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Human Iris Recognition for Biometric Identification

[1]Neha Borse, [2]Prof. S. D. Sawant

ENTC Department
[1]GS Moje College of Engineering, [2]NBN Sinhgad School of engineering
Savitribai Phule University, Pune, Maharashtra, India

***Abstract*: This paper introduces a new concept of optimal the security is an important aspect in our daily life whichever the system we consider security plays vital role. The biometric person identification technique based on the pattern of the human iris is well suited to be applied to access control and provides strong security. Security systems having realized the value of biometrics for two basic purposes: to verify or identify users. In this paper we focus on an efficient methodology for identification for iris detection, even when the images have obstructions, visual noise and different levels of illuminations and we use the CASIA iris which has images captured from distance while moving a person. Efficiency is acquired from iris detection and recognition when its performance evaluation is accurate**

***Keywords*: Growing Algorithm, pre-processing, Gabor filters, *Segmentation*, Hough Transform, Biometrics, Iris identification, CASIA Iris database.**

I. Introduction

Today's e-security are in critical need of finding accurate, secure and cost-effective alternatives to passwords and personal identification numbers (PIN) as financial losses increase dramatically year over year from computer-based fraud such as computer hacking and identity theft [12]. Biometric solutions address these fundamental problems, because an individual's biometric data is unique and cannot be transferred. Biometrics which refers to identifying an individual by his or her physiological or behavioural characteristics has capability to distinguish between authorized user and an imposter. An To choose the right biometric to be highly fit for the particular situation, one has to navigate through some complex vendor products and keep an eye on future developments in technology and standards. Here comes a list of Biometrics with comparatives:

Facial Recognition: Facial recognition records the spatial geometry of distinguishing features of the face. Different vendors use different methods of facial recognition, however, all focus on measures of key features of the face. Facial recognition has been used in projects to identify card counters or other undesirables in casinos, shoplifters in stores, criminals and terrorists in urban areas. This biometric system can easily spoof by the criminals or malicious intruders to fool recognition system or program. Iris cannot be spoofed easily.

Palm Print: Palm print verification is a slightly modified form of fingerprint technology. Palm print scanning uses an optical reader very similar to that used for fingerprint scanning; however, its size is much bigger, which is a limiting factor for use in workstations or mobile devices.

Signature Verification: It is an automated method of examining an individual's signature. This technology is dynamic such as speed, direction and pressure of writing, the time that the stylus is in and out of contact with the paper‖. Signature verification templates are typically 50 to 300 bytes. Disadvantages include problems with long-term reliability, lack of accuracy and cost.

Fingerprint: A fingerprint as in Figure1 recognition system constitutes of fingerprint acquiring device, minutia extractor and minutia matcher. As it is more common biometric recognition used in banking, military etc., but it has a maximum limitation that it can be spoofed easily. Other limitations are caused by particular usage factors such as wearing gloves, using cleaning fluids and general user difficulty in scanning.

Iris Scan*:* Iris is a biometric feature, found to be reliable and accurate for authentication process comparative to other biometric feature available today which is as shown Table1 (a) .

Table1 (a): Biometric comparison List

Method	Coded Pattern	Mis-identific	Security	Application
Iris Recognition	Iris pattern	1/1200000	High	High security facilities
Finger printing	Fingerprints	1/1,000	Medium	Universal
Hand Shape Size,	Length and thickness	1/700	Low	Low-security facilities
Facial Recognition	Outline, shape and distribution of	1/100	Low	Low-security facilities
Signature	Shape of letters	1/100	Low	Low-security facilities
Voice printing	Voice characteristic	1/30	Low	Telephone service

As a result, the iris patterns in the left and right eyes are different, and so scan be used quickly for both identification applications because of its large number of degrees of freedom. Iris as in Figure 2 is like a diaphragm between the pupil and the sclera and its function is to control the amount of light entering through the pupil. Iris is composed of elastic connective tissue such as trabecular meshwork. The agglomeration of pigment is formed during the first year of life, and pigmentation of the stoma occurs in the first few years [7] [8]. The highly randomized appearance of the iris makes its use as a biometric well recognized. Its suitability as an exceptionally accurate biometric derives from [4]:

I. The difficulty of forging and using as an imposter person;

ii. It is intrinsic isolation and protection from the external Environment;

iii. It' s extremely data-rich physical structure.

iv. Its genetic properties—no two eyes are the same. The characteristic that is dependent on genetics is the pigmentation of the iris, which determines its colour and determines the gross anatomy. Details of development, that are unique to each case, determine the detailed morphology; Voids stability over time; the impossibility of surgically modifying it without unacceptable risk to vision and its physiological response to light, which provides a natural test against artifice.

After the discovery of iris, John G. Daugman, a professor of Cambridge University [8][9], suggested an image-processing algorithm that can encode the iris pattern into 256 bytes based on the Gabor transform.

In general, the iris recognition system is composed of the Following five steps as depicted in Figure According to this flow chart, pre-processing including image enhancement.

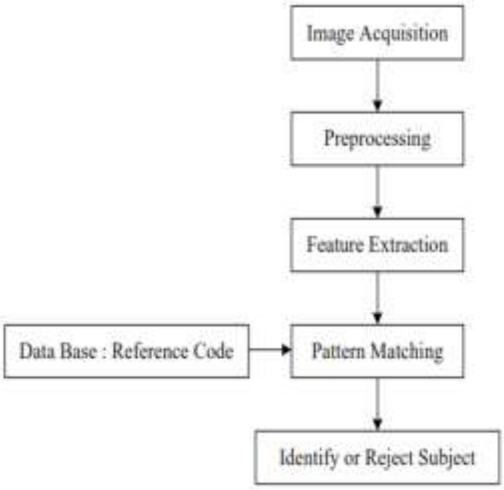
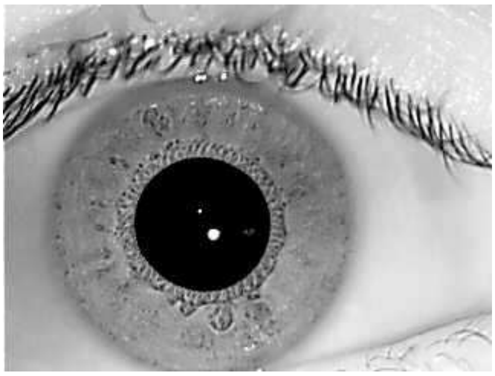


Figure : General steps of the iris recognition system

IMAGE ACQUISITION

An image of the eye to be analysed must be acquired first in digital form suitable for analysis. In further implementation we will be using CASIA database [17]. The main focus CASIA database is to minimize the requirement of user cooperation, i.e., the analysis and proposal of methods for the automatic recognition of Individuals, using images of their iris captured ate-distance

And minimizing the required degree of cooperation from the users, probably even in the covert mode [13].



Input Image

Implementation

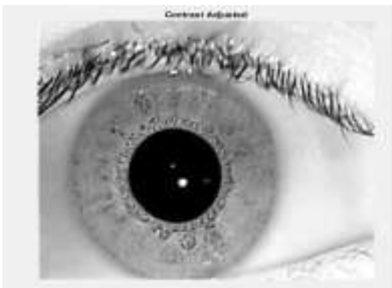
Irises are detected even when the images have obstructions, visual noise and different levels of illumination. Lighting reflections, eyelids and eyelashes obstructions are eliminated. Images with narrowed eyelids or eyes.

Low Pass Filter

Low pass filtering (aka smoothing), is employed to remove high spatial frequency noise from a digital image. The low-pass filters usually employ moving window operator which affects one pixel of the image at a time, changing its value by some function of a local region (window) of pixels. The operator moves over the image to affect all the pixels in the image.

Contrast Adjustment

Image enhancement techniques are used to improve an image, where "improve" is sometimes defined objectively (e.g., increase the signal-to-noise ratio), and sometimes subjectively (e.g., make certain features easier to see by modifying the colors or intensities). Intensity adjustment is an image enhancement technique that maps an image's intensity values to a new range. To illustrate, this figure shows a low-contrast image with its histogram. Notice in the histogram of the image how all the values gather in the center of the range. If you remap the data values to fill the entire intensity range [0, 255], you can increase the contrast of the image.



Morphology

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbours. By choosing the size and shape of the neighbourhood, you can construct a morphological operation that is sensitive to specific shapes in the input image.

The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbours in the input image.

Histogram equalization

The process of adjusting intensity values can be done automatically using histogram equalization. Histogram equalization involves transforming the intensity values so that the histogram of the output image approximately matches a specified histogram.

Edge Detection

In an image, an edge is a curve that follows a path of rapid change in image intensity. Edges are often associated with the boundaries of objects in a scene. Edge detection is used to identify the edges in an image.

Where the intensity changes rapidly, using one of these two criteria:

- Places where the first derivative of the intensity is larger in magnitude than some threshold
- Places where the second derivative of the intensity has a zero crossing

Edge provides a number of derivative estimators, each of which implements one of the definitions above. For some of these estimators, you can specify whether the operation should be sensitive to horizontal edges, vertical edges, or both. Edge returns a binary image containing 1's where edges are found and 0's elsewhere.

The most powerful edge-detection method that edge provides is the canny method. The Canny method differs from the other edge-detection methods in that it uses two different thresholds (to detect strong and weak edges), and includes the weak edges in the output only if they are connected to strong edges.

Gabor filters

In image processing, a Gabor filter, named after Dennis Gabor, is a linear filter used for edge detection. Frequency and orientation representations of Gabor filters are similar to those of the human visual system, and they have been found to be particularly appropriate for texture representation and discrimination. In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave.

Its impulse response is defined by a sinusoidal wave (a plane wave for 2D Gabor filters) multiplied by a function. Because of the multiplication-convolution property (Convolution theorem), the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function. The filter has a real and an imaginary component representing orthogonal directions. The two components may be formed into a complex number or used individually

Real

$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma)=\exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\cos\left(2\pi\frac{x'}{\lambda}+\psi\right)$$

Imaginary

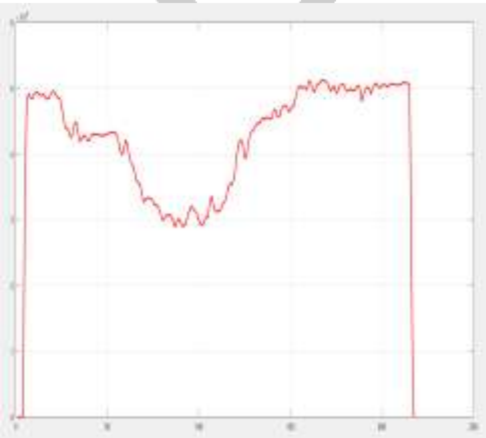
$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma)=\exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\sin\left(2\pi\frac{x'}{\lambda}+\psi\right)$$

where

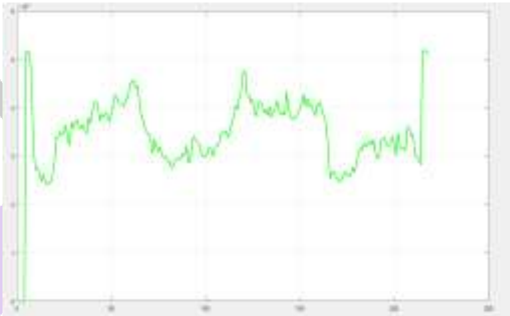
$$x'=x\cos\theta+y\sin\theta$$

and

$$y'=-x\sin\theta+y\cos\theta$$



Real Plot



Imaginary Plot

Hough transform

The Hough transform is a feature extraction technique used in image analysis, computer vision, and processing. The purpose of the technique is to find imperfect instances of objects within a certain class of shapes by a voting procedure. This voting procedure is carried out in a parameter space, from which object candidates are obtained as local maxima in a so-called accumulator space that is explicitly constructed by the algorithm for computing the Hough transform.

The classical Hough transform was concerned with the identification of lines in the image, but later the Hough transform has been extended to identifying positions of arbitrary shapes, most commonly circles or ellipses. The Hough transform as it is universally used today was invented by Richard Dude and Peter Hart in 1972, who called it a "generalized Hough transform" after the related 1962 patent of Paul Hough. The transform was popularized in the computer vision community by Dana H. Ballard through a 1981 journal article titled "Generalizing the Hough transform to detect arbitrary shapes".

Altering the algorithm to detect circular shapes instead of lines is relatively straightforward.

- First, we create the accumulator space, which is made up of a cell for each pixel. Initially each cell is set to 0.

- For each edge point (i, j) in the image, increment all cells which according to the equation of circle could be the centre of a circle. These cells are represented by the letter in the equation.

- For each possible value of found in the previous step, find all possible values of which satisfy the equation.

- Search for local maxima in the accumulator space. These cells represent circles that were detected by the algorithm.

If we do not know the radius of the circle we are trying to locate beforehand, we can use a three-dimensional accumulator space to search for circles with an arbitrary radius. Naturally, this is more computationally expensive.

This method can also detect circles that are partially outside of the accumulator space, as long as enough of the circle's area is still present within it.

In a two-dimensional space, a circle can be described by:

$$(x-a)^2 + (y-b)^2 = r^2$$

Where (a,b) is the center of the circle, and r is the radius. If a 2D point (x,y) is fixed, then the parameters can be found according to (1). The parameter space would be three dimensional, (a, b, r). And all the parameters that satisfy (x, y) would lie on the surface of an inverted right-angled cone whose apex is at (x, y, 0). In the 3D space, the circle parameters can be identified by the intersection of many conic surfaces that are defined by points on the 2D circle. This process can be divided into two stages. The first stage is fixing radius then find the optimal centre of circles in a 2D parameter space. The second stage is to find the optimal radius in a one dimensional parameter space.

X and Y Grid

ROI

Final Iris Detection

Identification

Identification modes are two main goals of every security system based on the needs of the environment. In the verification stage, the system checks if the user data that was entered is correct or not (e.g., username and password) but in the identification stage, the system tries to discover who the subject is without any input information. Hence, verification is a one-tone search but identification is a one-to-many comparison.

Conclusion

For robust and fast matching for healthcare application for patient identification. Proposed algorithm focus on the algorithm for rapid and accurate iris identification even if the images are occlude further algorithm will also focus on robust iris recognition, even with gazing-away eyes or narrowed eyelids which solves all the security related problems.

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