وزارة التعليم العالي والبحث العلمي

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كلية علوم الحاسوب وتكنلوجيا المعلومات

قسم علوم الحاسوب

IRIS RECOGNITION BASED ON WAVELET TRANSFORM

بحث مقدم كجزء من متطلبات التخرج والحصول على درجة
البكالوريوس في علوم الحاسوب

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"وقل ربي زدني علماً"

صدق الله العظيم

سورة طه – الآية 114

الاهداء . . .

اهدي ثمره بحثي المتواضع هذا الى من كان السبب الأول في استمراري حتى وصلت الى هذا النجاح

الى من نذروا دماءهم وارواحهم من اجل رفع راية الوطن ولأجل ان يعيش العراقين بأمان . .

الى الحشد الشعبي المقدس وشهدائه الابرار . .

الى عزتي وفخري . . . ابي

الى من الجنه تحت قدميها . . امي

الى من كان له الجهد الأكبر في هذا البحث . .

الأستاذ محمد حمزة

داعيةً من الله تعالى أن يحظى برضاهم وان يكون أولى خطواتي للنجاح بعونه تعالى . .

1-1 Introduction

Biometrics refers to metrics related to human characteristics. Biometrics authentication is used in computer science as a form of identification and access control. It is also used to identify individuals in groups that are under surveillance.

Biometric identifiers are the distinctive, measurable characteristics used to label and describe individuals. Biometric identifiers are often categorized as physiological characteristics

Physiological characteristics are related to the shape of the body. Examples include, fingerprint, face recognition, DNA, palm print, hand geometry, iris recognition, retina.

More traditional means of access control include token-based identification systems, such as a driver's license or passport, and knowledge-based identification systems, such as a password or personal identification number. Since biometric identifiers are unique to individuals, they are more reliable in verifying identity than token and knowledge-based methods; however, the collection of biometric identifiers raises privacy concerns about the ultimate use of this information.

1- Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on video images of one or both of the irises of an individual's eyes, whose complex patterns are unique, stable, and can be seen from some distance. A key advantage of iris recognition, besides its speed of matching and its extreme resistance to false matches, is the stability of the iris as an internal and protected, yet externally visible organ of the eye.

2- Retinal scan is a biometric technique that uses the unique patterns on a person's retina blood vessels. A retinal scan is a biometric technique that uses the unique patterns on a person's retina blood vessels. retinal patterns may be altered in cases of diabetes, glaucoma or retinal degenerative disorders

3- Fingerprint recognition or fingerprint authentication refers to the automated method of verifying a match between two human fingerprints. Fingerprints are one of many forms of biometrics used to identify individuals and verify their identity. The analysis of fingerprints for matching purposes generally requires the comparison of several features of the print pattern. These include patterns, which are aggregate characteristics of ridges, and minutia points, which are unique features found within the patterns. It is also necessary to know

the structure and properties of human skin in order to successfully employ some of the imaging technologies.

4- Palm vein technologies are one of the upcoming technologies which is highly secure. It is the world's first contactless personal identification system that uses the vein patterns in human palms to confirm a person's identity. It is highly secure because it uses information contained within the body and is also highly accurate because the pattern of veins in the palm is complex and unique to each individual. Moreover, its contact less feature gives it a hygienic advantage over other biometric authentication technologies.

1-2 Literature Survey

Many researchers discussed Human iris, the iris is a thin circular diaphragm, which lies between the cornea and the lens of the human eye. A front-on view of the iris is shown in the iris is perforated close to its center by a circular aperture known as the pupil. The function of the iris is to control the amount of light entering through the pupil, and this is done by the sphincter and the dilator muscles, which adjust the size of the pupil. The average diameter of the iris is 12 mm, and the pupil size can vary from 10% to 80% of the iris diameter.

The iris consists of a number of layers, the lowest is the epithelium layer, which contains dense pigmentation cells. The stromal layer lies above the epithelium layer, and contains blood vessels, pigment cells and the two iris muscles. The density of stromal pigmentation determines the color of the iris. The externally visible surface of the multi-layered iris contains two zones, which often differ in color. An outer ciliary zone and an inner pupillary zone, and these two zones are divided by the collarette – which appears as a zigzag pattern.

Iris recognition, the human iris contains a very unique pattern which can be used as the basis for biometric identification of individuals. Iris patterns possess high inter-class dependency, and low intra-class dependency, furthermore, the iris is enclosed by the cornea, making the iris pattern stable throughout adult life. These features make iris recognition, potentially, a very accurate biometric technology, allowing non-intrusive scanning with a low failure rate.

Iris recognition involves first extracting the iris from a digital eye image, and then encoding the unique patterns of the iris in such a way that they can be compared with pre-registered iris patterns. Since each individual iris has enormous pattern variability, large databases can be searched without fear of a false match.

The most widely used and successful commercial iris recognition system was developed and patented by Daugman in 1994. Trials of Daugman's system have reported a false error match rate of zero [6], a very impressive figure when compared with systems such as facial recognition with error rates of around 50%. Many other systems have been developed or proposed which use similar techniques to Daugman. These include prototype systems developed by Wildes et al, and Boles.

The iris is an externally visible, yet protected organ whose unique epigenetic pattern remains stable throughout adult life. These characteristics make it very attractive for use as a biometric for identifying individuals. Image processing techniques can be employed to extract the unique iris pattern from a digitized image of the eye, and encode it into a biometric template, which can be stored in a database. This biometric template contains an objective mathematical representation of the unique information stored in the iris, and allows comparisons to be made between templates. When a subject wish to be identified by an iris recognition system, their eye is first photographed, and then a template created for their iris region. This template is then compared with the other templates stored in a database until either a matching template is found and the subject is identified, or no match is found and the subject remains unidentified.

The Daugman system has been tested under numerous studies, all reporting a zero failure rate. The Daugman system is claimed to be able to perfectly identify an individual, given millions of possibilities. The prototype system by Wildes et al. also reports flawless performance with 520 iris images, and the Lim et al. system attains a recognition rate of 98.4% with a database of around 6,000 eye images. Compared with other biometric technologies, such as face, speech and finger recognition, iris recognition can easily be considered as the most reliable form of biometric technology. However, there have been no independent trials of the technology, and source code for systems is not available. Also, there is a lack of publicly available datasets for testing and research, and the test results published have usually been produced using carefully imaged irises under favorable conditions.

The objective will be to implement an open-source iris recognition system in order to verify the claimed performance of the technology. The development tool used will be MATLAB®, and emphasis will be only on the software for performing recognition, and not hardware for capturing an eye image. A rapid application development (RAD) approach will be employed in order to produce results quickly. MATLAB® provides an excellent RAD environment, with its

image processing toolbox, and high level programming methodology. To test the system, two data sets of eye images will be used as inputs;

The system is to be composed of a number of sub-systems, which correspond to each stage of iris recognition. These stages are segmentation – locating the iris region in an eye image, normalization – creating a dimensionally consistent representation of the iris region, and feature encoding – creating a template containing only the most discriminating features of the iris. The input to the system will be an eye image, and the output will be an iris template, which will provide a mathematical representation of the iris region

1-3 Aim of Project

With a huge progress of information technology in last years and menace on the personal data and their security, the requirement of design powerful and high accurate system for human Authentication and identification recognition become more important and most challenges topic. The aim is Iris recognition, Iris recognition is a method of biometric authentication, based on extraction features of the iris of an individual's eyes. Each individual has a unique iris, Biometric iris recognition systems should provide a reliable personal recognition schemes to either confirm or determine the identity of a person

1-4 Summary

In this chapter we discuss Biometric Technology, 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 and the one presented in this thesis, the iris. Also discuss Iris recognition and how it is involves first extracting the iris from a digital eye image, and then encoding the unique patterns of the iris in such a way that they can be compared with pre-registered iris patterns. Since each individual iris has enormous pattern.

2-1 Introduction

Iris eye (colored part) is the process of recognizing a person by analyzing the random pattern of the iris. The iris is a muscle within the eye that regulates the size of the pupil, controlling the amount of light that enters the eye. It is the colored portion of the eye with coloring… and Iris Recognition is one of the important biometric recognition systems that identify people based on their eyes and iris. In this paper the iris recognition algorithm is implemented via histogram equalization and wavelet techniques Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on video images of one or both of the irises of an individual's eyes, whose complex patterns are unique, stable, and can be seen from some distance.

Reliable automatic recognition of persons has long been an attractive goal. As in all pattern recognition problems, the key issue is the relation between interclass and intra-class variability: objects can be reliably classified only if the variability among different instances of a given class is less than the variability between different classes. For example, in face recognition, difficulties arise from the fact that the face is a changeable social organ displaying a variety of expressions, as well as being an active 3D object whose image varies with viewing angle, pose, illumination accoutrements and age It has been shown that for facial images taken at least one year apart even the best current algorithm shave error rates of 43%(Phillips et al. 2000) to 50% (Pent land et al. 2000). Against this intra-class (same face) variability inter-class variability is limited because different faces possess the same basic set of features in the same canonical geometry.

2-2 Iris database

CUHK Iris image dataset are authored by CHUN, Chun Nam Ben Computer Vision Laboratory, Department of Automation & Computer-Aided Engr., the Chinese University of Hong Kong, Hong Kong. The database consist of 254 images collected from 36 person for left and right eye. For each donator there are seven images. These databases contain only the iris images. The second database that have been used is UTIRIS dataset is authored by Mahdi S. Hosseini, Babak N. Araabi, Hamid Soltanian-Zadeh.it is Contain 1540 images from 79 individuals donator for both right and left eyes demonstrated in 158 classes in total. The Database is a copyright of Control and Intelligent Processing Centre of Excellence (CIPCE) Figure no 1 show example of the CUHK iris image and UTIRIS iris image.

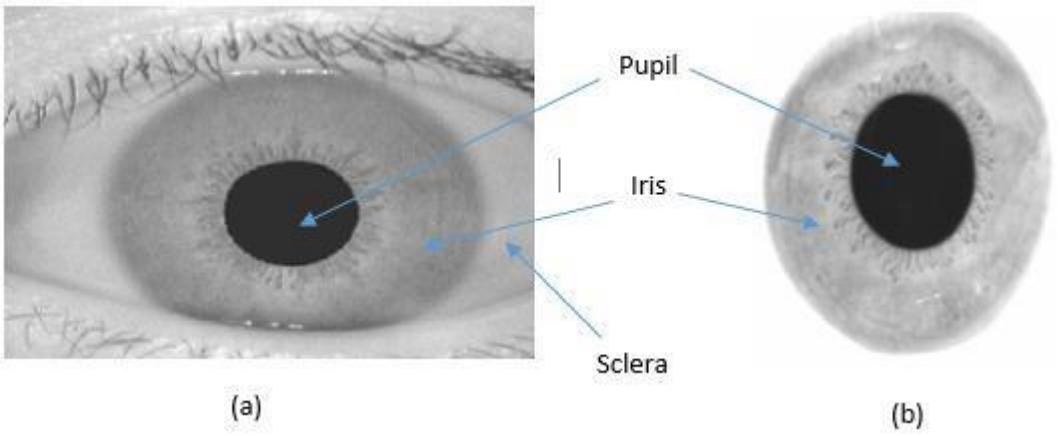

Figure 2-1 (a) sample of UTIRIS iris image (b) sample of

2-3 proposed schema

The propose schema of iris recognition system consist of enrollment and verify phases each one of them contain many steps standing with prepressing (this phase include resize, enhance the iris image, iris localization and normalization) the second step features extraction, by using wavelet haar transform greet set of raw feature them reduce the un useful feature by apply PCA often that new feature greeted depend on the selected feature, this features used in similarity measurement to check the matching rate.

2-3-1 Enrollment phase

The first part of iris recognition system involves preprocessing, iris localization and normalization, features extraction and features transformation by create features vector dictionary.

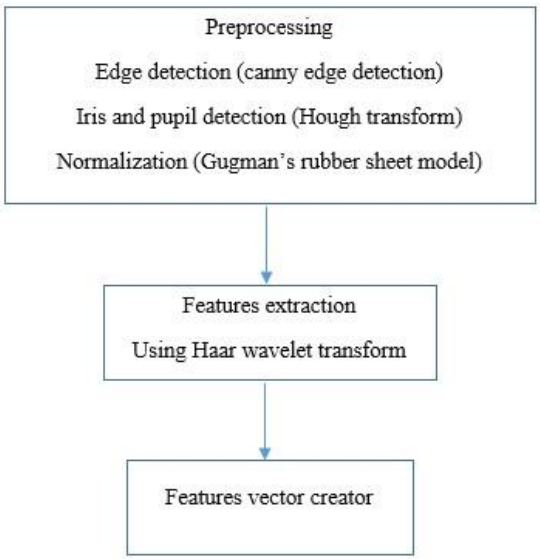

Figure 2-2 Enrollment phase

2-3-1-1 Iris Preprocessing, localization and normalization

In preprocessing step all images in both databases are uniformed by resize the dimensions of iris image and convert the images into gray scale then by applying canny edge detection algorithm to detect the boundary of all eye. Then iris localization is applied to detect the edge of iris and pupil from the input image. The iris region can be approximated by two circles first one for pupil and second one for iris. The eyelids and eyelashes normally occlude the upper and lower parts of the iris region. Also, specular reflections can occur within the iris region corrupting the iris pattern. There are many techniques that used for iris segmentation the most knowing techniques is Hough transform is a standard technique in computer vision algorithm that have been used to determine the parameters of simple geometric objects such as circle or lines in image.

2-3-1-2 Features extraction

The second major part in enrollment phase is features extraction and transformation. After segment iris image and detect boundary of iris and pupil based on Hough transform and normalization the iris region. Now the images are ready to extract the features. By applying Haar Wavelet packets as well as the energy of the packets sub images to extract the features of texture. In this work the2 levels wavelet packet decomposition of Haar wavelet transform employed to extract the texture of unwrapped iris region image. In the Haar wavelet transformation method, low-pass filtering is conducted by averaging two adjacent pixel values, whereas the difference between two adjacent pixel values is figured

out for high-pass filtering. The Haar wavelet applies a pair of high pass and lowpass filters to image decomposition first in image columns and then in image rows independently. As a first result the image divided into four sub bands as the first level's output of Haar wavelet. The four sub-bands are Low Low 1 (LL1) , High Low1 (HL1), Low High1 (LH1), and High High1 (HH1) . Upto two levels of decomposition are done to get the detail image. As shown in Figure number 2-3.

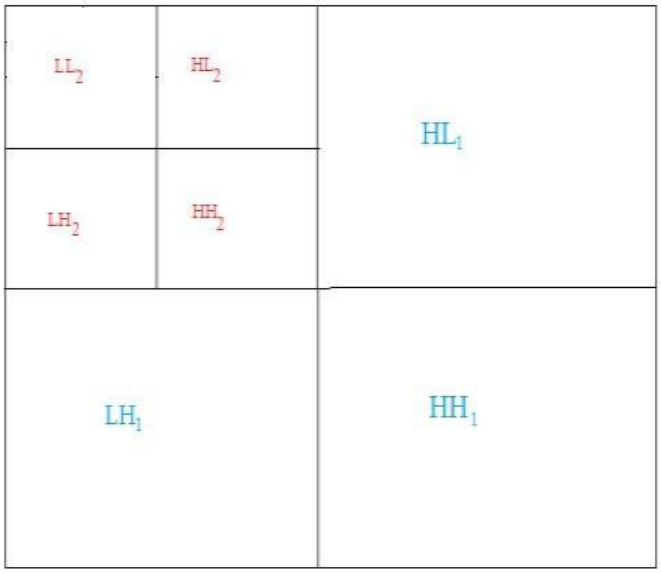

Figure number 2-3 structure of 2 level Wavelet decomposition

2-3-1-3 Features reduction and transformation

When the vector of raw features is extracted and select only the low low part of the haar wavelet transform in this step the reduction is ready to applied to minimize the number of redundancy features to increase the efficiency of recognition by choice the useful characterize of each iris image in database. In this phase PCA are applied as a reduction method. The selected features will be used to generate new features of each iris image to each person in the database. The new features that will generated are mean, median, standard deviation, variance, skewness, kurtosis, min and max. To generate this features will used the following equations:

$$\mu_X = \bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$$ ……. equation no (1)

$$\sigma_X = \sqrt{\frac{1}{n}\left\{\sum_{i=1}^{n} X_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} X_i\right)^2\right\}}$$ …….. equation no (2)

2-3-2 Verify phase

The second part of the iris recognition system is verifying phase, in this phase the unknown iris image will be process to check the similar pattern from the dataset that contain all most known iris image. The first step in this phase is preprocessing to enhance the query image to be ready to extract the features by using 2 levels of Haar wavelet transform and using the coefficients as a set of features. in this steps the features are transform into another pattern by select only the useful features that can be help in recognition part. Then when all the features of the unknown iris are generated, now the matching phase is ready to found the similar or closer result with the dataset. In this work will use Weighted Euclidean distance as a methods of similarity measurement, and compare the result of them.

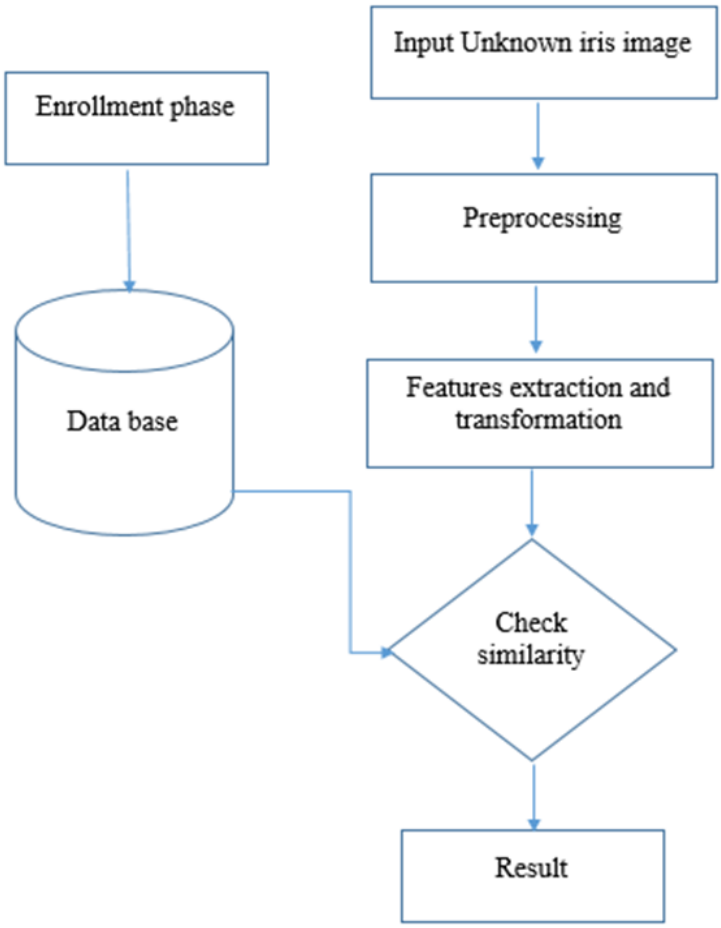

Figure number 2-4 verifying phase of iris recognition system

2-3-2-1 Matching measurement

To check the similarity between the query iris image and the pattern in the dataset

1. **Weighted Euclidean distance**

Weighted Euclidean distance (WED) is a technique can be used to compare between two vectors with same size, the WED gives a measure of how set of values are closer or similar, between two vectors of features the Weighted Euclidean distance can be calculated as an equation number 2-1.

$$WED = \sum_{i=1}^{N} \frac{(f_i - f_i^{(k)})^2}{(\delta^{(k)})^2} \quad \text{..... equation no (3)}$$

Where

f_i is the i^{th} feature of the unknown iris.

$f_i^{(k)}$ is the i^{th} feature of the iris template that save in dataset.

($\delta^{(k)}$ is standard deviation of the i^{th} feature of the iris template k.

The unknown iris found the matching template k , when WED is a minimum at k.

2- Cosine

The Cosine distance measure the similarity between two vector with non-zero vector integer or Boolean component, in the space a point may be through of as a direction. The cosine measurement distance between two vector is an angle between point and vector that make. This angle's degree between 0 to 180, depend on how many dimensions the space has. Where the Cosine of 0 is 1 and it is less than one for any other angle in positive space. If we have two vectors with the same values a cosine similarity of 1,and two vectors at 90° have a similarity of 0, and two vectors diametrically opposed have a similarity of -1. The equation number () show the formula of Cosine distance.

$\cos(A, B)\frac{A.B}{\|A\| \quad \|B\|}$ …….... Equation number (4)

2-4 Conclusion

In this work personal identification based on iris images are study, the system is divided into two major parts enrollment part and verifying part each one contains sub-steps preprocessing, features extraction then check the similarity using Euclidean distance. In preprocessing step all images in both databases are resize the dimensions of iris image and convert the images into gray scale Then iris localization is applied to detect the edge of Iris. By applying Haar Wavelet to extract the features of image, we use the2 levels of Haar; the image divided into four sub bands as the first level's output of Haar wavelet. The four sub-bands are Low 1 (LL1), High Low1 (HL1), Low High1 (LH1), and High High1 (HH1). two levels of decomposition is done to get the detail image. the features are transform into another pattern by select only the useful features that can be help in recognition part. Then check the similarity between the query iris image and the pattern in the dataset.

Future work

During the survey of this project work our project plain for future are:

1- Enhance our method in preprocessing phase that help us to recognize the details of iris images by apply Gaussian method after Histogram equalization method and test the result.

2- Test the algorithm on more than two databases and compare the result with another research paper to check the accuracy of our work.

3- Apply the system work real life and online.

4- Apply this work as entry for student and employees in our college Computer science and information technology.

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