# Personal Authentication Based on Iris Recognition

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***Abstract*— Iris recognition in personal authentication has been recognized as most powerful biometric technology. For everyone, Iris is the part of body that doesn't change in person lifetime. Hence Iris recognition is the important and different from other biometric technology. Iris pattern is also a unique. i.e no two persons have same Iris pattern not even same in two eyes of same person The first step in Iris recognition technology is to having a person eye scanned using infrared camera. Then pattern of iris is isolated from the rest of the image and analyzed& put it to a system coordinates. Extracted coordinates have digital information and will get digital signature that cannot be restored and reproduced even if it disclosed. This made iris recognition as the powerful technology to identify the person. Most accurate, Scalable, Non-contact properties made this technology even more powerful.**

***Index Terms:* Iris, Authentication, Scanned, Coordination, Technology, Biometric.**

## INTRODUCTION

Iris is the plainly visible, colored ring that surrounds the pupil. It is amuscular structure that controls pits, and furrows. The iris is not to be confused with the retina, which lines the inside of the back of the eye. No two irises are alike. There is no detailed correlation between the iris patterns of even identical twins, or the right and left eye of an individual. The amount of information that can be measured in a single iris is much greater than fingerprints, and the accuracy is greater than DNA.

Taking a Picture:
An iris recognition camera takes a picture from 5 to 24 inches away, depending on the type of camera. The camera uses non-invasive, near infrared illumination (similar to a TV remote control) that is barely visible and very safe. Proof Positive certified cameras are in compliance with all applicable international illumination safety standards, including ANSI/IESNA RP-27.1-96 and IEC 60825-1 Amend.2, Class 1 LED. The latest worldwide standards. Unlike other biometric technologies that can be used in surveillance mode, iris recognition is an opt-in technology. In order to use the technology you must first glance at a camera. Iris recognition cannot take place without your permission.

Iris Recognition
In less than a few seconds, even on a database of number of records, the IrisCode template generated from a live image is compared to previously enrolled ones to see if it matches any of them. The decision threshold is automatically adjusted for the size of the search database to ensure that no false matches occur even when huge numbers of IrisCode templates are being compared with the live one.
Some of the bits in an IrisCode template signify if some data is corrupted (for example by reflections, or contact lens boundaries), so that it does not influence the process, and only valid data is compared. Decision thresholds take account of the amount of visible iris data, and the matching operation compensates for any tilt of the iris.
A key advantage of iris recognition is its ability to perform identification using a one-to-all search of a database, with no limitation on the number of IrisCode records and no requirement for a user first to claim an identity, for example with a card.

Requirements:
Correctly identify the iris in the given photograph.
Correctly match the subject to a known identity.
Determine the subject's existence in the database within 10 seconds.
Must be able to properly identify a mismatched subject on a subsequent attempt

Stages of Iris Detection
Stage 1: Scan Eye
The eye scanning will be simulated in this system as we have no method of takingreal-time images of

subjects. Therefore, all eye images are to be jpeg image files at least 1000 x 1000 pixels in dimension. The eye is scanned by manually selecting the file and instructing the agent to scan it. The agent begins scanning an eye by turning the jpeg file into an image object infull color (24 bit RGB).

Stage 2: Eye Grayscaling Algorithm

The agent next converts the full-color image to an 8-bit representation. This reduces space complexity, making further computations faster without losing reliability.

Stage 3: Median Filter

Applies a median filter to the grayscaled image to reduce the amount of noise and artifacts before the pupil center detection.

Stage 4: Pupil Center Detection

To perform the fifth step, the agent must now find the center of the pupil to orientthe coordinate system at the center of the eye.

Stage 5: Canny Edge Detection

Step 5 also requires that the of the iris and pupil be marked so an edge detection process needs to be completed by the agent. We decided to have the agent use the 'Canny Edge Detection' algorithm.

Stage 6: Pupil And Iris Radius Detection Algorithm

In this stage the agent attempts to find the radius of both the pupil and iris using the center found in stage 3 and the edges found in stage 4. The radii will be used by the agent in both step 6 and 7.

Stage 7: Iris Localization

This process is mostly for visual purposes and refers to removing erroneous information from the original image outside of the iris radius, whereby leaving only the image within the bounds of the iris radius intact.

Stage 8: Iris Unrolling Algorithm

The agent must now use the radii found in stage 5 as well as the pupil center found in stage 3 to perform the unrolling of the iris. Traversing the eye in a polar coordinate, circular fashion, the agent maps information from the original image tothe output (unwrapped) image.

Stage 9: Iris Matching

Scans the eye to be matched using the previous 8 steps.

- Iterates over each of the identies in the memory and performs the followingsteps .
- Performs a mean filer on the unrolled image stored in memory
- Subtracts the mean filtered image from the unwrapped image of the eye being matched to
- Computes a percentage difference between the eye being matched and theidentity.
- Selects the identity that has the highest percentage match and displays the result to the user in a dialog box

Software Requirements Specification

The requestor should indicate which features are mandatory and which are optional, to avoid overly constraining design decisions. The requestor should avoid describing system internals, as this restricts implementation flexibility. Performance specifications and protocols for interaction with external systems are legitimate requirements

Requirements:

Software Used: JDK 1.5/Java Swing

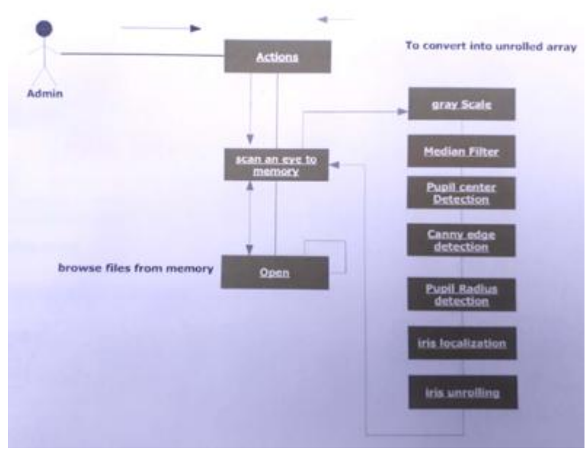
Hardware Used: Pentium IV, 128 MB of RAM, clock speed 900 MHz.

System Design

To design a iris recognition system based on an empirical analysis of the iris image and it is split in several steps using local image properties.

The system steps are

- capturing iris patterns
- determine the location of the iris
- boundaries converting the iris boundary to the stretched polar coordinate system
- extracting the iris code based on texture analysis using wavelet transforms
- Classification of the iris code.




UML Communication Diagram

Feature Code Generation

The majority of researchers have proposed wavelets approaches in order to capture local iris features at different scales. After the iris image segmentation process is completed, the iris code is performed using Haarwavelet packets as well as the energy of the packets sub-images to extract texture phase structure information of the iris and to compute the iris 64-bits codes. Figure 1. Wavelet packets decomposition for iris image The Iris code generation process can be summarized in the following:

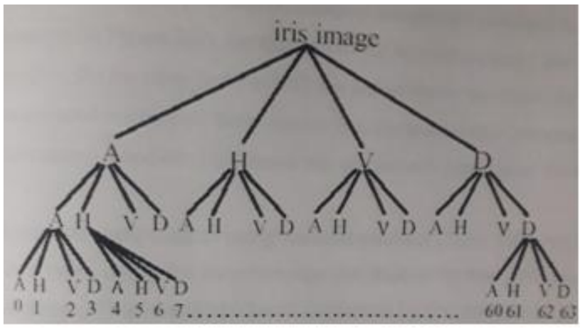



Figure 1. Wavelet packets decomposition for iris image

1. Wavelet packets decomposition: The Haar wavelet is used in a 3-level wavelet packet decomposition to extract the texture features of the unwrapped images. This generates 64 wavelet packets (output iris sub images), numbered 0 to 63. The images contain approximation (A), horizontal detail (H), vertical detail (V) and diagonal detail (D) coefficients respectively as shown in Figure 1.

$$E_i = \sum_{j.k} W_i(j,k)^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

In our approach, we use the appropriate wavelet packet energies of each iris image to compute the adapted threshold to encode the 64 sub images. Let El...E be the appropriate wavelet packet energies of the packets 1... respectively. We define the normalized adapted threshold S as follows:

$$S=Coeff.\frac{\mu(E1\ldots E\lambda)}{Max\,(E1\ldots E\lambda)} \qquad \ldots\ldots\ldots\ldots(2)$$

where (Ei... E) represents the mean wavelet peak energy value, Coeff as a constant and is the number of the appropriate energies. Therefore, the threshold S is not optimized experimentally (S=10) for all iris images but each iris wavelet decomposition produces the adapted threshold S.

3. Iris feature coding:

After determination the appropriate wavelet packets energies and the normalized adapted threshold, we can carry out the coding of the 64 wavelet packets energies to generate a compact iriscode by quantizing these energies into one bit accordingto each appropriate energy. Let E be theappropriate energy of the peak. Then the iriscode C computed according to E we define by the following:

$$C\lambda(j) = \begin{cases} 1 & if\ \frac{Ej}{E\lambda} > S \\ 0 & \end{cases} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

*Where j=0.....63*

In our approach, we have used significant wavelet Coefficients of the iris sub image. Each used appropriate energy resulting in a of 64 bits which correspond to the 64 sub images of the iris wavelet decomposition. Therefore, we obtain one iris code according to each energy.

We note that our iris coding gives distinct iris codes for each appropriate energy E

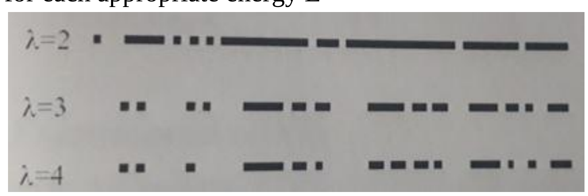



Figure 5.Iriscodes according to packet energies.

3. Iriscodes matching

The iris codes matching task is performed by pairing the iriscodes extracted from the input and the template iris images. The most common comparison method of iris signatures is the Hamming Distance (HD) . This comparison is to be made with the user's iris template, which will be calculated depending on the binary matching algorithm which is implemented by the Boolean exclusive-OR operator () applied to the 64 bit vectors that encode any two iris codes.

*Let* $T= \{C1(j) \quad j = 0 \ldots N\}$ *and* $I = \{C^1_k\ (j)\ j=0\ldots N\}$ ……………..(4)

The preceding distance is computed according to the appropriate energy (maximal value) between two iris signatures in order to decide if both come from images of the same iris (authentic distance) or from images of different iris (impostoristance). Therefore, the combination of two or several packets is likely to hold more discriminating information than what each of them does separately as mentioned in. So, the preceding distance can be extended for two appropriate energies of each iris image as follow :

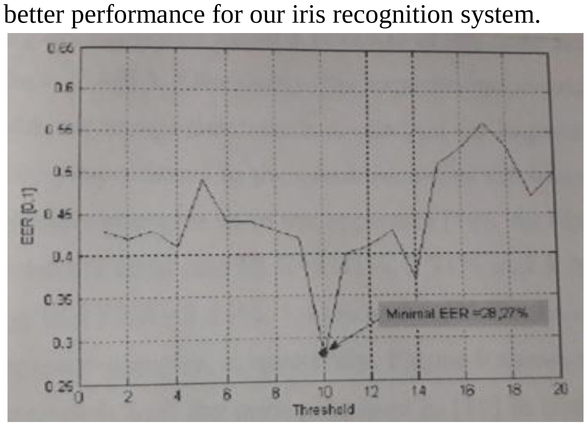
$$HD_{i,k}=\frac{1}{2*N}\sum_{j=0}^{j=N}.||C_i(j) \oplus C_k(j)||.||C_i(j) \oplus C_k(j)|| \ldots\ldots..(5)$$

4. Experimental results

Automatic detection of the pupils is easier because database images have a black circle in the pupil and some of these black circles cover the part of iris and also the specularreflection. First, we report the experimental results obtained running our algorithmusing several wavelets categories. Thereafter, we present some result to study the effect of the wavelet packet combination. Finally, we compare our performance with the algorithms reported which use the fixed threshold. For the first experiment, we have uses the first wavelet packet feature that has the maximal energy value to generate the iris signature . This experiment was motivated by an iris code computation using only two appropriate energies according to the equation (2 and 3) to compute the adapted threshold and one iris code according to the maximal energy.Clearly, using the first appropriate energy, the Haar wavelets are most suitable for iris recognition.

Thus, our matching algorithm is slower with the error rate EER=2,38%, 4.67%,4.68%, 5.28% and 6.28% for Biothogonal, Daubechies, Symlet, Coifletand Haar wavelets, respectively.

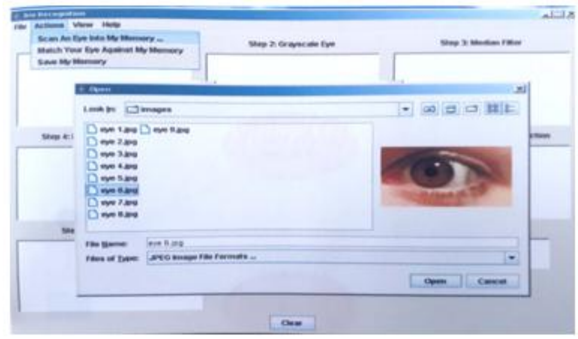
we can see consistent performance improvement of our matching using the first and the third energies of each iris image decomposition. Hence, using the combination of these appropriate energies for iris code generation, our matching algorithm is slower with the error rate EER=1.41% using Haar wavelets. The drawn significant result starting from these experiments is that the combination of the wavelet packets for the other wavelets types does not give a better performance for our iris recognition system.




The threshold optimized experimentally in the approach proposed

We illustrate in the above Figure, the minimal ERR curve by varying the threshold S from 1 to 20. With the threshold S=10, we obtain the minimal EER for the database. Clearly, the matchingalgorithm achieves better performance for the threshold S=10 using the packets 2 and 49 with EER-28.27%.

Screenshots



CONCLUSION

The primary focus of this work is a personal authentication system based on human iris verification using wavelet packets decomposition. The proposed technique uses only appropriate packets with dominant energies to encode iris texture according the adapted thresholds. The usefulness of this approach was confirmed in the experiments conducted here, which reveals that the verification results with an EER-0.3% has been obtained for packets combination, which means that our system is appropriate for very high security environments.

Iris recognition technology is used when to give high level of security. Ex: immigration office, hospital, international banking. it will certainly make great leap for forward as safe and easy authentication in IOT era. Even we can use this in mobile banking, e-commerce, stock exchange etc.

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