Asian Journal of Computer Science and Technology
ISSN: 2249-0701 (P) Vol.4 No.2, 2015, pp.35-38

DOI: https://doi.org/10.51983/ajcst-2015.4.2.1752

An Enhanced Biometric System for ATM Amount Withdrawals Using Iris Biometric Recognition Method

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(Received 10 October 2015; Revised 26 October 2015; Accepted 10 November 2015; Available online 18 November 2015)

Abstract - **A biometric system provides automatic recognition of an individual based on some sort of unique feature or characteristic possessed by the individual. Biometric systems have been developed based on fingerprints, facial features, voice, hand geometry, handwriting, the retina / iris.**

We are living in the age, in which the demand on security is increasing greatly. Consequently, biometric recognition, which is a safe, reliable and convenient technology for personal recognition, appears. This technology makes use of physiological or behavioral characteristics to identify individual. A biometric system is a pattern recognition system including acquiring the biometric feature from individual, extracting the feature vector from the raw data and comparing this feature vector to another person's feature vector. Fingerprint, palm-prints, face, iris, gait, speech and signature are widely used biometric features. Biometric recognition can be used in computer network login, internet access, ATM, credit card, national ID card, driver's license and so on. Nowadays, fingerprint recognition is used widely and successfully. Face recognition is studied by many scholars and experts. Iris recognition is a relatively new branch of biometric recognition. The human iris is the annular part between pupil and sclera. It has distinct feature such as freckles, coronas, stripes, furrows and so on. The retina is the neural part of the eye responsible for vision and the pattern of blood vessels serving the retina is as unique as a fingerprint.

The iris is biological feature of a human. It is a unique structure of human which remains stable over a person lifetime. The iris is the annular region of the eye. The left and right irises of an individual can be treated as separate unique identifier. A sample human eye image is given in the below diagram. The iris information can be collected by iris image. The accuracy of iris based recognition system is promising. Each iris is believed to be distinctive and even the irises of identical twins are also different [1]. The iris recognition system has become more users friendly and cost effective. The iris have a very low false accept rate as compared to other biometrics like finger print, face, hand geometry and voice.

Iris scans use the characteristics more similar to fingerprints than to the retinal vein pattern. The colored part of the eye appears to be as unique as fingerprints and retina. Scanning technology takes advantage of crypts, furrows, ridges, striatations, ligaments, and collaret. While 240 points are recorded, the image size is 512 bytes, over ten times larger than a retinal scan. The main advantage of the iris scans is the ability to perform them from a distance of up to three feet and short time of scan of only 20 seconds initially, with subsequent identification requiring only two seconds. Glasses and contact lenses do not interfere with the scanning process and identification.

Keywords: **Iris, Biometric, Iris Segmentation, Iris Normalization and Feature Extraction**

I.INTRODUCTION

Accuracy: Iris recognition has highest proven accuracy and has no false matches in over two million cross comparisons.
Uniqueness: No two irises are alike. There is no detailed correlation between the iris patterns of even identical twins, or the right and left eye of an individual.
High information Content: The amount of information that can be measured in a single iris is much greater than finger prints.
Real time: It allows high speed processing and the individual needs to just look into a camera for a few seconds.
Stability & permanence: The iris is stable for each individual through his or her life and do not change with age.
Low circumvention: Less susceptible to spoofing

II.APPLICATION OF IRIS RECOGNITION SYSTEM

There are numerous application areas in which iris recognition can be exploited, a few of which are outlined below.

- Security (access control to buildings, airports/seaports, ATM machines and border checkpoints; computer/network security; email authentication on multimedia workstations).
- Surveillance (a large number of CCTVs can be monitored to look for known criminals, drug offenders, etc. and authorities can be notified when one is located;
- General identity verification (electoral registration, banking, electronic commerce, identifying newborns, National IDs(Aadhar Card), passports, drivers' license, employee IDs).
- Criminal justice systems (mug-shot/booking systems, post-event analysis, forensics).
- Iris Image database investigations (searching image databases of licensed drivers, benefit recipients, missing children, immigrants and police bookings).

- "Smart Card" applications (in lieu of maintaining a database of iris images, the face-print can be stored in a smart card, bar code or magnetic stripe, authentication of which is performed by matching the live image and the stored template) .
- Multi-media environments with adaptive human-computer interfaces (part of ubiquitous or context-aware systems, behaviour monitoring at childcare or old people's centers, recognizing a customer and assessing his needs).
- Retinal and iris scans offer high accuracy, and the primary users of retinal scans are military and government facilities, such as CIA, FBI, and NASA. Scans are used to control access to high security areas.
- Iris recognition system are used at the places like ATM, passport, payroll, drivers license, credit cards, access control, smart cards, PIN and network security.

III. FEATURES OF IRIS RECOGNITION SYSTEM

The iris image consists of the colored tissue surrounding the pupil .The iris recognition systems are known as real time, high confidence recognition of person identification [5]. These systems are used in many applications like passports, activation security, and controlling access to restricted areas at airports, database access and computer login, access to building and homes, border crossings and other government programme. The iris recognition systems behave following features:

- Perform *1: n* identification with no limitation on numbers.
- The most robust biometric technology available in the market today never had a false acceptance.
- Biometric templates once captured do not need to be enrolled again, iris stable throughout a human life.

A.Iris dataset

One of the most popular and best known databases of the neural network application is the IRIS Data set. The IRIS data set includes three classes of 50 objects each, where each class brings up to a type of IRIS plant. The attributed that already been predicted belongs to the division of IRIS plant. The list of attributes present in the IRIS can be described as categorical, nominal and continuous. The IRIS Database contains the following properties:

1. Sepal Length in cm
2. Sepal Width in cm
3. Petal Length in cm
4. Petal width in cm

The fifth attribute can be predicted which is the class attribute this means that each instance also includes an identifying class name, which are as follows: IRIS Setosa, IRIS Versicolour, IRIS Virginica. This constitutes the matrix of 150 X 3.

IV.IRIS RECOGNITION SYSTEM AND ITS COMPONENTS

In general iris recognition system consists of following components: pre-processing algorithms that remove artifacts from the digital output. These algorithms usually enhance segment, normalize the digital images, a feature extractor that extracts significant features; a template generator that generates a biometric template which provides a discriminating representation of features; a storage component or the database that stores templates; and a classifier. A classifier compares the generated template with the other stored templates for recognition.

A.Iris Segmentation:

In the pre-processing stage iris segmentation and normalization was done. During the segmentation iris region is isolated in an eye image by eliminating eyelids, eyelashes. The segmented iris region is normalized using Daugman's rubber sheet model in the normalization stage. In pupil detection, the iris image is converted into grayscale to remove the effect of illumination. As pupil is the largest black area in the intensity image, its edges can be detected easily from the binarized image by using suitable threshold on the intensity image. Thus the first step to find or separate out the pupil apply histogram of input image from which we get threshold value for pupil, then apply edge detection, once edge of pupil find , then center coordinates and radius can be easily find out by following algorithm and code:

1. Find the largest and smallest values for both x and y axis
2. Add the two x-axis value and divide them by two will gives x- center point.
3. Similarly add two y-axis values, divide it by two, gives y- center point.
4. Radius is calculated by subtracting minimum value from maximum and divides it by two gives the radius of pupil circle.

```
[Y, X] = find (edge_pupil1);
Cir_CenX =round ((max(X) + min(X))/2);
Cir_CenY =round ((max(Y) + min(Y))/2);
r_pupil1 =round ((max(X) - min(X))/2);
r_pupil2 =round ((max(Y) - min(Y))/2);
if r_pupil1 > r_pupil2
r_pupil =abs (r_pupil1);
Else
r_pupil =abs (r_pupil2);
End
PupilCenterX1 =abs (Cir_CenX)
PupilCenterY1 =abs (Cir_CenY)
PupilR1 =abs (r_pupil)
```

Eyelash and eyelid always affects the performance of system. The eyelashes are treated as belonging to two types, separable eyelashes, which are isolated in the image, and multiple eyelashes, which are bunched together and overlap in the eye image. In this thesis iris circle diameter is assumed as two times pupil diameter and the noise, eyelash and eyelid, are avoided by considering lower 180 portion of iris circle.

B.Iris Normalization:

Once the iris region is localized in an eye image, the next stage is to normalize the circular iris region to a rectangular block so that it has fixed dimensions. For normalization of iris regions a technique based on Daugman's rubber sheet model was employed. A number of data points are selected along each radial line and this is defined as the radial resolution. The dimensional of the same iris inconsistencies between eye images are mainly due to the stretching of the iris caused by pupil dilation from varying levels of illumination. Other sources of inconsistency include, varying image distance, rotation of camera, head tilt, and rotation of eye within the eye socket. The normalization process will produce iris regions, which have the same constant dimensions, so that two photographs of same iris under different conditions will have characteristics features at the spatial location. The remapping of the iris region from (x, y) Cartesian coordinates to the normalized non-concentric polar representation is modeled as:

$$I(x(r, \theta), y(r, \theta)) \; I(r, \theta)$$

With

$$x(r, \theta) = (1 - r)\, xp(\theta) + r\, xl(\theta)$$

$$y(r, \theta) = (1 - r)\, yp(\theta) + r\, yl(\theta)$$

Another point of note is that the pupil region is not always concentric within the iris region, and usually slightly nasal. This must be taken into account if trying to normalize the doughnut shaped iris region to have constant radius. The centre of pupil is considered as the reference point, and radial vector pass through the iris region

C.*Feature Extraction*

In order to provide accurate recognition of individuals, the most discriminating information present in an iris pattern must be extracted. Only the significant features of iris must be encoded so that comparisons between templates can be made. The template that is generated in the feature encoding process will also need a corresponding matching metric, which gives a measure of similarity between two iris templates. This metric should give one range of values when comparing templates generated from same eye, known as inter-class comparisons, and another range of values when comparing templates created from different irises, known as inter-class comparisons. The decision can be made with high confidence as to whether two templates are from the same iris, or from two different irises. The feature extraction in this paper is implemented with the help cumulative sum changed analysis method, Circular and Radial Feature extraction and neural network.

A cumulative-sum-based analysis method given by Jong-Gook Ko et al. [3] is used to extract features from the iris templates. In this method, the normalized iris template is divided into cells for calculating cumulative sums. An average grey value of the cell is used to represent each cell.

The following steps are applied to extract features horizontally and vertically:

Features are extracted [Horizontally] as follows:

Step: 1. Fixed out the dimension of the normalized image.
Step: 2. Divide normalized iris image into basic cell region. One cell region equals to 3(row) X 10 (column) pixel size.
Step: 3. Represent each cell by their average grey value as a representative of respective cell.
Step: 4. Make the group of average values obtained [1X5].
Step: 5. Calculate cumulative sums over each group.

***Features are extracted [Vertically] as follows*:**

Step: 1. Take the transpose of normalized image matrix which becomes 150(rows) X 36(columns) pixel size.
Step: 2. Divide normalized image matrix into basic cell region. One cell region equals to10 (row) X 3 (column) pixel size.
Step: 3. Represent each cell by their average grey value as a representative of respective cell.
Step: 4. Make the group of average values obtained [1X3].
Step: 5. Calculate cumulative sums over each group.

V.STAGES INVOLVED IN IRIS DETECTION

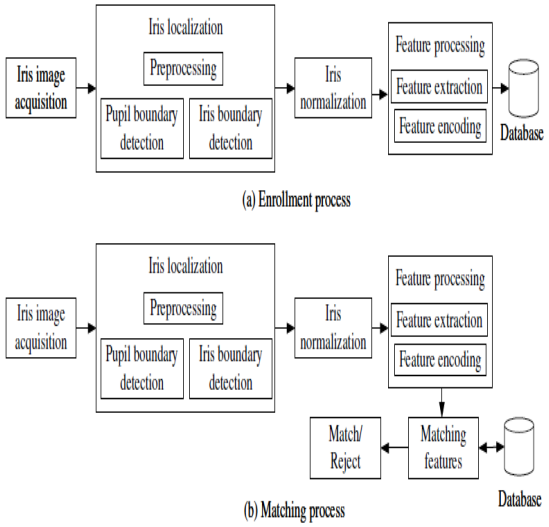

Fig.1 Stages involved in IRIS Detection

VI.PROPOSED METHODOLOGY

The aim of this research is to design and develop a Iris recognition application for Automatic Teller Machine (ATM) to reinforce security.

In the case of this system Infrared Iris Recognition seems to be the best technique. This means an infrared light camera is placed strategically to see the human face and eyes without moving the lens and getting a 3D geometry of the face and verifying it while the person is entering their password. Infrared Light cameras are used because they are less prone to defection due to light and can be used in complete darkness; this gives the system an edge over other biometric systems as they require intense quality control. This means there is more processing time required to run the system hence efficiency of the ATM is lost with the expense of a reinforcement application which makes the system as a whole less feasible.

VII. ALGORITHM TO TWO-STEP VERIFICATION FOR WITHDRAW THE AMOUNT FROM ATM MACHINE

Fig.2 ATM Machine

Step 1: Get the ATM card and PIN number from the respective bank by creating an account.
Step 2: If he/she is a new customer the front end system asks for the iris / retina image of the eye and calculates the feature extraction and match metrics. Else go to *step 3*.
Step 3: Insert the ATM card to the ATM machine.
Step 4: It asks for a PIN number to be entered.
Step 5: Then checks the PIN number with the value stored in the database.
Step 6: If a match occurs, then it asks for the image of the iris/retina and go to *Step 8*.
Step 7: Else it asks the customer to re-enter the password and to re-capture image of iris/retina. Maximum it allows three times to re-enter the password. If no match occurs of iris metrics the account will get blocked and go to *step11*.
Step 8: Takes the image of the iris/retina using the pseudo 3D image capture and matches with IRIS dataset
Step 9: Then compares with the iris images in the database.
Step 10: If a match occurs, then allows for withdrawal of money.
Step 11: Else it goes to the home page.

Since iris is unique to each person's this technique is accurate, reliable and achieves approximately 95% security over the frauds happening in the ATM.

VIII.CONCLUSION AND SCOPE OF FUTURE WORK

Since the PIN number can be easily identified and cracked the two-step verification is used for the ATM card. Hence the account is much more secure towards the illegal access of account by getting the image of the iris and obtaining the feature extraction and matching metrics and it is compared with the iris database (dataset). System has allowed the customer to withdraw only when the iris image is matched. The whole system was built on the technology that makes the system additional safe, reliable and straightforward to use.

Speed of execution and low power consumption hardware platform can be enhanced with the use of more sophisticated microcontroller to put forward biometric security to the ATMs.

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