A NOVEL APPROACH FOR AN ACCURATE HUMAN IDENTIFICATION THROUGH IRIS RECOGNITION USING BITPLANE SLICING AND NORMALISATION

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ABSTRACT

Unlike other biometrics such as fingerprints and face, the distinct aspect of iris comes from randomly distributed features. This leads to its high reliability for personal identification and at the same time, the difficulty in effectively representing such details in an image. Iris recognition illustrates work in computer vision, pattern recognition, and the man-machine interface. The purpose is real-time, high confidence recognition of a person's identity by mathematical analysis of the random patterns that are visible within the iris of an eye from some distance. Iris is a protected internal organ whose random texture is stable throughout life, it can serve as a kind of living password that one need not remember but one always carries along. Because the randomness of iris patterns has very high dimensionality, recognition decisions are made with confidence levels high enough to support rapid and reliable exhaustive searches through national-sized databases. Iris recognition has shown to be very accurate for human identification. This paper proposes a technique for iris pattern extraction utilizing the least significant bit-plane through binary morphology applied to the bit-plane and by evaluating the standard deviation of the image intensity along the vertical and horizontal axis, the pupillary boundary of the iris is determined. The limbic boundary is identified by adaptive thresholding method. Because the extraction approach restricts localization techniques to evaluating only bit-planes and standard deviations, iris pattern extraction is dependent on circular edge detection. The iris normalization was invariant for translation, rotation and scale after mapping into polar coordinates. Experiment and results show that the proposed method has an encouraging performance, shows 98.7% localization and normalization success and reduces the system operation time. The proposed method involves Bit plane slicing, Standard deviation windows, Adaptive thresholding, Normalization modules.

Keywords: *iris, pattern, identification, thresholding, pupilary, normalization*

1.INTRODUCTION

Biometrics is the science of measuring physical properties of living beings. It is a collection of automated methods to recognize an individual person based upon a physiological or behavioral characteristics. The characteristics measured are face, fingerprints, hand geometry, handwriting, iris, retinal, vein, voice etc. In present technology scenario biometric technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solutions. As the level of security breaches and transaction fraud increases, the need for highly secure identification and personal verification technologies is becoming apparent. Biometrics involves using the different parts of the body, such as the fingerprint or the eye, as a password or form of identification. Currently, in crime Investigations fingerprints from a crime scene are being used to find a criminal. However, biometrics is becoming more public. Iris scans are used in United Kingdom at ATM's instead of the normal codes. In Andhra Pradesh Iris recognition is being used to issue house hold ration cards.

Practically all biometric systems work in the same manner. First, a person is enrolled into a database using the specified method. Information about a certain characteristic of the human is captured. This information is usually placed through an algorithm that turns the information into a code that the database stores. When the person needs to be identified, the system will take the information about the person again, translates this new information with the algorithm, and then compares the new code with the ones in the database to discover a match and hence, identification.

Biometrics works by unobtrusively matching patterns of live individuals in real time against enrolled records. Leading examples are biometric technologies that recognize and authenticate faces, hands, fingers, signatures, irises, voices, and fingerprints. Biometric data are separate and distinct from personal information. Biometric templates cannot be reverse-engineered to recreate personal information and they cannot be stolen and used to access personal information

Requirements of a biometric feature are Uniqueness, Universality, Permanence, Measurability, User friendliness, Collectible, Acceptability. We use four categories for comparison between different types of biometrics, they are Comfort, Accuracy, Availability, Costs .

As one can see, determining an 'optimal' biometric method is hardly possible. For biometric traits ranking high in accuracy, fingerprints currently have the lowest costs. The iris rates high in all categories, unfortunately including cost. If the costs would sink significantly, the iris would be ideal. DNA loses points in accuracy, because it can't differentiate between monozygotic twins today.

2. IRIS

The iris has been historically recognized to possess characteristics unique to each individual. In the mid 1980s, two ophthalmologists 'Drs. Leonard Flom' and 'Aran Safir' proposed the concept that no two irises are alike[6]. They researched and documented the potential of using the iris for identifying people and were awarded a patent in 1987. Soon after, the intricate and sophisticated algorithm that brought the concept to reality and it was developed by Dr. John Daugman and patented in 1994[3]. The original work and continued development have established Iridian's iris recognition algorithm as the mathematically unrivaled means for authentication.

Features of the Iris: The human iris is rich in features, can be used to quantitatively to distinguish one eye from another. The iris contains many collagen us fibers, contraction furrows, coronas, crypts, color, serpentine vasculature, striations, freckles, rifts, and pits. Measuring the patterns of these features and their spatial relationships to each other provides other quantifiable parameters for identification process. The statistical analyses indicated that the Iridian Technologies IRT process uses 240 degrees-of-freedom (DOF), or independent measures of variation to distinguish one iris from another. It allows iris recognition to identify persons with an accuracy with a magnitude greater than any other biometric systems.

Uniqueness of the Iris: The iris is unique due to the chaotic morphogenesis of that organ. Dr. John Daugman stated that "An advantage the iris shares with fingerprints is the chaotic morphogenesis of its minutiae. The iris texture has chaotic dimension because its details depend on initial conditions in embryonic genetic expression; yet, the limitation of partial genetic penetrance (beyond expression of form, function, color and general textural quality), ensures that even identical twins have uncorrelated iris minutiae. Thus the uniqueness of every iris, including the pair possessed by one individual, parallels the uniqueness of every fingerprint regardless of whether there is a common genome".

***Stability of the recognition*:** Though the iris is protected behind eyelid, cornea, aqueous humor, and frequently eyeglasses or contact lenses. An iris is not normally contaminated with foreign material, and human instinct being what it is, the iris, or eye, is one of the most carefully protected organs in one's body. In this environment, and not subject to deleterious effects of aging, the features of the iris remain stable and fixed from about one year of age until death.

The human eye has physiological properties that can be exploited to impede use of images and artificial devices to spoof the system. As a matter of policy, Iridian Technologies, Inc. does not discuss the details of these properties or specific countermeasures in the open media. The iris is perforated close to its centre by a circular aperture known as the pupil. The function of the iris is to control the amount of light entering through the pupil, and this is done by the sphincter and the dilator muscles, which adjust the size of the pupil. The average diameter of the iris is 12 mm, and the pupil size can vary from 10% to 80% of the iris diameter. The iris consists of a number of layers, the lowest is the epithelium layer, which contains dense pigmentation cells. The stromal layer lies above the epithelium layer, and contains blood vessels, pigment cells and the two iris muscles. The density of stromal pigmentation determines the colour of the iris. The externally visible surface of the multi-layered iris contains two zones, which often differ in colour. An outer ciliary zone and an inner pupillary zone, and these two zones are divided by the collarette – which appears as a zigzag pattern.

The iris is the plainly visible, colored ring that surrounds the pupil. It is a muscular structure that controls the amount of light entering the eye, with intricate details that can be measured, such as striations, pits, and furrows. The iris is not to be confused with the retina, which lines the inside of the back of the eye. Figure1 shows human eye characteristics. 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.

Iris: This is the colored part of the eye: brown, green, blue, etc. It is a ring of muscle fibers located behind the cornea and in front of the lens **.**

Pupil: Pupil isthe hole in the center of the iris that light passes through. The iris muscles control its size.
Sclera:The sclera is the white, tough wall of the eye. It along with internal fluid pressure keeps the eyes shape and protects its delicate internal parts.

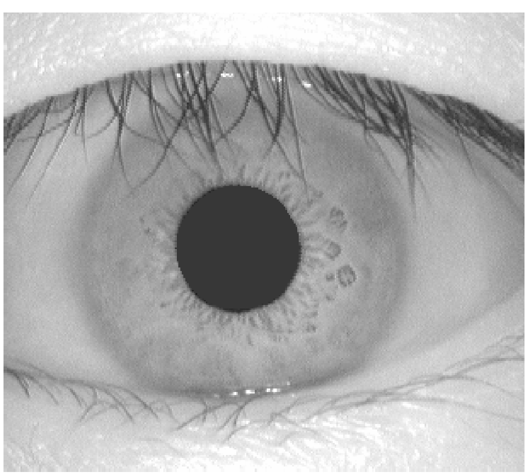

Figure 1) Image of an IRIS

It has been suggested that an open source implementation of a new iris recognization method, in order to independently evaluate the algorithm and to automate the recognition of the iris by reducing complexity and increasing algorithm speed. Since ophthalmologists Flom and Safir first noted the uniqueness of the iris patterns in 1987[6], various algorithms have been proposed for iris recognitions, that include the quadrature approach, zero crossing of the one-dimensional wavelet the independent component analysis approach, Gabor filtering and wavelet transform, and the texture analysis using multi-channel. Recently, Du et al. designed a local texture analysis algorithm to calculate the local variances of iris images and generate a one dimensional iris signature which relaxed the requirement of entire whole iris for identification and recognition[7][8].

However, all of these algorithms assume that a circular iris pattern has been successfully extracted from a captured image but these algorithms are very complex, takes longer time for code extraction and code matching from the database. But this paper proposes a new and easy methods for *iris localization* and *iris normalisation* when compared to other algorithms which are used for *iris recognition*.

3. METHODOLOGY:

This paper deals with the generation of stable key from iris image and it is carried over using CASIA iris database. The input image was subjected to segmentation to detect the two circles i.e., iris/sclera boundary and the iris/pupil boundary. The resultant image is normalized to produce iris regions. The proposed method involves four modules namely *i)Bit plane slicing, ii)Standard deviation windows, iii)Adaptive thresholding and iv) Normalization.*

Introduction to Iris* Recognition*: Iris recognition technology combines computer vision, pattern recognition, statistical inference, and optics.

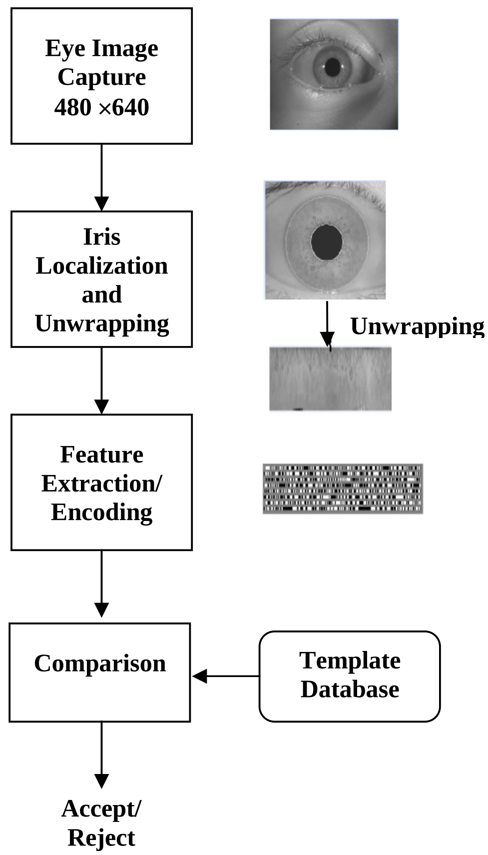

Fig. 2) Basic design of Iris Recognition

Its purpose is real-time, high confidence recognition of a person's identity by mathematical analysis of the random patterns that are visible within the iris of an eye from some distance. Because the iris is a protected internal organ whose random texture is complex, unique, and stable throughout life, it can serve as a kind of living passport or password that one need not remember but can always present. Because the randomness of iris patterns has very high dimensionality, recognition decisions are made with confidence levels high enough to support rapid and reliable exhaustive searches through national-sized databases. The algorithms for iris recognition were developed at Cambridge University by John Daugman.

The technical performance capability of the iris recognition algorithm far surpasses that of any other biometric technology now available. Objective measures, such as a cross-over error rate, are at levels that cannot be reached by other biometrics. Iridian's algorithm is designed for rapid (seconds) exhaustive search of very large databases; a distinctive capability required for authentication today.

The iris is an externally visible, yet protected organ whose unique epigenetic pattern remains stable throughout adult life. These characteristics make it very attractive for use as a biometric for identifying individuals. Image processing techniques can be employed to extract the unique iris pattern from a digitized image of the eye, and encode it into a biometric template, which can be stored in a database. This biometric template contains an objective mathematical representation of the unique information stored in the iris, and allows comparisons to be made between templates. When a subject wishes to be identified by an iris recognition system, their eye is first photographed, and then a template created for their iris region. This template is then compared with the other templates stored in a database until either a matching template is found and the subject is identified, or no match is found and the subject remains unidentified.

Iris recognition allow user to hands-free operation in application. Iris recognition has highest proven accuracy, had no false matches in over two million cross comparison, according to Biometric Testing Final Report. It allow high speed also for large populations, just look into a camera for a few seconds. The iris is stable for each individual throughout his or her life and do not change with age. The weaknesses are Intrusive, High cost, Contact lenses , sunglasses , optical glasses.

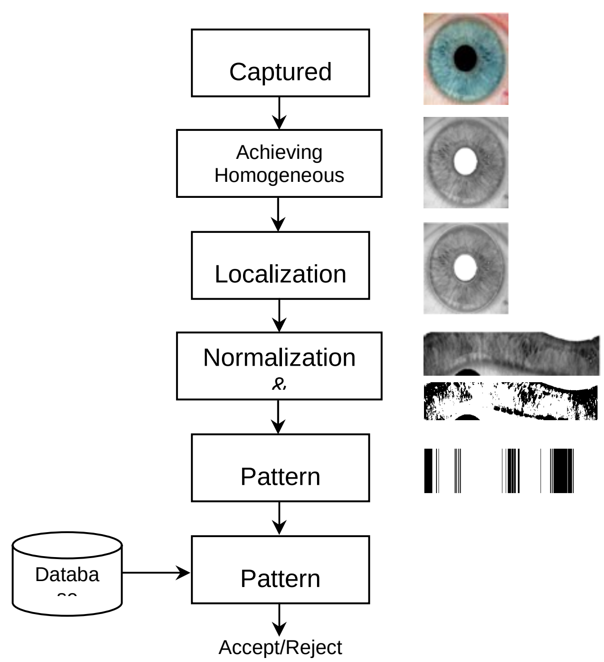

Fig. 3) Flowchart of Iris Recognition

4. STEPS INVOLVED

The first step towards achieving a homogenous region is by setting the values of pixels below 60 and above 240 are equal to 255. By doing this we can easily identify the IRIS boundaries. The purpose for adjusting these values is to reduce the effect of specularities that may be present in the pupil. The input is a Captured Eye image and the output is Homogenized Image.

Iris localization involves Pupilary Boundary Detection and Limbic Boundary Detection. The methods used for the detection of PupilaryBoundary(Inner Boundary) are i)Bit Plane Slicing, ii) Morphological Operations, and iii) Standard deviation windows.

We convert the image into 8-bit plane.Our image contains 8 layers i.e., least significant bit plane layer contains binary image. So, by removing all the upper layers of an image we get binary image. Bit-plane 0, the least significant bit-plane, is used to determine the papillary boundary because it not only provides a relatively homogenous region that is easily identifiable as the pupil, but also because it is fast and easy to extract from the original image. The input is a Homogenized image and the output is the least significant bit-plane image.

Erosion and *dilation* are two morphological operations that are very useful in processing binary images Erosion expands the group of zeroes and shrinks the group of ones and Dilation expands the group of ones and shrinks the group of zeros. The input is the least significant bit-plane image and the output is homogeneous pupil masked image.

We use standard deviation windows to calculate local standard deviations in the vertical and horizontal directions. By using windows, we can determine papillary boundaries. The end points in the cardinal directions **N, E, S, W** are identified. By using these cardinal points and CIRCLE ***eq***. we get the papillary Boundary. We get midpoints of an pupilary boundary and radius of the pupil. By calculating the distance between each pixel coordinates of image and mid points, comparing with original radius of pupil we get radius of pupil

$$\mathbf{X^2 + Y^2 = R^2}$$

We consider E ,W points for getting the radius of the pupil and midpoint of pupil.

By using Adaptive thresholding technique we can determine the limbic boundary Note that the iris texture is brighter than the sclera . By finding the difference between these two regions we find out the limbic boundary value . So that we can recognize limbic boundary .we get midpoints of a limbic boundary and radius of the limbic. By calculating the distance between each pixel coordinates of image and mid point coordinates of limbic, comparing with original radius of limbic we get radius of limbic boundary.

Iris normalization and enhancement involves converting the polar coordinate system to Cartesian coordinate system. Then converting the iris region from Cartesian coordinates to the normalized non-concentric polar representation is modeled as

$$I(x(r,ø),y(r, ø))\rightarrow I(r, ø)$$

With

$$x(r, ø) \rightarrow (1-r)Xp(ø)+rXi(ø)$$
$$y(r, ø) \rightarrow (1-r)Yp(ø)+rYi(ø)$$

where I(x,y) is the iris region images (x,y) are the orginal Cartesian coordinates (r, ø) are the corresponding normalized polar coordinates and Xp,Yp and Xi,Yi are the coordinates of pupil and iris boundary along o direction .

Note : _ **ø** varies from 0 t0 360

r varies from 0 to Ri-Rp where Ri=Radius of Iris, Rp=radius of pupil

Converting enhanced image into logical image

Pattern Recognition: Texture near the papillary boundary and limbic boundary inside the iris has some errors. So we take the middle row of iris in order to overcome the errors. We convert the middle row of bits in to hexadecimal code. In our project the probability of occurring secret code is nearly $\mathbf{16^{90}}$ **.** We consider 360 bits of middle row of an *enhanced image.* Convert these bits into *hexadecimal code.*

F=1001 1110 1100… 0110 1100 0101 1101 1011

9 E C 6 C 5 D B

(360 Bits code)-----(90 Hexadecimal code)

PATTERN MATCHING: Hexadecimal code is taken from database and converted into bits. The comparison is done by computing the HAMMING DISTANCE between the two codes. The Hamming distance between an Iris code A and another code B is given by

$$HD = \frac{1}{N}\sum_{j=1}^{N} A_j \otimes B_j$$

Hamming Distance: Given two patterns A and B the sum of disagreeing bits(sum of the exclusive–OR between) divided by N the total number of bits in the pattern. If two patterns are derived from the same iris, the hamming distance between them will be close to 0.0 then it is accepted or else rejected.

5. CONCLUSION

Iris boundaries are recognized by using simple methods and the less complex and faster algorithms than previous algorithms and it eliminates pupilary noises and reflections. Homogenization removes specularities of the pupil. Bit plane slicing, morphological operations and standard deviations windows helps to recognize pupilary radius and pupilary mid-point. By solving these parameters in circle equation, we can recognize pupilary boundary (inner boundary) accurately. Adaptive threshoulded method can find the limbic radius and limbic mid-point. By solving these parameters in circle equation, we can recognize limbic boundary (outer boundary) accurately. The region between inner and outer boundary is iris, it is in the polar form and converted into linear form by converting the polar coordinate system to cartesian coordinate system, then converting the iris region from Cartesian coordinates to the normalized non-concentric polar representation we get normalized image. By doing enhancement, the logical image with 360 in length and breadth is the difference between the outer and inner boundary is produced. The texture near the limbic and pupilary boundary inside the iris has some noises due to eyelashes and eyelids, by taking the middle row of the enhanced image a secret code is extracted from it. The secret code is converted into Hexadecimal code of length 90. Hamming code distance is being used for pattern matching. It can give the 16^{90} different iris codes . It can overcome the noises caused by pupil in the image.

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