Iris

The most accurate biometric feature is the human eye iris, due to the characteristics it enjoys, and which make it possible to be used to identify people. The eye iris texture differs from one person to another; it

May 2011
21
Global Journal of Computer Science and Technology Volume XI Issue VII Version I

even differs between identical twins, and the right and left eyes of the same person too.[1], [4].

Iris characteristics can be summarized in the following:

- Iris is more unique than other biometric features like (fingerprints, retina, hand, face, voice, walk, etc).
- Iris capture is non-intrusive and does not cause any inconvenience to people unlike the DNA which is highly accurate but intrusive and may cause discomfort and violation of privacy.
- Iris is an internal organ and well protected from external dangers.
- Iris is fixed since early infantry and throughout person's life.
- Iris capture procedure can be performed from a suitable convenient distance.
- Iris is not affected by genetics.
- Iris signature can be easily obtained, encoded and used in digital environment.

There are also some challenges for using the Iris for identifying people:

- The object to deal with (iris) is small.
- The dynamic movement of Iris which requires extra technical efforts to capture the right angle of iris.
- Iris is positioned behind a curved and reflective surface namely cornea.
- We may not get a good capture of the iris due to eyelashes, eyebrows and contact lens.
- Iris size changes with light source. It gets wider in dark and smaller in light.
- To have a perfect iris image, the light source must be hidden and not shiny.

III. Application of the Iris in Biometric Systems

Iris recognition has tremendous potential for security in any field. The iris is extremely unique and cannot be artificially impersonated by a photograph (Daugman, 2003).This enables security to be able to restrict access to specific individuals.

An iris is an internal organ making it immune to environmental effects. Since an iris does not change over the course of a lifetime, once an iris is encoded it does not need to be updated. The only drawback to iris recognition as a security installment is its price, which will only decrease as it becomes more widely used.

A recent application of iris recognition has been in the transportation industry, most notably airline travel. The security advantages given by iris recognition software have a strong potential to fix problems in transportation (Breault, 2005). Its most widely publicized use is in airport security. IBM and the Schiphol Group engaged in a joint venture to create a product that uses iris recognition to allow passengers to bypass airport security (IBM 2002). This product is already being used in Amsterdam. A similar product has been installed in London's Heathrow, New York's JFK, and Washington's Dulles airports (Airport, 2002). These machines expedite the process of passengers going through airport security, allowing the airports to run more efficiently.

Iris recognition is also used for immigration clearance, airline crew security clearance, airport employee access to restricted areas, and as means of screening arriving passengers for a list of expelled persons from a nation (Daugman, 2005). This technology is in place in the United States, Great Britain, Germany, Canada, Japan, Italy, and the United Arab Emirates.

IV. Biometric System Stages

The system has the following stages [8]

a) *Image acquisition*

We use a special camera to capture a clear picture of the eye, in order to have a clear shot of the inner eye boundaries with the pupil and the outer boundaries with eye Sclera.

b) *Preprocessing*

In this stage several activities takes place to process the image. We shall try to summarize them as follows:

a) Convert the color RGB image to Gray scale.
b) Normalize of the image's histogram in order to distribute the density on the entire range [0-256].
c) Images dimensions are unified.
d) Determine the inner and outer boundaries of the eye iris. In this step, the determination of the inner boundaries of the Iris is identified; with the assumption that the pupil position from the outer boundaries compared to the inner boundaries of the Iris with a rate of 1.5 from the eye center as shown in the following figure:

We may also add a constant value related to the race of the human (white, black, and yellow) as we have noticed from the many thousands of experiments conducted to this respect.

e) Iris center is then determined assuming that it is equal to the center of the pupil, although in many cases we found that both centers may have a difference between 5-6 pixels, but such small difference will affect our results.
f) Then we convert Image's Cartesian coordinates to Polar coordinates using the following method:

- With the assumption that the center of pupil is identical of the Iris center, we draw x, y access at the center of the image.
- We assumed that the cross section of these lines with the outer boundaries forms the frame edges where the picture is placed within.
- Then we convert the Cartesian coordinates to Polar coordinates based on the center of the image and not based on the center of the pupil.
- Then we remove the pupil area because it contains no information, and hence we are left with a clear iris.

In general, we can convert Cartesian coordinates to Polar coordinates using the following equations:

$$I\left(x(p,\theta), y(p,\theta)\right) = I(p,\theta)$$
$$x(p,\theta) = (1-p)\,.\,Xp(\theta) + p\,.Xi(\theta)$$
$$y(p,\theta) = (1-p)\,.\,Yp(\theta) + p\,.Yi(\theta)$$

Whereas

$$Xp(\theta) = Xp\theta(\theta) + Rp\,.\cos(\theta)$$
$$Yp(\theta) = Yp\theta(\theta) + Rp\,.\sin(\theta)$$
$$Xi(\theta) = Xi\theta(\theta) + Ri\,.\cos(\theta)$$
$$Yi(\theta) = Yi\theta(\theta) + Ri\,.\sin(\theta)$$

With

$[(2\pi,0)\theta]\theta$ and $p[p(1,0)]$ represents the parameters that describe the conversion system to Polar coordinates.

Rp , *Ri* represents the radius of the pupil and iris respectively; and

Yi(θ) , Xi(θ) and p(θ),Xp(θ) represents the iris and pupil boundaries coordinates respectively.

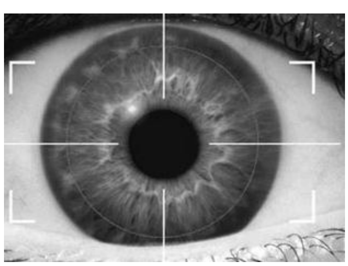


Figure (1) Original Image - the vertical and horizontal lines crossing the eye pupil at the capture stage

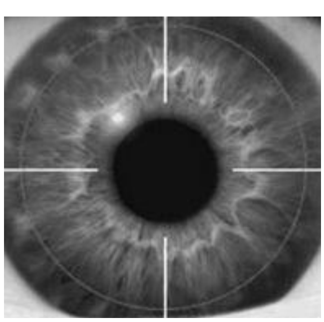


Figure (2) iris image after determining its inner and outer boundaries (outlines located)

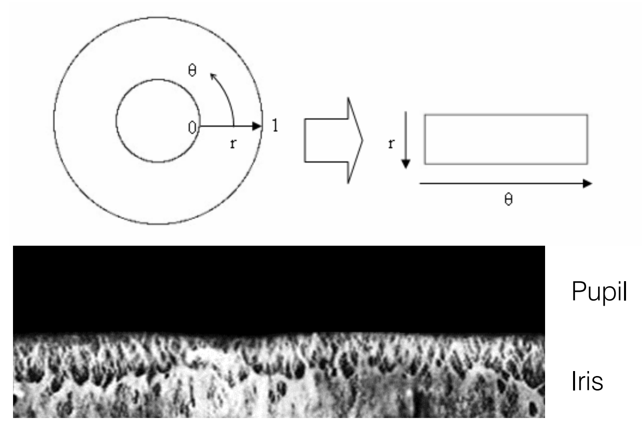


Figure (3) the iris image after conversion from Cartesian to Polar coordinates (Re-sampled Polar-Cartesian)

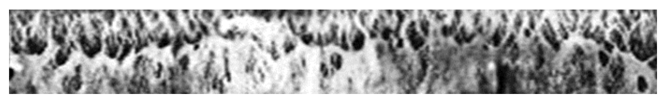


Figure (4) the iris image that will be processed and encoded (Intensity Enhanced)

c) *Post-processing stage.*

In this stage we encode the iris in order to save it at the end of the entry as a template. This process can be performed by the application of Gabor filter [8] or Wavelet Transformation [2], [3].

Application of Gabor Filter:

- We apply Gabor filer on the iris part and we get at the end we get two values that determines the image's elements. One of these values is real and the other is imaginary.
- Then we extract the phase for each value and prepare them for encoding.
- At this stage we encode the phases assuming "1" for values greater than 1 and "0" for values less than in order to get final values representing the phase.

Application of Wavelet Transformation

The aim of using this method is to have few images for the eye in different resolutions. Wavelet is cable of dealing with the smallest details in the image which is an advantage compared with other transformation methods.

* When application of Wavelet, the image passes through two types of filters, high and low frequency as shown in Figure (5):

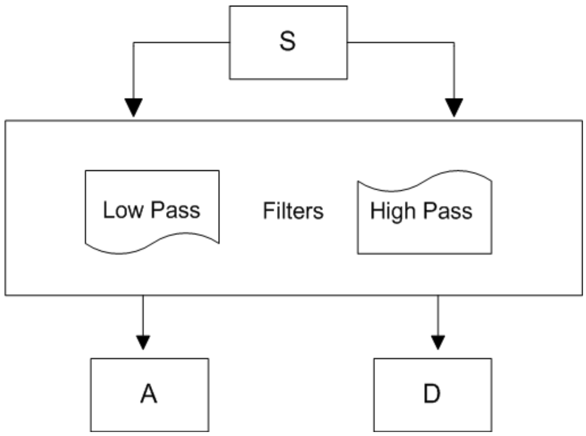


Figure (5): First stage in application of Wavelet transformation

We get two coefficients namely: “A” representing low frequencies in the signal called approximation coefficients, and we get “D” representing high frequencies in the signal called detailed coefficients; This coefficients also has detailed confidents namely (H) horizontal, (V) vertical and (D) diagonal.

* We then pass these approximate coefficients in to high and low frequencies filters in order to get new set of coefficients namely A1 and D1; and so on we repeat the process several times. In ideal situations when dealing with images the process is repeated /3/ times and when dealing with uni-directional frequencies, the process is repeated /7/ times.

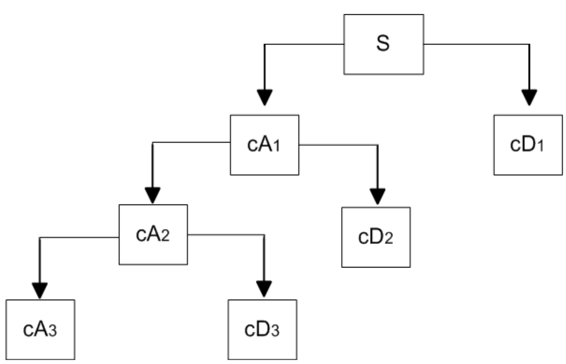


Figure (6): 3-level Wavelet transformation

* We can also apply the same analysis on the detailed coefficients until we get a magnified signal analysis.

* The next important step is to choose the best filter as there are many of them:

- Haar
- Daubechies
- Biorthogonal
- Coiflets
- Symlets
- Morlet
- Mexican Hat
- Meyer

In this research paper, we shall use “Haar” for simplicity; and as we apply this filter we get various different images of the same iris in different resolutions; we then combine the D and V coefficients for the last level of the analysis in one matrix. After that we add the H coefficient to the matrix to get a final one which will be encoded as a template for the original iris used for future comparisons.

d) *Matching Stage*

This process is carried out using the stored template and the captured iris using the hamming distance given in the following formula:

$$HD = \frac{1}{N}\sum_{j=1}^{N} Xj(XOR)Yj$$

Whereas,
“N” is the number of elements in the matrix.
“X,Y” are the elements in the both matrixes being compared.

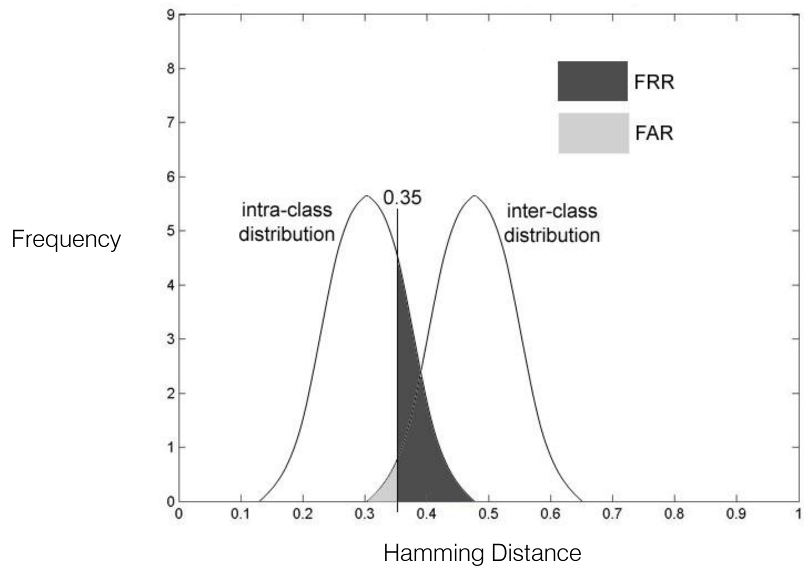
The matching is considered to be identical if HD = 0 and if HD = 1 then there is no match. By matching we mean deciding the identity of the person subject to the test.

e) *The Decision Stage*

In this stage we determine the Threshold of the matching value which will highly affect the nature of the decision the system will carry out. This stage is also critical as it also determine the fault rates of the system namely the False Accept (FAR) and False Reject Rates (FRR).

In the system that was designed by “J. Daugman, 2003” the Threshold was 0.32, meaning if HD < 0.32 then we have a match, and if HD > 0.32 then we don’t have a match.

Global Journal of Computer Science and Technology Volume XI Issue VII Version I May 2011



References Références Referencias

1. Kheder Durah, ICT Consultant, Associate Professor and Deputy Dean at Faculty of Computer Science and Engineering, Taibah University, Yanbu Branch, Kingdom of Saudi Arabia, email: kdurah@gmail.com, Tel: (+966)552658076.
2. Omar Al Zoubi, Assistant Prof. and Dept. Head at Faculty of Computer Science and Engineering, Taibah University, Yanbu Branch, Kingdom of Saudi Arabia, email: dr_omar1978@yahoo.com, Tel: (+966)530634650.
3. Bilal Alzoubi, Assistant Prof. Faculty of Computer Science, OmAlqora University, ALQunfdah, Kingdom of Saudi Arabia, email: bilal_14879jo@yahoo.com , Tel: (+966)507233770.
4. S. Sanderson, J. Erbetta. Authentication for secure environments based on iris scanning technology. *IEE Colloquium on Visual Biometrics*, 2000.
5. J. Daugman. How iris recognition works. Proceedings of 2002 International Conference on Image Processing, Vol. 1, 2002.
6. E. Wolff. *Anatomy of the Eye and Orbit*. 7th edition. H. K. Lewis & Co. LTD, 1976.
7. R. Wildes. Iris recognition: an emerging biometric technology. *Proceedings of the IEEE*, Vol. 85, No. 9, 1997.
8. J. Daugman. Biometric personal identification system based on iris analysis. United States Patent, Patent Number: 5,291,560, 1994.
9. J. Daugman. High confidence visual recognition of persons by a test of statistical independence. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 15, No. 11, 1993.
10. R. Wildes, J. Asmuth, G. Green, S. Hsu, R. Kolczynski, J. Matey, S. McBride. A system for automated iris recognition. *Proceedings IEEE Workshop on Applications of Computer Vision*, Sarasota, FL, pp. 121-128, 1994.
11. W. Boles, B. Boashash. A human identification technique using images of the iris and wavelet transform. *IEEE Transactions on Signal Processing*, Vol. 46, No. 4, 1998.
12. S. Lim, K. Lee, O. Byeon, T. Kim. Efficient iris recognition through improvement of feature vector and classifier. *ETRI Journal*, Vol. 23, No. 2, Korea, 2001.
13. S. Noh, K. Pae, C. Lee, J. Kim. Multiresolution independent component analysis for iris identification. *The 2002 International Technical Conference on Circuits/Systems, Computers and Communications*, Phuket, Thailand, 2002.
14. Y. Zhu, T. Tan, Y. Wang. Biometric personal identification based on iris patterns. *Proceedings of the 15th International Conference on Pattern Recognition*, Spain, Vol. 2, 2000.
15. C. Tisse, L. Martin, L. Torres, M. Robert. Person identification technique using human iris recognition. *International Conference on Vision Interface*, Canada, 2002.
16. Chinese Academy of Sciences – Institute of Automation. *Database of 756 Greyscale Eye Images*. http://www.sinobiometrics.com Version 1.0, 2003.
17. C. Barry, N. Ritter. *Database of 120 Greyscale Eye Images*. Lions Eye Institute, Perth Western Australia.

18. W. Kong, D. Zhang. Accurate iris segmentation based on novel reflection and eyelash detection model. *Proceedings of 2001 International Symposium on Intelligent Multimedia, Video and Speech Processing*, Hong Kong, 2001.
19. L. Ma, Y. Wang, T. Tan. Iris recognition using circular symmetric filters. National Laboratory of Pattern Recognition, Institute of Automation, Chinese Academy of Sciences, 2002.
20. N. Ritter. Location of the pupil-iris border in slit-lamp images of the cornea. *Proceedings of the International Conference on Image Analysis and Processing*, 1999.
21. M. Kass, A. Witkin, D. Terzopoulos. Snakes: Active Contour Models. *International Journal of Computer Vision*, 1987.
22. N. Tun. *Recognising Iris Patterns for Person (or Individual) Identification*. Honours thesis. The University of Western Australia. 2002.
23. D. Field. Relations between the statistics of natural images and the response properties of cortical cells. *Journal of the Optical Society of America*, 1987.
24. P. Burt, E. Adelson. The laplacian pyramid as a compact image code. *IEEE Transactions on Communications*. Vol. 31 No. 4. 1983.
25. P. Kovesi. *MATLAB Functions for Computer Vision and Image Analysis*.Available at: http://www.cs.uwa.edu.au/~pk/Research/MatlabFns/index.html
26. A. Oppenheim, J. Lim. The importance of phase in signals. *Proceedings of the IEEE 69*, 529-541, 1981.
27. P. Burt, E. Adelson. The laplacian pyramid as a compact image code. *IEE Transactions on Communications*, Vol. COM-31, No. 4, 1983.
28. J. Daugman. Biometric decision landscapes. *Technical Report No. TR482, University of Cambridge Computer Laboratory,* 2000.
29. T. Lee. Image representation using 2D gabor wavelets. *IEEE Transactions of Pattern Analysis and Machine Intelligence*, Vol. 18, No. 10, 1996.
30. Birkhauser, "Friendly Guide to Wavelet", Boston 1994.
31. MATLAB 5, source code for the iris recognition software presented in this publication is available via the World Wide Web at the address. http://www.csse.uwa.edu.au/~masekl01/.
32. J. Daugman, "Anatomy and Physiology of the Iris", 2003 from www.cl.cam.ac.uk/users/jgd/addisadvans.html.
33. European Commission Joint Research Center (DG JRC) Institute for progressive technologies studies, 2005 www.jrc.es
34. J. Daugman, "How Iris Recognition Works", Proceedings of 2002 International conference on Image processing val. 1, 2002.
35. J. Daugman, "Complete Discrete 2D Gabor Transfors by neural Networks for Image Analysis and Comparession", Vol.36 No. 7 1988.