وزارة التعليم العالي والبحث العلمي

جامعة القادسية

كلية علوم الحاسوب وتكنلوجيا المعلومات

قسم الحاسوب

Retinal image recognition system based on Haar Wavelet

بحث مقدم الى مجلس كلية علوم الحاسوب وتكنلوجيا المعلومات كجزء من متطلبات نيل شهادة البكلوريوس

أعداد

بروج مصطفى كامل

أيمان مرزوك سلمان

الدكتور فهد عواد

أشراف

م.م محمد حمزة عبد

بسم الله الرحمن الرحيم

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ

صدق الله العلي العظيم

سورة البقرة (٣٢)

الأهداء

باسم الخالق الذي اضاء الكون بنوره البهي وحده اعبد وله وحده اسجد خاشعا شاكرا لنعمته وفضله علي في اتمام هذا الجهد

...الى

صاحب الفردوس الاعلى وسراج الامة المنير وشفيعها النذير البشير

محمد (صلى الله عليه واله وسلم) فخرا واعتزازا

... الى

من سهر الليالي ... ونسي الغوالي ... وظل سندي الموالي ... وحمل همي غير مبالي

بدر التمام ... والدي الغالي

... الى

من اثقلت الجفون سهرا ... وحملت الفؤاد هما ... وجاهدت الايام صبرا ... وشغلت البال فكرا ... ورفعت الايادي دعاءا ... وايقنت بالله املا

اغلى الغوالي واحب الاحباب ... امي العزيزة الغالية

... الى

ورود المحبة ... وينابيع الوفاء ... الى من رافقوني في السراء والضراء

الى اصدق الاصحاب ... اخوتي واخواتي

... الى

القلعة الحصينة التي الجأ اليها عند شدتي

اصدقائي الاعزاء

نهدي ثمرة جهدنا المتواضع

الشكر والتقدير

لا بد لنا ونحن نخطو خطواتنا الأخيره في الحياة الجامعية

من وقفة نعود ألى أعوام قضيناها في رحاب الجامعة

مع اساتذتنا

الكرام الذين قدموا لنا الكثير باذلين بذلك

جهودا كبيرة في بناء جيل الغد

لتبعث الأمة من جديد

وقبل أن نمضي نقدم أسمى أيات الشكر والأمتنان والتقدير

والمحبة ألى الذين حملوا أقدس رسالة في الحياة

ألى الذين مهدوا لنا طريق العلم والمعرفة

ألى جميع اساتذتنا الأفاضل

وأخص بالتقدير والشكر

م.م محمد حمزة عبد

على أتمام هذا البحث وقدم لنا العون ومد لنا يد المساعدة

وزودنا بالمعلومات اللازمة لأتمام هذا البحث

له منا كل الشكر والامتنان

ونعمم الشكر لجميع اساتذتنا في الجامعة

Content

CHAPTER ONE
INTRODUCTION

1-1Introduction

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. Authentication of a person can be done through pass code, smart card, inserting a physical security key into the computer's USB port or biometrics. Some of services provider like Google they used two verification steps to increase the security of personal email or data on G-drive. It is optional additional measure for users to secure their accounts during logging for first time users are required to verify their identity using a second way after typing their username and password when logging in first time on a new device. Common methods include entering a code sent to a user's mobile phone through a text message contain the passcode, entering a code using the Google Authenticator smartphone app, or by inserting a physical security key into the USB port of the computer. Remembering password or managing smart card or keeping physical security key are difficult, compare with biometrics based authentication is highly preferred system. Some companies start adding biometric authentication "fingerprint, face" to their product devices like apple and Samsung companies [1].

Pattern recognition based on retinal of human eye for authentication is unique and more suitable method, but face various challenges in the process of recognition viz. acquisition of high quality image, segmentation of the concentric boundaries, select the proper features that belong to each person and matching.

1-2 Aim of project

Among the feature that can be measured the iris(retina) the biotechnology traits become the basis for a large-scale and the high protection level in the identification and verification of personal the more security breaches and swindlers have increased the need for a high degree of safety in determining identification and verification of personal – based solutions to the vital features capable of provide confidentiality and personal data as is the need to the use of the vital features in each of the government departments and financial applications sales of health and social services as well as in national security application .

Such as access control and define crimes and border security, one of these vital features irises with the characteristics of each eye is not similar to other fully...

1-3 Security tools

The system and method store biometric information on a token having a magnetic storage medium. A biometric image is captured, biometric data is produced and a copy protect code is generated. The biometric data and copy protect code are stored on the magnetic storage medium of the token for subsequent use in verifying an authorized user of the token. The copy protect code prevents data from being altered on the first or second tracks of the medium, and prevents biometric data from being copied from one token/card to another [2].

The present invention makes it possible for a user to have a security key created from one or more biometric elements of the user, such as a fingerprint. For example, a biometric feature or combination of biometric features of the user can be used to create an instance of a problem which can only be solved by data inherent in the biometric feature or combination of biometric features. The user can supply the data to solve the problem by inputting, through an appropriate input device, an image, or other representation of the biometric elements from which the data that will solve the instance of the problem is derived. If problem is solved, either completely or partially, using the derived data then the identity of the user can either be verified or ascertained. The solution can then be used for other purposes such as the generation of a cryptographic key.

1-4 Retinal image data base

In this project work we will use two kinds of data base DRIVE and DRIONS

1-4-1 DRIVE:

The photographs for the DRIVE database were obtained from a diabetic retinopathy screening program in The Netherlands. The screening population consisted of 400 diabetic subjects between 25-90 years of age. Forty photographs have been randomly selected, 33 do not show any sign of diabetic retinopathy and 7 show signs of mild early diabetic retinopathy. Each image has been JPEG compressed [3].

The images were acquired using a Canon CR5 non-mydriatic 3CCD camera with a 45 degree field of view (FOV). Each image was captured using 8 bits per color plane at 768 by 584 pixels. The FOV of each image is circular with a diameter of approximately 540 pixels. For this database, the images have been cropped around the FOV. For each image, a mask image is provided that delineates the FOV.

The set of 40 images has been divided into training and a test set, both containing 20 images. For the training images, a single manual segmentation of the vasculature is available. For the test cases, two manual segmentations are available; one is used as gold standard, the other one can be used to compare computer generated segmentations with those of an independent human observer. All human observers that manually segmented the vasculature were instructed and trained by an experienced ophthalmologist. They were asked to mark all pixels for which they were for at least 70% certain that they were vessel .All of the images contained in the

database were actually used for making clinical diagnoses. To ensure the utmost protection of patient privacy, information that might allow the identity of a patient to be reconstructed has been removed, and we have no actual knowledge that the images could be used alone or in combination to identify any subject. To minimize any further risk of breach of privacy

1-4-2 DRIONS-DATABASE

The database consists of 110 color digital retinal images. Initially, it were obtained 124 eye fundus images selected randomly from an eye fundus image base belonging to the Ophthalmology Service at Miguel Served Hospital, Saragossa (Spain). From this initial image base, all those eye images (14 in total) that had some type of cataract (severe and moderate) were eliminated and, finally, was obtained the image base with 110 images.for the 110 images selected, all those visual characteristics related to potential problems that may distort the detection process of the papillary contour[4]. The mean age of the patients was 53.0 years (S.D. 13.05), with 46.2% male and 53.8% female and all of them were Caucasian ethnicity. 23.1% patients had chronic simple glaucoma and 76.9% eye hypertension. The images were acquired with a color analogical fundus camera, approximately centered on the ONH and they were stored in slide format. In order to have the images in digital format, they were digitized using a HP-PhotoSmart-S20 high-resolution scanner, RGB format, resolution 600x400 and 8 bits/pixel.

1-5 summary

In The first chapter discussed the general view of image processing and the security issues and what are the methods of biometric are used. Also it has been containing the retinal image databases that have been used in our project.

CHAPTER TWO

THEORY BACKGROUND

2- 1 Introduction

Retina is the inner layer of the eye, and is characterized by being thin thickness does not exceed the thickness of the paper and a book containing ten layers composed of nerve cells and nerve fibers and cells receiving the light and supporting tissue. Retina works to convert light rays into nerve impulses are transmitted through the optic nerve to the higher brain centers and is done in the photoreceptors.

Photoreceptors are two types: rod cell help night-vision does not distinguish colors, and the other type sensitive cone cells, also for the light, but the colors marked. Both type of cells that cover the internal thin layer of the eye called the retina, so its ability to create a picture [5].

Bacillus cells sensitive to light a simple intensity (night vision) do not distinguish colors, while cone cells respond to light with a high intensity (Night Vision) and distinguish colors. Found in both types of cells specific proteins called obstinate variety, and those Neurons are sensitive to light. Color vision occur depending on the functional integration of the cone cells, and what the different types of Neurons - some of which responds to the red color of which responds to the color blue, including the type that responds to the color blue - this vision during the day. Vision under strong lighting conditions called], which see the day, the vision under low light conditions called (see darkness), a dark vision or night vision. Eyes operate using (Bacillus cells) effectively under high visibility conditions in the dark, while working with a cone cells with high efficiency under visibility conditions in the light or see Vertebrate retina is a tissue sensitive to light line the inner layer of the eye, and I've reached optics to analyze the visual images on the retina, where the same function as the camera. Upon the arrival of light to the retina begin a series of chemical and electrical events that lead to the presence of nerve impulses that are sent to various visual centers of the brain where transport through the optic nerve. In the genetic evolution of vertebrates: arise retina and optic nerve extensions of cerebral development, therefore, we find that the retina is part of the central nervous system and also find that the retina is the only part apparent and non-gummy from the central nervous system. Also, we find that the retina is a complex structure consisting of several layers of neurons connected to each through the so-called synapses which is about the confluence of two cells with each other, and we find also that neurons sensitive to light only be photoreceptor cells, where it is receiving the light is divided into two types:

1-sticks and their main function in dim light as it works to provide a vision of white, black, and the number is more concentrated in the retina parties.

2-cones and function during the day to support the vision and realize the rest of the colors and are concentrated in the center of the retina.

A third type, little kind of light receptors, which is a nodal cells (neurons in the retina) sensitive to light which is of interest to the responses of the reflectivity in bright daylight.

Nerve signal issued from conical cells and complex process through other nerve cells in the retina and take output under the form of dynamic signals in the ganglion cells in the retina that have to be nervous fiber optic nerve. There are several features of visual perception can be attributed to the retina and optic encoding process Daylight**.**

When examining the sector in the retina, we find that in the human retina in vertebrates is composed of ten distinct layers is from the inside to the outside, namely:

1-Internal membrane limited

2-A nervous tissue layer

3-the ganglion cell layer (which lead to the formation of the optic nerve cells).

4-Dverah inner layer form

5- Inner nuclear layer contains bipolar cells (a type of nerve cell)

6- Outer layer

7- External nuclear layer

8-limited external membrane, which separates the inner parts of the parts of photoreceptor cells and nuclear

9- A receiving layer of the light is rods and cones

10-Fabric coating chromosome of the retina.

2-2 Proposal work

In this work we will test two types of retinal image databases DRIVE and DRIONS and it contain two parts: first part is enrollment part this phase contains three steps starting with preprocessing, features extraction and features transformation. Same as with the second part verifying part and add extra step "matching" .figure number one show the steps of enrollment and verifying of the retinal image recognition system.

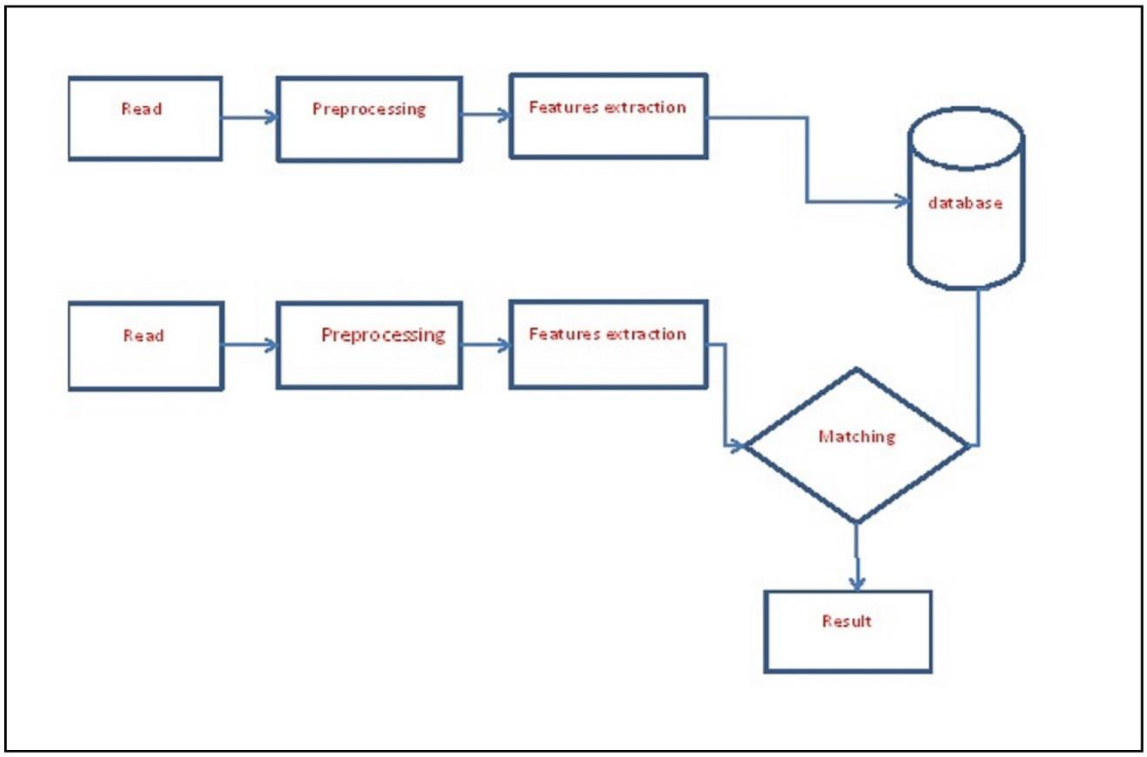

Figure number (1) proposed schema

2-2-1 Enrollment part

The first part of retinal recognition system involves preprocessing, vein of retinal segmentation, features extraction and features transformation by create features vector dictionary to use in verifying phase.

1- Preprocessing and segmentation

In preprocessing step all vein images in both databases are uniformed by resize the dimensions of retinal images and convert the images into gray scale. Then by applying histogram equalization and adaptive histogram equalization to enhance the appearance of the images.

2- Features extraction

The 2nd major part in enrollment phase is features extraction and transformation. After segment retinal vein image. Now the images are ready to extract the features[6]. 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 vein region in 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 low-pass 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) . Up to two levels of decomposition are done to get the detail image. As shown in Figure number 2.

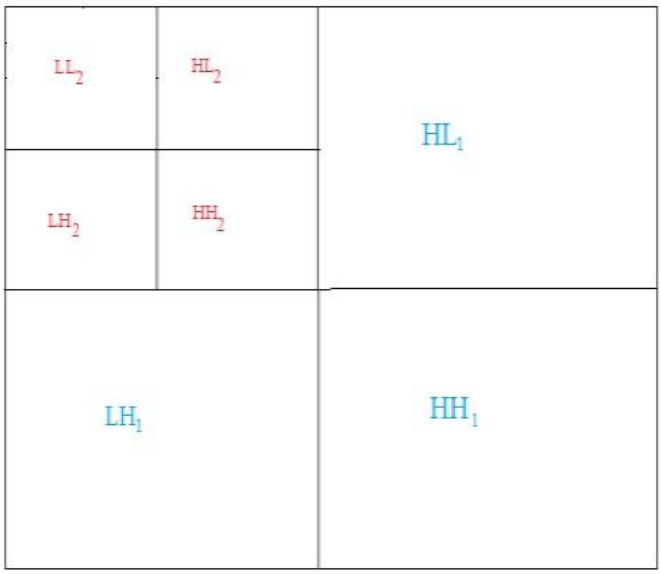

Figure no 2 structure of 2 levels Wavelet decomposition

2-2-2 Verify phase

The second part of the retinal image recognition system is verifying phase, in this phase the unknown retinal image will be process to check the similar pattern from the dataset that contain all most known retinal 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. Then when all the features of the unknown image are generated, now the matching phase is ready to found the similar or closer result with the dataset. In this work will use two methods of similarity measurement, and compare the result of them.

2-2-2-1 Similarity measurement

To check the similarity between the query retinal image and the pattern in the dataset
We will using Weighted Euclidean distance.

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)

$$WED = \sum_{i=1}^{N} \frac{(f_i - f_i^{(k)})^2}{(\delta^{(k)})^2} \qquad (2\text{-}1)$$

Where

fi 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.

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

2-City Block Distance

The city block distance between two vectors with k dimension is calculated as an equation number (2-2)

$$CBD=\sum_{j=1}^{k} \left| aj - bj \right| \qquad (2\text{-}2)$$

The city block distance is always greater than or equal to zero the measurement would be zero for identical points and high for points that show little similarity.
This distance measure yields result similar to the Euclidean distance. Note, however, that with city block distance, the effect of a large different in a single dimension is dampened.

3-Cosine Distance

The Cosine distance measure the similarity between two vectors with integer or Boolean component, in the space a point may be through of as a direction. The cosine measurement distance between two vectors is an angle between point and vector that make. This angle's degree between0 to 180, depend on how many dimensions the space has.

Cosine distance between two vectors is calculated as an equation number (2-3).

$$COS(A, B) = \frac{A.B}{||A||\ ||B||} \qquad (2\text{-}3)$$

2-3 Summary

In the second chapter the Investigation, General Background of retinal image recognition and the structure of propose work where the system divided into two part enrolment part and verify part.

2-4 Conclusions

In this study, we present an automated approach for imprint retinal extraction using (MATLAB).The main steps are involved: we use in this project two database DRIVE that contains 400 diabetic subjects between 25-90 years of age forty photographs have been randomly selected, 33 do not show any sign of diabetic retinopathy and 7 show signs of mild early diabetic retinopathy. Each image has been JPEG compressed, DRIONS the database consists of 110 color digital retinal images. Initially, it were obtained 124 eye fundus images selected randomly from an eye fundus image base belonging to the Ophthalmology Service at Miguel Served Hospital, Saragossa (Spain). The first part of project is enrollment part is applied to the original retinal image in order to remove the noise and increase contrast of retinal blood vessels and morphology operations are employed to extract feature from images by using Haar Wavelet packets the2 levels wavelet packet decomposition of Haar wavelet transform employed to extract the texture of vein region in image. The second part of the retinal image recognition system is verifying phase, in this phase the unknown retinal image will be process to check the similar pattern from the dataset that contain all most known retinal 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. Then when all the features of the unknown image are generated, now the matching phase is ready to found the similar or closer result with the dataset. In this work will use method of similarity measurement Weighted Euclidean distance, City Block Distance and Cosine Distance to compare the result between the query retinal image and the pattern in the dataset.

2-5 Future Plan

Our future plan to improve retinal recognition systems are:

1-Used Gabor filter as features of the retinal image.

2-Used LDA as a reduction method to reduce un useful features.

3-Used more than two database.

4-Used the histogram to diagnoses disease of retinal.

5-Callect the new images from many wars and apply the algorithm on them and compare the result with the other database.

References

[1]- L. Hong, A. K. Jain, and S. Penchant, “Can multibiometrics improve

performance?,” in *Proc. AutoID’99*, Summit, NJ, Oct. 1999, pp. 59–64.

[2]- Li, Q., J. You, J. Wang and A. Wong, 2010. A fully automated system for retinal vessel tortuosity diagnosis using scale dependent vessel tracing and

grading. Proceedings of the IEEE 23rd International

Symposium on Computer-Based Medical Systems

(CBMS), Oct. 12-15, IEEE Xplore Press, Perth, WA

221-225. DOI: 10.1109/CBMS.2010.6042645

[3]- J.J. Staal, M.D. Abramoff, M. Niemeyer, M.A. Viergever, B. van Ginneken, "Ridge based vessel segmentation in color images of the retina", IEEE Transactions on Medical Imaging, 2004, vol. 23, pp. 501-509.

[4]- E.J. Carmona, M. Rincon, J. Garcia-Feijoo and J. M. Martinez-de-la-Casa (2008). Identification of the optic nerve head with genetic algorithms. Artificial Intelligence in Medicine, Vol. 43(3), pp. 243-259.

[5]- (Neuroscience. 2nd edition Purvis D, Augustine GJ, Fitzpatrick D, et al., editors Sunderland (MA)

Clinical Anatomy of the Visual System, 2nd edition. Lee Ann Remington

[6]- Villalobos, F.M., Felipe, E.F.: A Fast Efficient and Automated Method to Extract Vessels

from Fundus Images. Journal of Visualization, J. Vis. 13, 263–270 (2010) ISSN: 1343-8875, doi:10.1007/s12650-010-0037-y.