

Personal Authentication Based on IRIS Recognition

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Abstract— (Iris recognition is the process of recognizing a person by analyzing the apparent pattern of his or her iris. There is a strong scientific demand for the proliferation of systems, concepts and algorithms for iris recognition and identification. This is mostly because of the comparatively short time that iris recognition systems have been around. In comparison to face, fingerprint and other biometric traits there is still a great need for substantial mathematical and computer-vision research and insight into iris recognition. One evidence for this is the total lack of publicly available adequate datasets of iris images. The program converts a photo of an eye to an 'unrolled' depiction of the subject's iris and matches the eye to the agent's memory. If a match is found, it outputs a best match. The current functionality matches that proposed in the original requirements.

Index Terms— Human Iris Authentication, Statistical Correlation Coefficient, False Acceptance Rate, False Rejection Rate, Biometrics, image quality, Machine learning, iris recognition.

I. INTRODUCTION

The human iris is so unique that no two irises are alike, even among identical twins, in the entire human population. Recently, human iris biometric based identification has attracted the attention of research and development community. Iris recognition has many advantages over the other forms of biometric identification. Iris recognition is the most accurate form of identification known to man. It is also capable of making a match from a database of over 1 million records in less than a second. The iris image remains stable from the age of about 10 months up until death. Non-invasive, users wearing gloves, protective wear, glasses, safety goggles and even contact lenses can operate iris recognition systems. This means that not only is iris recognition the most accurate biometric technology, it is also the safest.

All images taken for this work are from MMU1 Iris database. MMU1 iris database contributes a total number of 450 iris images which were taken using LG IrisAccess®2200. This camera is semi automated and it operates at the range of 7-25 cm. They come from Asia, Middle East, Africa and Europe. Each of them contributes 5 iris images for each eye. These images are 100 × 100 24-bit Bitmap (.bmp), each occupying 32,768 bytes on a hard drive. After generating Iris pattern images take 10 different 12 × 8 iris pattern images of each authorized individuals of an organization to make a database against his/her identification number. Now, By considering Biological characteristics of IRIS Pattern we use Statistical Correlation Coefficient for this 'IRIS Pattern'

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recognition where Statistical Estimation Theory can play a big role.

Security and the authentication of individuals is necessary for many different areas of our lives, with most people having to authenticate their identity on a daily basis; examples include ATMs, secure access to buildings, and international travel. Biometric identification provides a valid alternative to traditional authentication mechanisms such as ID cards and passwords, whilst overcoming many of the shortfalls of these methods; it is possible to identify an individual based on "who they are" rather than "what they possess" or "what they remember". Iris recognition is a particular type of biometric system that can be used to reliably identify a person by analysing the patterns found in the iris. The iris is so reliable as a form of identification because of the uniqueness of its pattern. Although there is a genetic influence, particularly on the iris' colour, the iris develops through folding of the tissue membrane and then degeneration (to create the pupil opening) which results in a random and unique iris. In comparison to other visual recognition techniques, the iris has a great advantage in that there is huge variability of the pattern between individuals, meaning that large databases can be searched without finding any false matches.

II. IRIS RECOGNITION TECHNOLOGIES

A. The Iris

The iris has many features that can be used to distinguish one iris from another. One of the "primary visible characteristic is the trabecular meshwork, a tissue which gives the appearance of dividing the iris in a radial fashion"⁴ that is permanently formed by the eighth month of gestation. During the development of the iris, there is no genetic influence on it, a process known as "chaotic morphogenesis" that occurs during the seventh month of gestation, which means that even identical twins have differing irises. The iris has in excess of "266 degrees of freedom" i.e. the number of variations in the iris that allow one iris to be distinguished from another. The fact that the iris is protected behind the eyelid, cornea and aqueous humour means that, unlike other biometrics such as fingerprints, the likelihood of damage and/or abrasion is minimal. The iris is also not subject to the effects of aging which means it remains in a stable form from about the age of one until death. The use of glasses or contact lenses (coloured or clear) has little effect on the representation of the iris and hence does not interfere with the recognition technology.

B. Iris Recognition Process

The process of capturing an iris into a biometric template is made up of 3 steps:

1. Capturing the image
2. Defining the location of the iris and optimising the image
3. Storing and comparing the image.

a) *Capturing the Image*

The image of the iris can be captured using a standard camera using both visible and infrared light and may be either a manual or automated procedure. The camera can be positioned between three and a half inches and one meter to capture the image. In the manual procedure, the user needs to adjust the camera to get the iris in focus and needs to be within six to twelve inches of the camera. This process is much more manually intensive and requires proper user training to be successful. The automatic procedure uses a set of cameras that locate the face and iris automatically thus making this process much more user friendly.

b) *Defining the Location of the Iris and Optimising the Image*

Once the camera has located the eye, the iris recognition system then identifies the image that has the best focus and clarity of the iris. The image is then analysed to identify the outer boundary of the iris where it meets the white sclera of the eye, the pupillary boundary and the centre of the pupil. This results in the precise location of the circular iris.

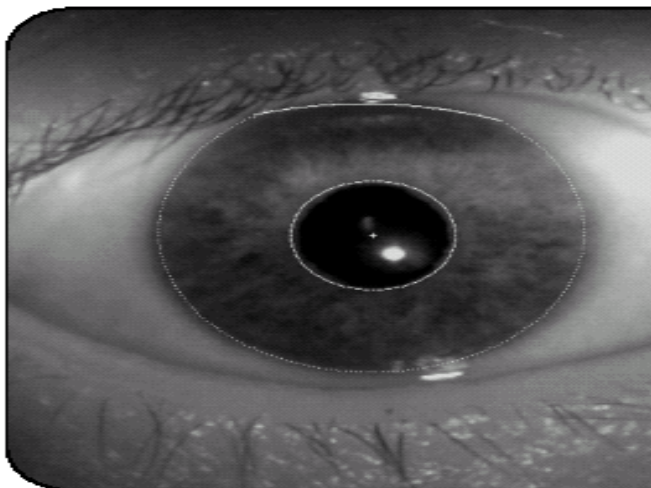


Fig 1: Circular Iris Location

The iris recognition system then identifies the areas of the iris image that are suitable for feature extraction and analysis. This involves removing areas that are covered by the eyelids, any deep shadows and reflective areas. The following diagram shows the optimisation of the image.

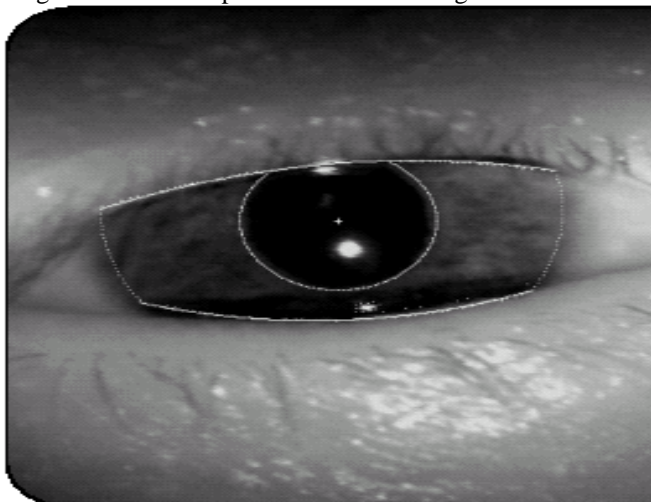


Fig 2: Optimising the Image

c) *Storing and Comparing the Image*

Once the image has been captured, “an algorithm uses 2-D Gabor wavelets to filter and map segments of the iris into hundreds of vectors (known here as phasors)”⁹. The 2-D Gabor phasor is Simply the “what” and “where” of the image. Even after applying the algorithms to the iris image there are still 173 degrees of freedom to identify the iris. These algorithms also take into account the changes that can occur with an iris, for example the pupil’s expansion and contraction in response to light will stretch and skew the iris. This information is used to produce what is known as the IrisCode®, which is a 512-byte record. This record is then stored in a database for future comparison. When a comparison is required the same process is followed but instead of storing the record it is compared to all the IrisCode® records stored in the database. The comparison also doesn’t actually compare the image of the iris but rather compares the hexadecimal value produced after the algorithms have been applied.

The following table shows the probabilities of false accept and false reject with iris recognition technology:

Table 1 Hamming Distances & Error Probabilities¹⁰

Hamming distance	False accept probability	False reject probability
.28	1 in 10	1 in 11,400
.29	1 in 10	1 in 22,700
.30	1 in 6.2 billion	1 in 46,000
.31	1 in 665 million	1 in 95,000
.32	1 in 81million	1 in 201,000
.33	1 in 11 million	1 in 433,000
.34	1 in 1.7 million	1 in 950,000
.342	1 in 1.2 million	1 in 1.2 million
.35	295,000	1 in 2.12million
.36	57,000	1 in 4.84 million
.37	12,3000	1 in 11.3 million

C. Iris process flow diagram

8 Stages of Iris Detection:

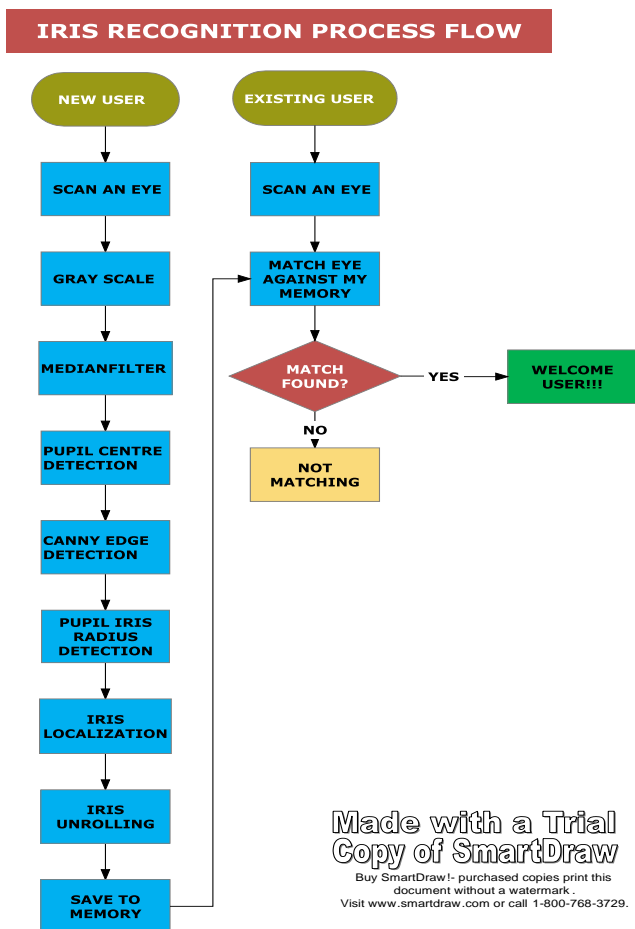
Stage 1: Scan Eye: The eye scanning will be simulated in this system as we have no method of taking real-time images of subjects. Therefore, all eye images are to be jpeg image files at least 1000 x 1000 pixels in dimension. The eye is scanned by manually selecting the file and instructing the agent to scan it. The agent begins scanning an eye by turning the jpeg file into an image object in full color (24 bit RGB).

Stage 2: Eye Grayscale 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 orient the coordinate system at the center of the eye.

Stage 5: Canny Edge Detection: Step 5 also requires that the edges 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 to the output (unwrapped) image.

Stage 9: Iris Matching: Scans the eye to be matched using the previous 8 steps.

- Iterates over each of the identities in the memory and performs the following steps.
- Performs a mean filter 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 the identity.
- Selects the identity that has the highest percentage match and displays the result to the user in a dialog box.

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.

III. PROPOSED SYSTEM

Biometric-based personal verification and identification methods have gained much interest with an increasing emphasis on security. Iris recognition is a fast, accurate and secure biometric technique that can operate in both verification and identification modes. The iris texture pattern has no links with the genetic structure of an individual and since it is generated by chaotic processes. Externally visible; patterns imaged from a distance Iris patterns possess a high degree of randomness.

ADVANTAGES: In proposed system we are using three new methods to improve performance of a single biometric matcher.

- Uniqueness: set by combinatorial complexity.
- Variability: 244 degrees-of-freedom.
- Entropy: 3.2 bits per square-millimeter.
- Highly protected, internal organ of the eye.

IV. EXPERIMENTAL RESULTS

In this section, we analyze the performance of the proposed iris verification algorithm. So, to evaluate the performance of our algorithm, different experiments on the Institute of Automation, Chinese Academy of Science, CASIA databases have been carried out. As mentioned in , automatic detection of the pupils is easier because CASIA database images have a black circle in the pupil and some of these black circles cover the part of iris and also the specular reflection. First, we report the experimental results obtained running our algorithm using 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 in 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 (to encode 64 bits of the wavelet packets). This experiment was motivated by an iris code computation using only two appropriate energies according to the equation to compute the adapted threshold and one iris code according to the maximal energy. The energy corresponding to sub image 0 has not been used because this sub image contains offset information.

V. CONCLUSION AND FUTURE SCOPE

This paper presents a literature review on the various iris recognition techniques. This paper emphasizes on biometric identification scheme that utilizes iris image as verification source because this organ's characteristics do not

vary so much with ageing effect. Most of the time for iris localization and segmentation wavelets are effective solution and for coding purpose Gabor filters are used. Canny edge detector's performance is much better compare to other edge detection techniques. Finally, for template matching hamming distance method perform well.

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.

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