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RESEARCH ARTICLE

Integration of Challenge-Response Test and Feature Extraction Method for Security Enhancement

Shelza Thakur[1], Vandana[2]
[1]CSE & Carrer Point University Hamirpur, India
[2]CSE & Carrer Point University Hamirpur, India
[1] shelzathakur09@gmail.com

Abstract— ***Iris recognition is considered as one of the best biometric method used for human identification and verification. The performance of biometric system based on iris recognition depends on the selection of iris features. In this paper Gray Level Co-occurrence Matrix(GLCM) method is used for extracting the texture. The GLCM is a statistical method that includes local features like Contrast, Correlation, Energy, Homogeneity, Entropy. The proposed approach comprises of five main steps: image acquisition, challenge response test (CRT), pre-processing, texture extraction and matching. This approach is a non filter based iris recognition technique and is invariant to iris rotation and reduces the time complexity.***

Keywords— ***iris, pupil, CRT, pre-processing, GLCM***

I. INTRODUCTION

With the increasing demand of enhanced security in our daily lives, reliable personal identification through biometrics is currently an active topic in the literature of pattern recognition. Biometric solutions, such as identification systems using fingerprint, iris, face, palmprint, etc., have many advantages over the traditional authentication techniques based on what you know or what you possess. Among them, iris recognition is tested as the most accurate manner of personal identification. Therefore, nowadays many automatic security systems based on iris recognition have been deployed worldwide for border control, restricted access, and so on [1].Technically, IRIS consists of five main processing steps namely Image acquisition, Image segmentation, Normalization, Feature Extraction and finally matching. Among these, feature extraction plays an important role. Feature extraction is a key process where the two dimensional image is converted to a set of mathematical parameters. It determines the matching score and in turn determines the identity of a person.

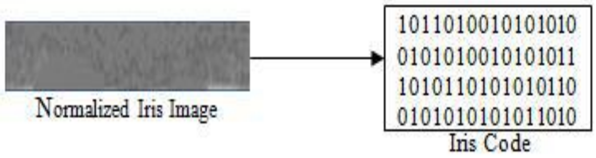

Figure 1. Feature Extraction in IRIS

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II. METHOD USED IN OUR ALGORITHM

According to International Standard Organization (ISO), biometric means automated recognition of individuals on the basis of their physiological and behavioral characteristics. A biometric system is also known as human recognizer or human identifier or human authenticator. Every human being can be uniquely identified on the basis of physiological & behavioral characteristics.[3] We used the following in our algorithm to recognition the iris:

A. Challenge-response Test

Challenge response method requires user support. In the case of iris recognition process the system is recognize that the iris is original or other artificial sources. Challenge response test could be performed where the user could be randomly find out to blink or to look in different directions such as look left and right or look up and down. In case of iris acquisition at the time to get pictures of iris an automatic reflex of the body can be generate by changing lighting level because the internal part of iris i.e. pupil changes its size according to light conditions. It may be driven larger or small. The response time of a system is about 250 ms for constriction and 400 ms for dilation.[6]

B. Gray Level Co-occurrence Matrix

Haralick et all first introduced the use of co-occurrence probabilities using GLCM for extracting various texture features. GLCM is also called as Gray level Dependency Matrix. It is defined as “A two dimensional histogram of gray levels for a pair of pixels, which are separated by a fixed spatial relationship.”

III. PROPOSED IRIS RECOGNITION ALGORITHM

The proposed iris recognition system is shown in the Fig.3. In this proposed work the system is divided into five steps: Iris image acquisition, challenge response test, pre-processing, texture extraction and matching.

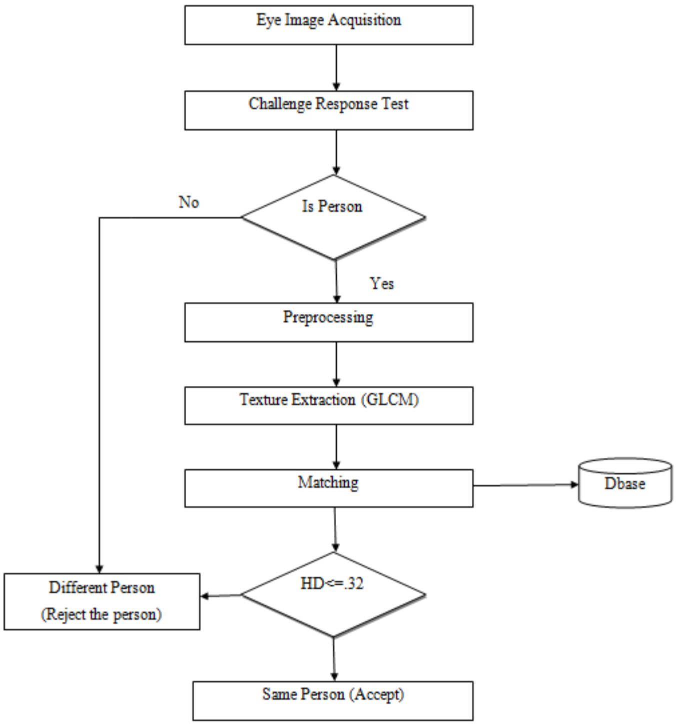

Fig.3. Block diagram of proposed work

Algorithm: The proposed work of iris recognition step is described as following steps:

Step-1 Image Acquisition: The first step of the iris recognition system is image acquisition. This step is very complicated because the size and color of iris of every person is different. It is very difficult to capture clear images using the standard CCD camera in different environmental conditions. Sometimes the acquisition process produces different results for the same person due to the different lighting effect, positioning and different separation of distance.

Step-2 Challenge-response Test: Biometric features may be counterfeited and criminally used. This is a crucial weakness of the biometric system. This module aims to ensure that an input image actually originates from a

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person instead of iris photographs, phony eyes, or other artificial sources. This method verifies the response of the pupil diameter by varying illumination levels at the same distance from the eye. The algorithm of this method is elaborated as follows:

Step 1: Capture the same person's eye images under different lighting levels

Step 2: Measure the pupil diameter from the captured eye images.

$$(x-x_1)(x-x_2) + (y-y_1)(y-y_2) = 0 \quad (1)$$

$$T_d = \sum_{i=0}^{n=1} |\phi_i - \phi_{i+1}| \quad (2)$$

$$CRT = \begin{cases} \text{True}, & \text{if } T_d \neq 0 \\ \text{False}, & \text{otherwise} \end{cases} \quad (3)$$

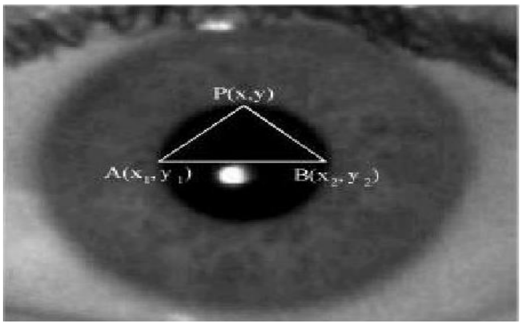

Fig.2.Measurement of diameter of the pupil boundary

If these values are divergent then the image is actually from a real source (human), otherwise artificial sources may have been used. The diameter of the pupil is calculated by satisfying (1). Equations (2) and (3) describe the challenge-response process.
where T_d is total diameter of the pupil in the capturing sequences, CRT is a challenge-response test parameter, n is number of eye images, $\boldsymbol{\phi}_i$ and $\boldsymbol{\phi}_{i+1}$ are diameters of the pupil under different illuminations. This method assures that an input is coming from a real sequence and not from photographs or other artificial sources. The biometrics-capturing device needs to be capable of ensuring that they are inspecting genuine user features (as opposed to a photograph or recording) and that the output signal is not substituted. If these values are divergent then the image is actually from a real source (human), otherwise artificial sources may have been used. This is used to prevent replay attacks lifted from video-signals, for instance by connecting a video recorder to the frame-grabber.[4]

Step-3 Pre-processing:
It is a process to isolate the iris region from the rest of the acquired image. Iris can be approximated by two circles, one for iris/sclera boundary and another for iris/pupil boundary.

Step-4 Texture Extraction:

GLCM method is a way of extracting second order statistical texture features. The approach has been used in a number of applications. A GLCM is a matrix where the number of rows and columns is equal to the number of gray levels, G, in the image. The matrix element **P(i, j | Δx, Δy)** is the relative frequency with which two pixels, separated by a pixel distance **(Δx, Δy)**,occur within a given neighbourhood, one with intensity i and the other with intensity j. One may also say that the matrix element **P(i, j | d, θ)** contains the second order statistical probability values for changes between gray levels i and j at a particular displacement distance d and at a particular angle (θ).
A GLCM Pd [i, j] is defined by first specifying a displacement vector d = (dx, dy) and counting all pairs of pixels separated by d having gray levels i and j.

$$P_d[i,j]=n_{ij}$$

where n_{ij} is the number of occurrences of the pixel values (i, j) lying at distance d in the image.
The co-occurrence matrix P_d has dimension n x n, where n is the number of gray levels in the image. From this co-occurrence matrix P_d we can derive the following statistics as texture features.

1) *Contrast*

$$\text{Contrast} = \sum_{i\,j=1}^{n} P_d\,(i-j)^2$$

Contrast returns a measure of the intensity contrast between a pixel and its neighbour over the whole image.

2) *Dissimilarity and Homogenity*

$$\text{Dissimilarity} = \sum_{i\,j=1}^{n} P_d\,|i-j|$$

$$\text{Homogenity} = \sum_{i\,j=1}^{n} \frac{P_d}{1 + |i + j|}$$

Homogeneity returns a value that measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.

3) Angular Second Moment (Energy)

$$\text{ASM (Energy)} = \sum_{i\,j=1}^{n} {P_d}^2$$

ASM returns the sum of squared elements in the GLCM.

4) Entropy

$$\text{Entropy} = \sum_{i\,j=1}^{n} P_d(-\ln P_d)$$

Entropy is a measure of information content. It measures the randomness of intensity distribution.

Step-5 Matching:

The maximum Hamming distance that exists between two irises belonging to the same person is 0.32. Thus, when comparing two iris images, their corresponding binary feature vectors are passed to a function responsible of calculating the Hamming distance between the two.
If hamming Distance<=0.32, then
Accept the person (same person).
Else
Reject the person (different person).[7]

IV. CONCLUSIONS

The proposed feature extraction method extracts the local properties of normalized iris image and challenge response test used to ensure that the captured image of iris is taken from the original source or artificial source using Daugman ‘s algorithm which reduces the time complexity and increases the accuracy. This method is also appropriate for the real time applications like person identification in airports and borders, e-voting, terrorist identification etc. It has been concluded that challenge response test and GLCM method is much more accurate and efficient as compared to the existing approaches.

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