Impact Factor (SJIF): 5.301

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 5, Issue 5, May-2018

Iris Code Analysis and Preservation Implication Using Daugman Algorithm

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ABSTRACT- The authentication of a specific person based on the unique characteristics of that particular individual is provided by biometric Verification method. Biometrics is a technological and scientific authentication method which is used for security and replacement systems for ID cards, tokens or pins. There are many biometric technologies such as face recognition, fingerprint, voice authentication etc, but iris recognition plays a crucial role related to the security issue because it is one of the most reliable, robust, accurate biometric system for a specific user. It is well protected and it is difficult to modify. Currently hacker easily get the information of a particular user by decompressing the iris image and generating a iris template. This paper provide a solution to overcome these issues by generating a more secured and unique cryptographic key from the iris template. This is achieved by extracting the features of through the pre-processing such as segmentation and normalization. Iris code is generated by using the linear binary patterns and the generated code is encrypted using AES Encryption Algorithm. The Encryption Algorithm is employed to encrypt and decrypt the identity data into the database and the matching is done by Hamming distance. This system provides a high security with a low false acceptance rate.

KEYWORDS- Biometrics, Segmentation, Normalization, Iris code, Hamming Distance, Encryption Algorithm.

I. Introduction

For authentication purpose developing a high security system have been a most important goal. So, Based on the high quality of the image, Iris Biometric Technology utilizes the pattern recognition technique which is considered as most accurate and reliable identification system. Even though iris recognition system is most accurate and robust it can be easily hacked by the hackers by generating the biometric template. Therefore to increase the security a secret key is generated and encrypted into the database for authentication.

The coloured portion of the eye which regulates the size of the pupil is called iris. For personal identification iris have a stable and distinctive feature which is stable with age. The main aim of iris is to control the size of pupil. The iris is been surrounded by sclera. The transparent layer called cornea covers sclera. For an individual life time iris image remains to be constant and for these reasons it is considered to be the most reliable and efficient recognition system.

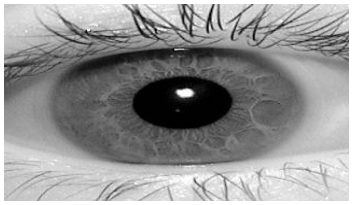

Fig 1

Iris recognition system needs an iris image of an individual and the features of an iris to extract the template Segmentation and Normalization are used. To increase the overall accuracy the segmentation and normalization are used. After extracting the features the iris code is generated using linear binary patterns. In order to avoid the attacks, the generated iris code is encrypted into database as cipher text for security reasons. Thus this paper has an ideal biometric authentication system which has the properties such as privacy, security and non-repudiation.

II. Related Work

In[1] The author discussed about the on generation and analysis of synthetic iris image. In this work, we describe a model-based method to generate iris images and evaluate the performance of synthetic irises by using a traditional Gabor filter-based iris recognition system. A comprehensive comparison of synthetic and real data is performed at three levels of processing: 1) image level, 2) texture level, and 3) decision level. A sensitivity analysis is performed to conclude on the importance of various parameters involved in generating iris images.

In[2] The author proposes an improvement of partial iris pattern identification using Radon transform. Several changes are done as follows: Partial iris representation is changed to solve the problem that errors in Radon transform arise at the connecting area of the right and left partial iris images. Local histogram equalization is applied to enhance the details of iris patterns. Lastly Radon transform is computed from a binary image rather than a grayscale image in order to reduce the feature sensitivity. The experimental results illustrate that the performances of identification systems with our improved approach are much higher than those of our previous approach. The best EER is 3.695%, matching the features with absolute distance.

In[3] The author discussed about the accurate and fast iris segmentation. In this work the problems are efficiently addressed by a rank filter and a histogram filter. The rank filter eliminates most of the eyelashes, while the histogram filter deals well with the shape irregularity. This is due to the large database size and the poorer image quality in the former database.

In[4] The author have discussed about the iris matching based on personalize weight map. In this paper, the large difference between the training set and the testing set, which explains that personalized weight maps trained by a different data set are also applicable to other testing data set. ROC curves are commonly used for comparing different pattern recognition algorithms and lower curve indicates better performance

In[5] The author have discussed about the improved iris recognition through fusion of hamming distance and fragile bit distance. If the Hamming distance is below some low threshold, the comparison is classified as a match. Instead, bit fragility occurs when the inner product between a filter and a particular part of the iris produces a result with small magnitude or with a phase close to the quantization.

III. Methodology

In this work, the features of iris is extracted using the pre-processing techniques such as segmentation and normalization. Then using the linear binary patterns the iris code is generated and is encrypted in the database for authentication. Daugman algorithm is designed to perform this decompression by exploiting a graph composed of the bit pairs in Iris Code compression (Daugman) algorithm, prior knowledge from iris image databases, and the theoretical results. The post processing techniques are Normalization, Segmentation and also the Gabor filters which influence the distributions of the bits, that the bitwise Hamming distance can be regarded as a bitwise phase distance to be calculated using graph-based estimation algorithm. For these reasons, the human iris is an ideal feature or highly accurate and efficient identification systems. Like most other biometric authentication systems, the input eye contained images needto be processed so that the characteristic iris features can be extracted for comparison which is shown in below at Figure 1

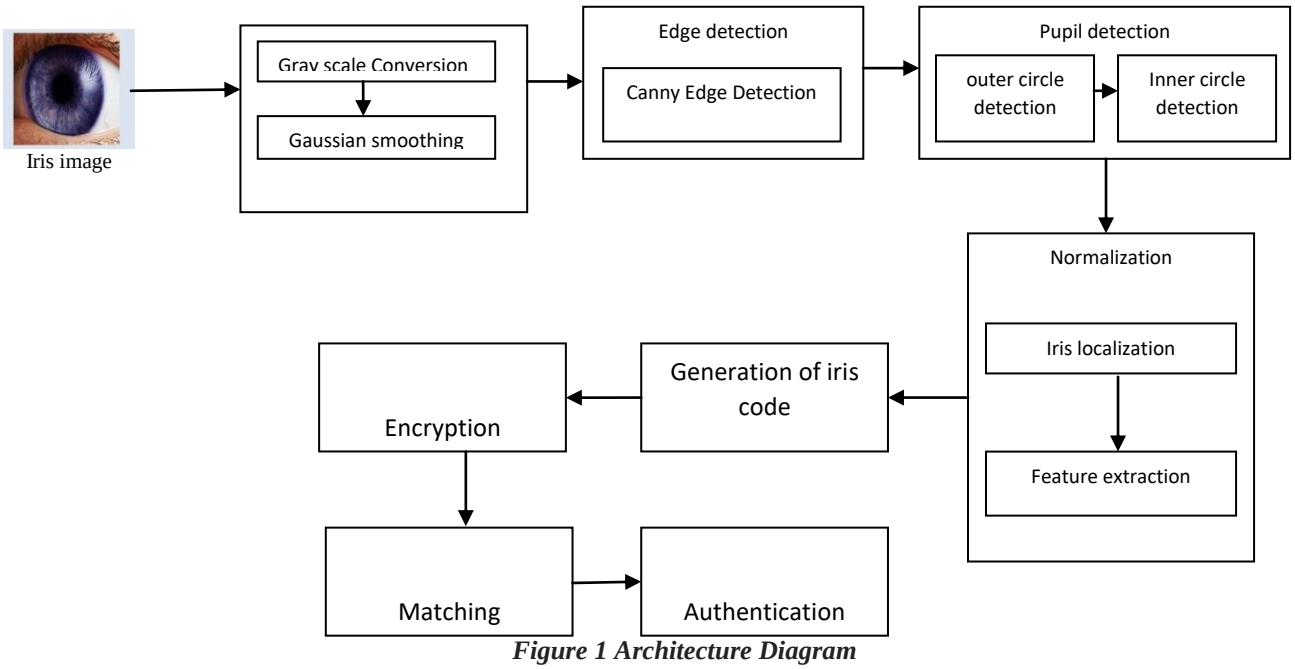

Figure 1 Architecture Diagram

IMAGE CONVERSION

In this process the original image will be converted into the gray scale image. Gray scale image is also known as binary image. This sort of image is also known as black and white images, are composed exclusively of gray shades, varying from black at the weakest intensity to white at the strongest.

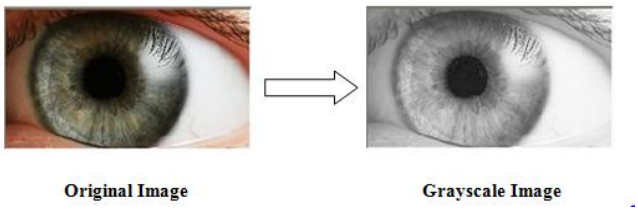

Fig 2 Image Conversion

WHY GRAYSCALE

- Less information will be provided for each pixels.
- Sufficient for many tasks and there is no complexity.
- Harder to process colour images

ALGORITHM USED FOR GRAY SCALE CONVERSION

- Get the red, green, and blue values of a pixel.
- Find the average of RGB (i.e), Average =(R+G+B)/3.
- The R,G and B value of the pixel is replaced with average (Avg) calculated in step 2.

EDGE DETECTION

One of the fundamental tool in image processing and computer vision, particularly in the areas of feature detection and feature extraction is Edge detection, which aim at identifying the brightness of the image over a particular area and the part of area which has more discontinuities.

CANNY EDGE DETECTION ALGORITHM

The edges are found using Canny Edge Detection algorithm where the grayscale intensity of the image changes the most. By making use of gradient of the image the edges can be identified.

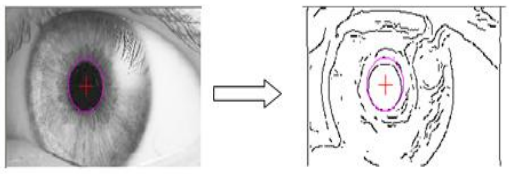

Fig 3 Edge Detection

The algorithm runs in 5 separate steps:

1. **Smoothing**: The noise in the image is removed by blurring the iris image.

2. **Finding gradients**: The edges which has larger magnitude is marked.

3. **Non-maximum suppression**: All the other edges are suppressed except the local maxima and those are marked as edges.

4. **Double thresholding**: By thresholding the potential edges are determined.

5. **Edge tracking by hysteresis**: All the edges which are not connected to a strong edge are suppressed. And thus the final edges is determined by suppressing the disconnected edges.

PUPIL DETECTION

An annular portion called iris, which is found between the pupil (inner boundary) and the sclera (outer boundary) is acquired and pre-processed for extracting its unique features. Iris localization is the first step to detect the pupil which is the black circular part surrounded by the iris tissue. To detect the outer radius of iris patterns, the centre of the pupil is used. The important steps which are involved for pupil detection is mentioned below:

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

Circular Hough Transformation is used for detecting the pupil. The basic idea of this technique is to find curves and arcs which is present in the image, that can be parameterized like straight lines, polynomials, circles, etc., in a suitable parameter space. Blurring of the image dilute the boundaries of the edges.

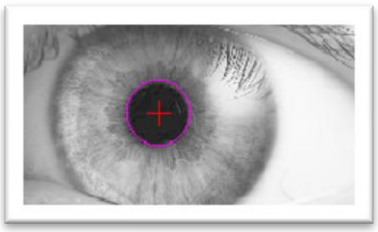

Fig 4 Pupil Detection

NORMALIZATION

The next step after Segmentation is Iris Normalisation. Before feature extraction the blurred images should be removed. In normalization the Cartesian co-ordinate is converted into polar co-ordinate. This method's main aim is to unwrap the iris texture into a fixed rectangular block. This method helps us to bring the iris image into a standard form, so that the feature extraction process can be made simple. However, the circular shape of an iris implies that there are different number of pixels over each radius. The polar resolution of irises is then dynamically adjusted with respect to the number pixels in each radius. The experimental results demonstrate that the dynamic normalization scheme performs better than the fixed-size approach.

FEATURE EXTRACTION

Corners in the normalized iris image can be used to extract features for distinguishing two iris images. The steps involved in corner detection algorithm are as follows

S1: The normalized iris image is used to detect corners using covariance matrix

S2: The detected corners between the database and query image are used to find cross correlation coefficient

S3: If the number of correlation coefficients between the detected corners of the two images is greater than a threshold value then the candidate is accepted by the system

GENERATION OF IRIS CODE

LBP describes the qualitative intensity relationship between a pixel and its

neighbourhoods, which is robust, discriminate, and computationally efficient so it is well suited to texture analysis. Firstly, the input iris image should be pre-processed and normalized to correct the position and scale variations before iris feature extraction and matching.

STEPS IN LINEAR BINARY PATTERNS

i. Divide the examined image to cells (i.e. 3x3 pixels)
ii. Locate the centre pixel in the image.
iii. For each pixels in the cell, compare the pixel to each of its neighbour(on its left-top, left middle, left bottom, right-top, etc.). Follow the pixels along a circle, i.e. clockwise or counter-clockwise.
iv. Where the centre pixel's value is greater than the neighbour, write "1". Otherwise write "0". This gives the 8 digit binary number.

v. Compute the value for all the cells.
vi. Concatenate the value of the cells and that value is encrypted and stored in the database.

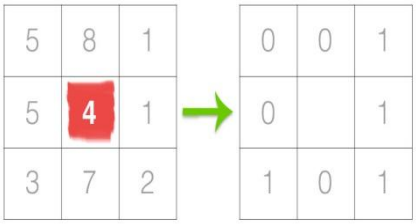

Fig 5 Linear Binary Pattern

MATCHING

Two irises are determined to be of the same class by a comparison of the feature vectors, using a Daugman like X-OR operation. Finally matching would be done of the iris. The matching would be done with the trained images. So that, if the images are matched and present in our database it shows the details of that person. Details such as his personal details, health details. If he is not matched with the database, then his details will be collected for further investigation, if it is needed. Hamming distance is done by using two string of same size. By comparing the string the error is detected.

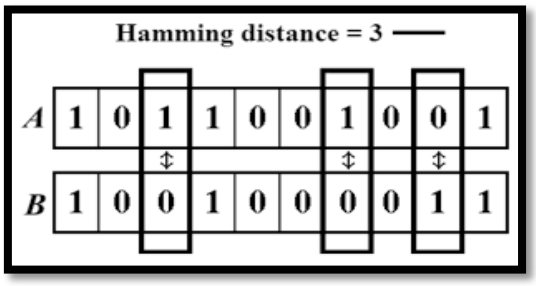

Fig 6 Hamming Distance

For example, There are two strings namely 01101010, 11011011. They differ in four places, so the Hamming distance d(011010111011011)= 4.

IV. CONCLUSION

In Biometric system, obtained template is always stored as template in database. Hence if stolen, the system becomes unusable. In this paper, we have proposed a iris cryptographic system for a specific user by using the iris code of a person. In this work, we get the attributes from the client/user and embed those attribute value using the threshold value which is obtained from the iris and is encrypted and stored in the database for authentication. For the future work, compact iris code can be generated for the mobile phones and PDA's and different error correction algorithm can be studied and can be applied to enhance the efficient and performance of iris cryptographic system.

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