Image Quality Assessment for Iris Recognition

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Abstract- Iris recognition is a biometric technology to identify humans by capturing and analyzing the distinctive patterns of iris within the human eye. This paper involves developing an 'open-source' iris recognition system so as to verify each individuality of the human iris and conjointly its performance as a biometric.To determine the recognition performance of the system databases of grey-scale eye images are used. The development tool to be used is MATLAB, which emphasis only on performing recognition, and not on capturing of an eye image using hardware. A rapid application development (RAD) approach is employed to produce results quickly. The method presented in this paper is composed of a number of sub-systems, which correspond to every stage of iris recognition. These stages are localization, normalization, features of the iris were encoded by convolving the normalized iris region with Gabor filters and phase quantizing the output so as to supply a bitwise biometric guide,and comparing using hamming distance

Index Terms- Iris recognition, biometric recognition, Iris

I. INTRODUCTION

Overview

A biometric system provides recognition of individual automatically based on some unique feature or characteristic possessed by the individual. Biometric systems are developed based on fingerprints, facial features, voice, hand geometry, handwriting, the retina, and the one presented in this is, the iris.

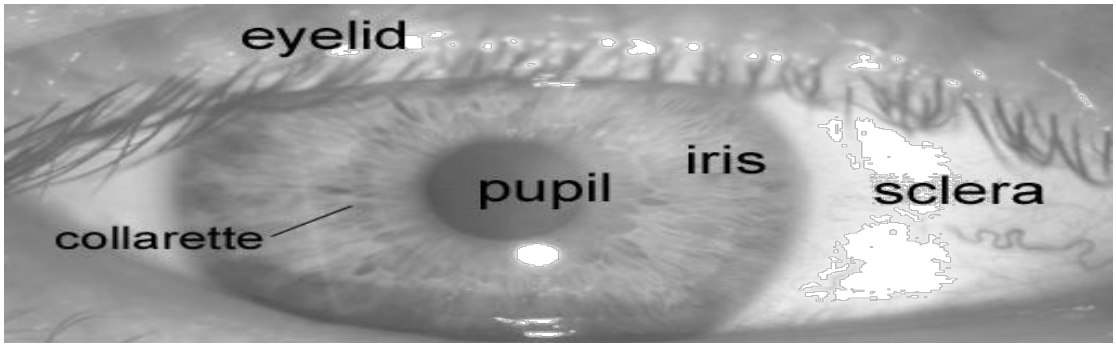

Figure 1 A front view of the human eye.

Biometric systems work by initially capturing a sample of the feature, like recording a digital sound signal for voice recognition, or taking a digital color image for face recognition. The sample is then transformed using some mathematical function into a biometric template. The templet will provide normalized economical and extremely discriminating illustration of the feature, which may then be objectively compared with alternative templates to determine identity. Most biometric systems permit two modes of operation. An enrolment mode for adding templates to database, and an associated identification mode, wherever a template is made for a individual then a match for pre-enrolled templates is searched in the database.

A good biometric is characterised by use of a feature that is; extremely distinct – in order that the prospect of any two individuals having an equivalent characteristic are nominal, stable – in order that the feature doesn't change over time, and be captured easily – so as to provide convenience to the user, and prevent misinterpretaion of the feature.

Problem statement

The biometric technologies, like face, speech and finger recognition can be easily Hacked, they're very intrusive and have low accuracy (For example, in face recognition, difficulties arise from the very fact that the face may be a changeable social organ displaying various expressions. In finger print recognition, it's simply hacked by synthetic process). Iris recognition is thought to be the foremost reliable and accurate biometric system in the market. This method is defined by use of a feature extraction that is; extremely unique –in order that there's no likelihood of any 2 individuals having a similar characteristic of iris, it's stable – in order that the feature doesn't amend over time, and be captured easily – so as to provide convenience to the user, and prevent misinterpretation of feature.

Objective

The objective is to implement open source iris recognition system so as to verify the claimed performance of the technology. The development tools used are MATLAB, and stress is solely on the software for performing recognition, and not hardware for capturing an eye image. Rapid application development (RAD) approaches are used to provide results quickly. MATLAB® provides excellent RAD environment, with its image process toolbox, and high level programming methodology. To check the system, data sets of eye images are used as inputs; a information of 756 grayscale eye images courtesy of The Chinese Academy of Sciences – Institute of Automation (CASIA).

The system is to be composed of variety of sub-systems that correspond to every stage of iris recognition. These stages are a localization– locating the iris region in an eye image, normalization – making a dimensionally consistent illustration of the iris region, and feature extraction – making a template containing solely the foremost discriminating feature of the iris. Hamming distance is used to check whether the images are matching or not. The input to system is an eye image, and an iris template will be its output, which will provide a mathematical representation of the iris region.

Scope

The scope of this paper is:

- To construct and implement the algorithm to extract iris features by localization, normalization, feature encoding.
- We use canny edge Detection scheme and a circular Hough Transform, to detect thes boundaries of the iris in thedigital image of eye.
- The Gabor filter is used to encode the deterministic patterns in a individual iris in the form of a feature vector.
- Comparing the quantized vectors using the Hamming Distance operator, to finally determine whether two irises are similar.
- Matlab programming is used to get analysis and do comparison.

II. LITERATURE SURVEY

Existing System

To do iris recognition, the protection method considered is iris-spoofing attack and iris-synthetic attack. They have used 2 databases which have real and their fake images they are, ATVS-FIr DB and CASIA-IrisV1.The two goals they had to achieve for this system was multi-biometric and multi-attack. Multi-biometric which is how well the system works for different modalities and multi-attack is system should identify all types attacks namely, spoofing synthetic etc. Databases have different type of data sets like trained and test sets. This enhances security using image quality assessment by adding liveness assessment in a user-friendly, non-intrusive and fast manner [1].

To be biometric characteristics, the feature should possess these universality, uniqueness, permanence, acceptance, performance, circumvention. Iris recognition uses random patterns of iris for identifying a person. Irises have high permanence. Size of iris template is small which is similar to fingerprint recognition which gives quick matching used for large population. The performance gains visible are reliability, accuracy ,security which comes at cost of some constraints ,operation on operating environments[2].

From this view, the quality of iris images which is assessed by measuring anyone of these properties:focus, motion blur, occlusion, and others including the contrast or the dilation of the pupil. The number of sources of information are used to measure these properties such as the high frequency power spectrum, angle information provided by pixel intensity of certain eye regions, directional filters, or different ratios comparing the iris area to that of the image, or the iris and pupil sizes. Iris quality can be assessed by analyzing the image in a holistic manner, or combining the quality from local blocks of the image. Occlusion-related features try to detect those areas of the iris which are disturbed by external elements such as the eyelids or the eyelashes [3].

Biometric system works according to one of the two modes which are verification or identification. In verification mode, apersons identity is validated by the system by comparing the biometric captured characteristics with the person's biometric template pre-stored in the system database. In such a system, a person who wishes to be recognized claims an identity. In identification mode, the system acknowledges a person by looking out the complete temperory database for a match. The system conducts a one-to-many comparison to ascertain an individual's identity or fails if the subject isn't within the system database. A biometric matching system's response is usually an matching score s (usually a number) that quantifies the similarity between the input and the database templet representations [4].

The Hough transform is a standard computer vision algorithm that is used to see the parameters of geometric objects, like lines and circles,present in image. The circular Hough transform, can be used to deduce the radius and centre coordinates of the pupil and iris regions. Automatic segmentation algorithm based on the circular Hough transform can be employed.Separable eyelashes are detected using 1D Gabor filters, since the convolution of a separable eyelash with the Gaussian smoothing function gives low output value. The automatic segmentation model proved to be successful [5].

To capture all the detailed pattern of iris, an imaging system should resolve a minimum of 70 pixels in iris radius. The phase demodulation process to encode iris patterns is used. Local regions of an iris are projected onto quadrature 2-D Gabor wavelets, giving complex-valued coefficients whose real and imaginary parts specify the coordinates of a phasor in the complex plane. Optical size of iris within the image depends upon the distance to the eye. Hamming Distance (HD) is the measure of the difference between any two irises where the two iris codes are taken in binary forms. Representations for pattern recognition should be invariant to changes in size, position, and orientation of the patterns. If P1 is that the false match likelihood for single matched verification trials, then clearly PN is that the probability of making atleast one false match when looking out a database of N unrelated patterns,

this should happen N independent times; then it is the likelihood that such a false match never happens[6].

Iris muscle is used by iris recognition to perform verification. Retinal recognition uses the distinctive pattern of blood vessels on an individual's retina at the rearend of the eye for evaluating iris recognition performance in terms of match rates, enrollment and acquisition rates, and level of effort from the user. A rectilinear format during which the image will be raw or compressed and might vary in size is based on field of view and compression or grey color [7].

Proposed System

The proposed system includes developing an open source iris recognition system so as to verify each of the uniqueness of the human iris and conjointly its performance as a biometric. Two database grayscale eye images in digitized form are used for determining the recognization performance.

The iris recognition system consists of steps that referred to as as segmentation that relies on the Hough transform, and is able to localize the circular iris and pupil region, occluding eyelids and eyelashes, and reflections. The extracted iris region was then normalized into a rectangular block with constant dimensions to account for imaging inconsistencies. Finally, the data from 1D Log-Gabor filters was extracted and quantal to four levels to encode the distinctive pattern of the iris into a bitwise biometric templet. The Hamming distance was utilized for classification of iris templates, and two templates were found to match if a test of statistical independence was failing.

The development tool used is MATLAB, where only the software is used for performing recognition, without use of hardware for capturing an eye image.The Hamming distance algorithm employed incorporates noise masking, in order that only significant bits are used in calculating the Hamming distance between two iris templates. The hamming distance is used to perform matching, i.e to compare the two images binary code with exclusive-OR operator resulting to the output. The way is by identify the input image from collection of images.

III. IMPLEMENTATION

A. Programming Tool used : MATLAB

The matrix laboratory is the language of technical computing and fourth-generation programming language. A proprietary programming language developed by Math Works. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python.

MATLAB offers lots of additional Toolboxes for different areas such as Control Design, Image Processing, Digital Signal Processing (DSP), etc.The MATLAB platform is optimized for solving engineering and scientific problems. The matrix-based MATLAB language is the world's most natural way to express computational mathematics. Built-in graphics make it easy to visualize and gain insights from data. A vast library of prebuilt toolboxes lets you get started right away with algorithms essential to your domain. The desktop environment invites experimentation, exploration, and discovery. These MATLAB tools and capabilities are all rigorously tested and designed to work together.

MATLAB is used for machine learning, signal processing, image processing, computer vision, communications, computational finance, control design, robotics, and much more. MATLAB code can be integrated with other languages, enabling you to deploy algorithms and applications within web, enterprise, and production systems.

B. Algorithms

Canny Edge Detector Algorithm

This algorithm is also known as optimal edge detector. There are three criterions for this algorithm. The first is to give low error rate. The second criteria is that the edges should be well localized i.e, the distance between edge pixels found by detector and actual edge is to be minimum. The third criteria is to have only one response to a single edge.

Step 1: The first step is to filter out noise in the original image before trying to locate and detect any edges. Because the Gaussian filter can be computed using a simple mask, it is also used in canny algorithm. Once a suitable mask has been calculated, the Gaussian smoothing can be performed using standard convolution methods.

Step 2: After filtering noise and smoothing the image, the second step is to find the strength of the edge by taking the gradient of the image. The spatial gradient measurement on an image is performed using sobel operator.

The edge strength of the gradient is then calculated using the formula, |G|=|Gx|+|Gy|

The Unwrapping Algorithm

The 'donut' shape image requires repeated rectangula-to-polar conversion of grabbing pixels in this region. The iris region is first unwrapped into rectangular region,to make things easier using basic trignometry, allowing the iris decoding algorithm to address pixels in simple (row, column) format.

In fig below, points Cp and Ci are represents the detected centers of the pupil and iris respectively. A extended wedge of angle dθ starting at an angle θ, from both points Cp and Ci, with radii Rp and Ri, respectively is taken.

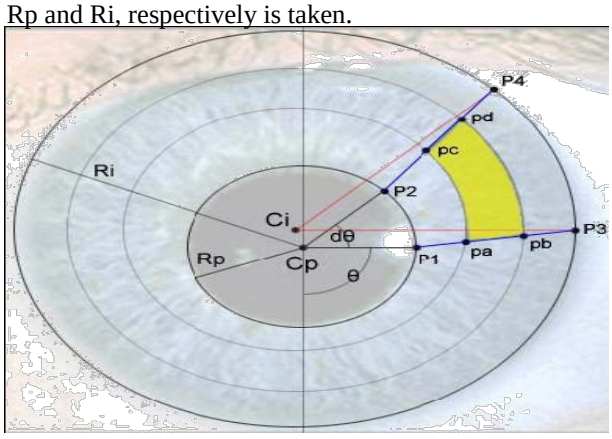

Figure 2: Unwrapping the iris region

A skewed wedge polygon P1P2P3P4 is formed by the intersection points of these wedges with the pupil and iris circles. Points Pa through Pd are interpolated along line segments P1-P3 and P2-P4.

$$P_1 = \mathrm{Cp} + \mathrm{Rp}\,(\cos(\theta) - \sin(\theta))$$
$$P_2 = C_p + R_p\,(\cos(\theta + \mathrm{d}\theta) - \sin(\theta + \mathrm{d}\theta))$$
$$P_3 = \mathrm{Ci} + \mathrm{Ri}\,(\cos(\theta) - \sin(\theta))$$
$$P_4 = C_i + R_i\,(\cos(\theta + \mathrm{d}\theta) - \sin(\theta + \mathrm{d}\theta))$$

$$P_a = P_1\left(1 - \frac{k}{N}\right) + \frac{P_3 k}{N}$$
$$P_b = P_1\left(1 - \frac{k+1}{N}\right) + \frac{P_3\,(k+1)}{N}$$
$$P_c = P_2\left(1 - \frac{k}{N}\right) + \frac{P_4 k}{N}$$
$$P_d = P_2\left(1 - \frac{k+1}{N}\right) + \frac{P_4\,(k+1)}{N}$$

IV. CONCLUSION

Iris recognition system can localizie the circular iris and pupil region, consisting of an automatic segmentation system based on the Hough Transform.The extracted iris region is normalized into a rectangular block with constant dimensions to keep an account for imaging inconsistencies. The classification of iris template is done by using Hamming distance. The software system is able to perform classification accurately. The system is tested for a number of eye images. In this paper a system can take images (as input of human eye) and can distinguish between papillary body and iris part of the human eye. For performing this, different mathematical functions and calculations are used to detect various eye boundaries and it encircles outer boundary of pupil which is inner boundary for the iris using modified Canny edge detector algorithm. After this the detection of outer boundary of the iris is done. Matlab and emphasis is given on software for performing recognition, and not hardware for capturing an eye image.

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