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Effective Use of Iris Code in Real Time Surveillance System

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Abstract

Iris is one of the important biometrics techniques. The pupil may vary in from 10% to 80% of the iris diameter, but fundamental rods & cons structure for an individual remains unique till the life time. The important thing is its feature which has a unique pattern and not related to genetic feature. In this we replace the convex polyhedral cone concept, which is complicated. The scanned image is converted to gray scale. Remove sparse noise by using median filter. Detecting the iris pattern by means of edge detection. Determining the pupil and iris radius by means of pupil detection The main reason to Perform localization is to determine the boundary of iris and removing eye lids and eye lashes. Normalization is performed to eliminate the unwanted part of the image other than the iris. Extracting the unique iris features by means of feature extraction. Generate the iris code by using the normalized image and threshold values. Match the iris code to the code in database by using hamming distance concept. The overall success rate achieved 90%.

1. Introduction

Iris recognition is a highly accurate method of biometric authentication, based on the unique and persistent characteristic of the iris, the coloured part of the eye that surrounds the pupil. Iris recognition algorithms have been shown to produce "perfect recognition rates" (Masek, 2003), and it is suggested that the probability of two irises producing the same digital irises code is as low as 1 in 10^{78} and it is claimed that iris recognition can identify people more accurately than by DNA identification (Sanderson and Erbetta, 2000

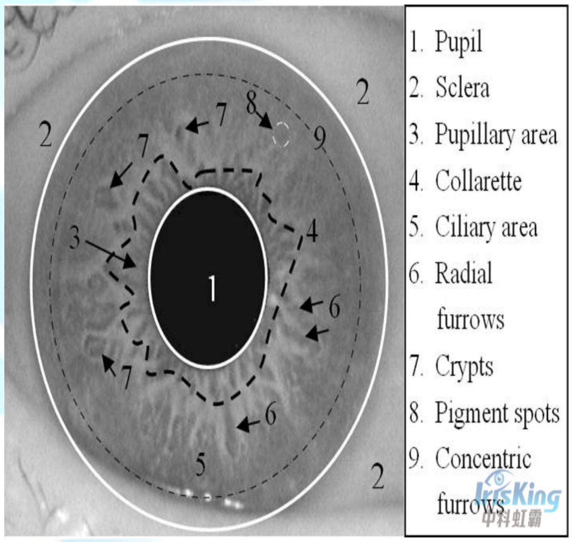

Fig.1: The Parts Of Eye

The above is the example of eye sample and the parts of eye is clearly explained.

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 color of the iris. The externally visible surface of the multi-layered iris contains two zones, which often differ in color.
Computing an colored image is very difficult. In the proposed system we convert colored image to grayscal image Where the image is monochromatic and the values will be in black and white format, calculating binary values is very easy.

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In existing system we compute iris in terms of convex polyhedral cones where we convert the two dimensional image into three dimensional image, it is very complex and takes large amount of time to compute. Maintaing the three dimensional iris values in terms of matrix
Is very difficult to compute the iris.

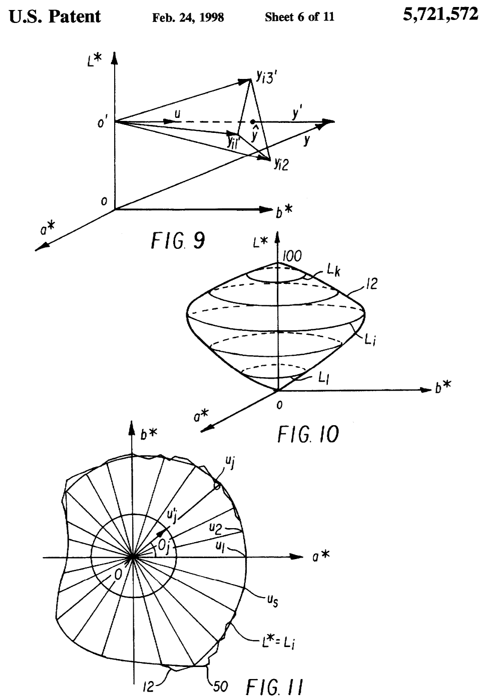


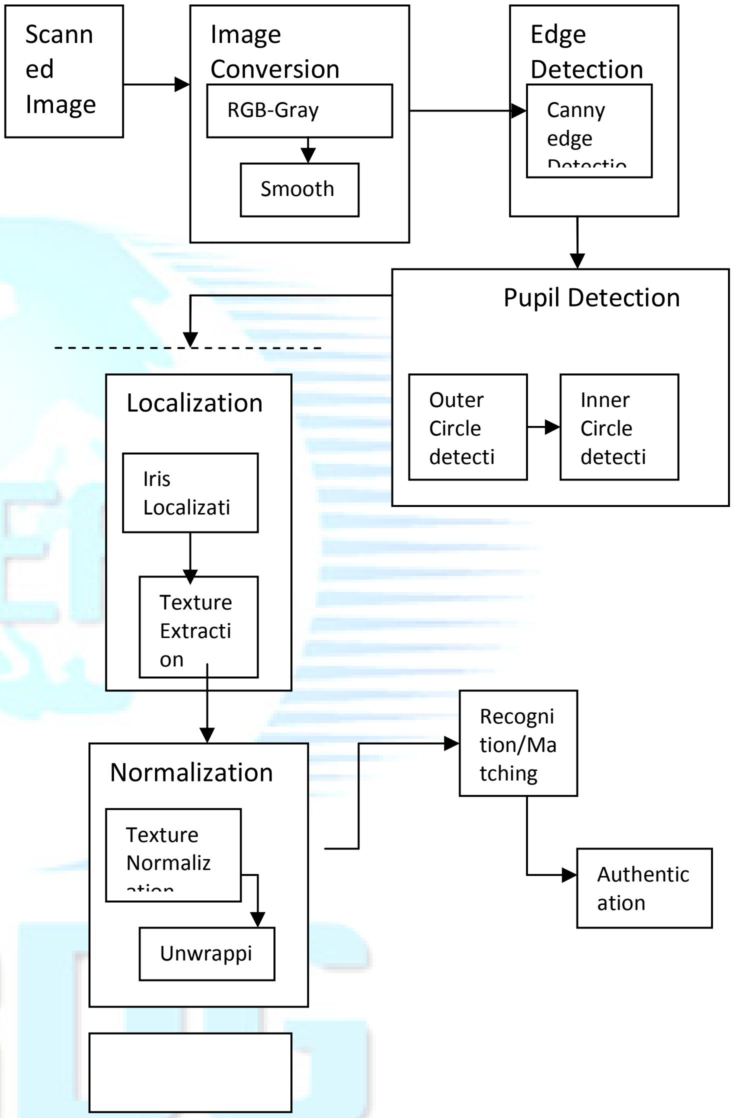
Fig.2: convex polyhedral cones

Initially we used this method to calculate the iris patterns. Iris patterns using convex polyhedral were very close accurate.

In the existing system storing the iris images in the database takes huge space.
In proposed system we convert iris image into iris code which is very simple and easy to maintain the data.

- ➢ GRAYSCALE CONVERSION
- ➢ EDGE DETECTION
- ➢ PUPIL DETECTION
- ➢ NORMALIZATION
- ➢ FEATURE EXTRACTION
- ➢ MATCHING

The system architechture diagram of iris code generation is given below.



2. Grayscale Conversion

Grayscale images are distinct from one-bit black-and-white images, which in the context of computer imaging are images with only the two colors, black, and white (also called *bi-level* or *binary images*). Grayscale images have many shades of gray in between. Grayscale images are also called monochromatic, denoting the absence of any chromatic variation.

Grayscale images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet, etc.), and in such cases they are monochromatic proper when only a given frequency is captured. But also they can be synthesized from a full color image.

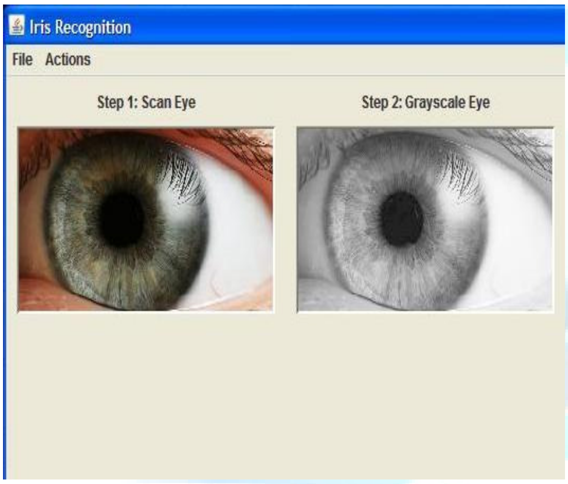


Fig.3: Grayscale Image

Converting colored iris to grayscale image has many advantages, whenever a eye is got infected authentication fails at that time but whenever we convert image into grayscale image we can rectify the eye infections. Converting grayscale image to mathematical value is easy.

3. Smoothing

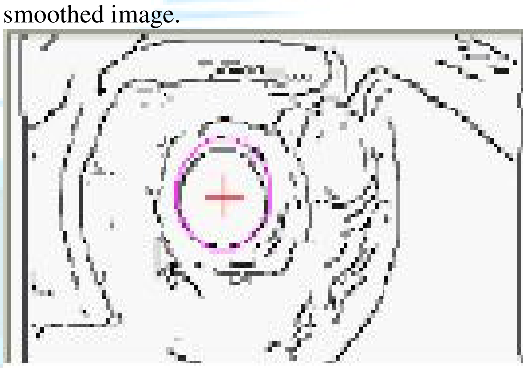
To improve the quality of the image processing we go for smoothing process. In this process we use median filters to smooth the image. The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise (but see discussion below).

The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) signals such as images, more complex window patterns are possible

4. Edge Detection

Edge detection is a fundamental tool in image processing and computer vision, particularly in the areas of feature detection and feature extraction which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities.

The edges extracted from a two-dimensional image of a three-dimensional scene can be classified as either viewpoint dependent or viewpoint independent. A viewpoint independent edge typically reflects inherent properties of the three-dimensional objects, such as surface markings and surface shape. A viewpoint dependent edge may change as the viewpoint changes, and typically reflects the geometry of the scene, such as objects occluding one another. The Canny algorithm basically finds edges where the grayscale intensity of the image changes the most. These areas are found by determining gradients of the image. Gradients at each pixel in the smoothed image.



The algorithm runs in 5 separate steps:
1. Smoothing: Blurring of the image to remove noise.
2. Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.
3. Non-maximum suppression: Only local maxima should be marked as edges.
4. Double thresholding: Potential edges are determined by thresholding.

5. Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

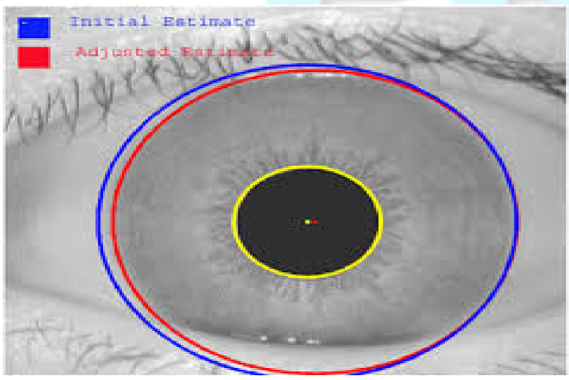
4. Pupil Detection

The acquired iris image has to be preprocessed to detect the iris, which is an annular portion between the pupil (inner boundary) and the sclera (outer boundary). The first step in iris localization is to detect pupil which is the black circular part surrounded by iris tissues. The center of pupil can be used to detect the outer radius of iris patterns. The important steps involved are:

1. Pupil detection(Inner Circle)
2. Outer iris localization

Circular Hough Transformation for pupil detection can be used. The basic idea of this technique is to find curves that can be parameterized like straight lines, polynomials, circles, etc., in a suitable parameter space.

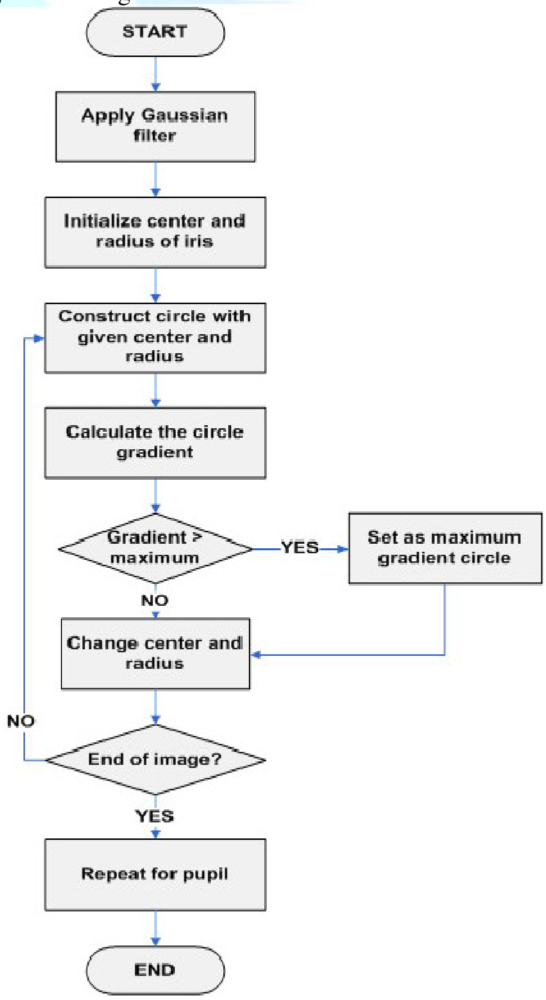
Detection of inner pupil boundary
External noise is removed by blurring the intensity image. But too much blurring may dilate the boundaries of the edge or may make it difficult to detect the outer iris boundary, separating the eyeball and sclera. Thus a special smoothing filter such as the median filter is used on the original intensity image. This type of filtering eliminates sparse noise while preserving image boundaries. After filtering, the contrast of image is enhanced to have sharp variation at image boundaries using histogram equalization.



Iris Localization

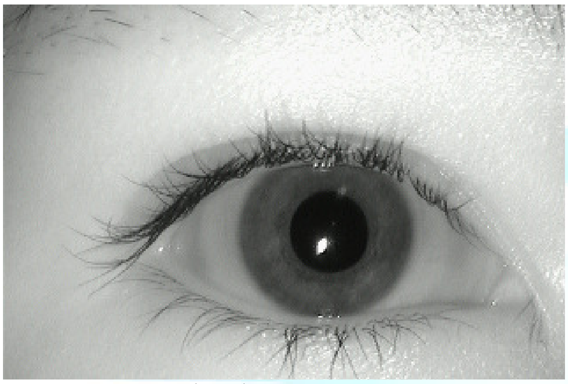
We have used Daugman's Integro-differential Operator for localization. Daugman's algorithm is based on applying an integro-differential operator to find the iris and pupil contour

Daugman's Integro-Differential Equation Where: 0 0 0 x , y , r the center and radius of coarse circle (for each of pupil and iris). G (r) Gaussian function. r □ : The radius range for searching for. I(x, y) the original iris image. G (r) □ Is a smoothing function,the smoothed image is then scanned for a circle that has a maximum gradient change, which indicates an edge. Eyelids are localized in a similar manner, with the path of contour integration changed from circular to an arc.

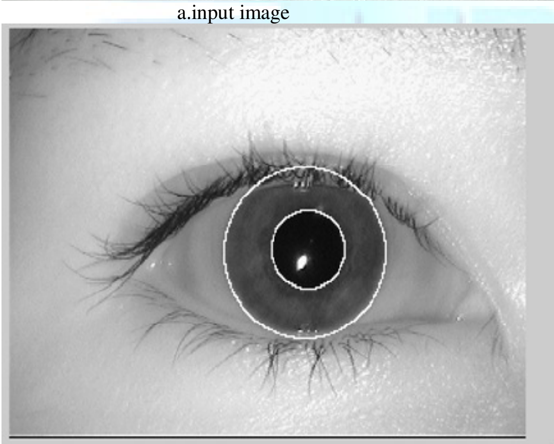


Problem was in determining the pupil boundary the maximum change should occur at the edge between the very dark pupil and the iris, which is relatively darker than the bright spots of the illumination

As a solution to this problem, modification to the integro-differential operator is proposed to ignore all circles if any pixel on this circle has a value higher than a certain threshold. This threshold determined to be 200 for the grayscale image. This ensures that only the bright spots



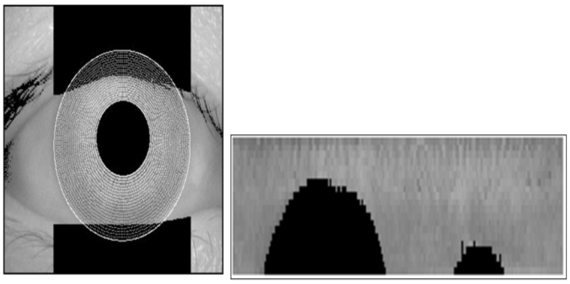
a.input image



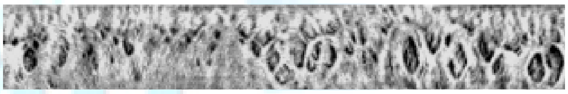
b.image after localization

5. Iris Normalization

Daugman's normalization method transforms a localized iris texture from Cartesian to polar coordinates. The proposed method is capable of compensating the unwanted variations due to distance of eye from camera (scale) and its position with respect to the camera (translation). The Cartesian to polar transform is defined as: Where The process is inherently dimensionless in the angular direction. In the radial direction, the texture is assumed to change linearly, which is known as the rubber sheet model. The rubber sheet model linearly maps the iris texture in the radial direction from pupil border to limbus border into the interval [0 1] and creates a dimensionless transformation in the radial direction as well. Although the normalization method compensates variations due to scale, translation and pupil dilation, it is not inherently invariant to the rotation of iris. Rotation of an iris in the Cartesian coordinates is equivalent to a shift in the polar coordinates. In this method, iris templates are shifted and compared in n different directions to compensate the rotational effects. Here size of normalized image is 64 X 512.



a) iris region b) normalization iris region



Enhancement

Histogram Equalization Histogram equalization was used for enhancement of
image for getting proper intensity. Image After enhancement by histogram
equalization technique

Feature Extraction

The circular iris image is unwrapped into a strip format to extract the key patterns of the iris Feature extraction is a key process where the two dimensional image is converted to a set of mathematical parameters.The iris contains important unique features, such as stripes, freckles, coronas, etc. These features are collectively referred to as the texture of the iris. Gaussian filters are used to extract features.\

Iris Code Generation

We applied used Gaussian filter for extract the iris feature

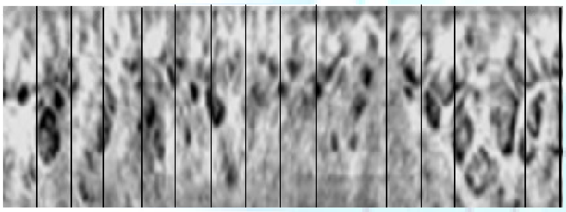
To create iris code feature extracted image is divide into vertically 16 blocks

Step 1. Normalized image size is of 64X512. We Divide normalized iris image into basic cell regions for generation of iris code. One cell region has 64 (row) ×32
(col) pixels size. A Standard deviation of pixels value is used as a representative value of a basic cell region for calculation.

Step 2. Now we got 16 bit values we have to convert this into 16 bit binary value by considering the threshold as mean from each block.

Step 3. If the pixel values of is greater than threshold make it 1.

Step 4. Else make it 0 By following above step we can obtain 16 bit binary IrisCode for Verification.



Division of normalized iris image into cell regions and grouping of cell regions.

IrisCode :1 0 1 0 0 1 0 0 0 1 1 1 1 1 1 1

Matching

The pattern matching process is mainly decomposed into four parts:

- Bringing the newly acquired iris pattern into spatial alignment with a candidate database entry.
- Choosing a representation of the aligned iris
- pattern that makes their distinctive pattern
- apparent.
- Evaluating the goodness of a match between the
- newly acquired and database representation.
- Deciding if the newly acquired data and the database entry were derived from the same iris based on the goodness of the match.

Hamming Distance

We have used Hamming distance for finding the matches; it gives a measure of how many bits are same between two bit patterns [10]. Using the Hamming distance of two bit patterns, a decision can be made as to whether the two patterns were generated from different irises or from the same one.

Since an individual iris region contains features with high degrees of freedom, each iris region will produce a bit-pattern which is independent to that produced by another iris, on the other hand, two iris codes produced from the same iris will be highly

.

If two bits patterns are completely independent, such as iris templates generated from different irises, the Hamming distance between the two patterns should equal 0.5. This occurs because independence implies the two bit patterns will be totally random, so there is 0.5 chance of setting any bit to 1, and vice versa. Therefore, half of the bits will agree and half will disagree between the two patterns. If two patterns are derived from the same iris, the Hamming distance between them will be
close to 0.0, since they are highly correlated and the bits should agree between the two iris codes[12] [16]. The Hamming distance is the matching metric employed by Daugman, and calculation of the Hamming distance is taken only with bits that are generated from the actual iris region.

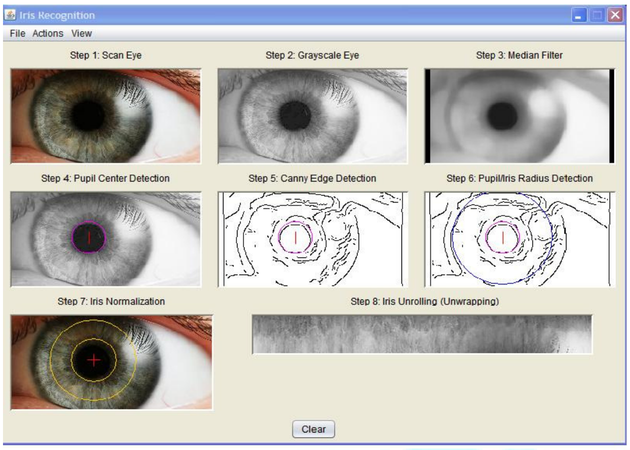
in the two bit strings that follow:

A	0 1 0 0 1 0 1 0 0 0
B	1 1 0 1 0 1 0 1 0 0
A XOR B =	1 0 0 1 1 1 1 1 0 0

The Hamming distance (H) between these 10-bit strings is 6, the number of 1's in the XOR string. The iris is compared to previous stored iris code to compute the Hamming distance between them. Hamming distance is simply the fraction of bits that the
two iris codes disagree. Hence the Hamming distance of an iris code to itself is 0, the Hamming distance to its complement is 1 and the expected Hamming distance between 2 random iris codes is 0.5.

The Hamming distance can be computed using the elementary logical operator XOR (Exclusive-OR) and thus can be done very
fast. To compensate for possible tilt of the head, the comparison is made with several different relative shifts along their angular axes [13] [14]. Here is the example of how to calculate the hamming distance between two iris codes

IrisCode1 :1 1 0 0 1 0 1 1 1 0 1 0 0 0 1 1
IrisCode2 :1 1 0 0 1 0 1 0 0 1 1 0 0 1 0 1
Hamming distance of above two IrisCode is
HD : 0.3125



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