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Methodology for Iris Recognition for Application in Biometric Systems

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Abstract: **Biometrics comprising two words – "bios" and "metron", meaning "life" and "measure" includes methods for unique identification of humans on the basis of their behavioral or physical traits. The biometric technologies analyze unique features such as fingerprints, retinas, hand patterns etc. and have wide applications in the area of security surveillance, access control, authentication and identification. These offer a profound method for identifying humans based on unique features which remain relatively stable over time, hence are authentic and reliable. When compared with other technologies like face and speech recognition, Iris recognition has been found to be most promising. Although there is still a long way to go for the technology to be properly leveraged, but it definitely promises to be the buzzword in the upcoming future. The paper proposes a methodology in which iris pattern is first segmented, then its components are normalized simply and with the image enhancement and then filtering is done using wavelet decomposition and Fourier transformation.**

Keywords: **Biometrics, Iris Recognition, Security**

1. INTRODUCTION

The field of Biometrics deals with the measurement and analysis of unique characteristics in humans which could be used for identification and authentication and develop surveillance systems for security purposes. Biometric characteristics are of two types: Physiological and Behavioral. Any human characteristic can be used for biometrics if it is unique, universal and permanent. The iris though visible outwardly, is a protected organ and has a unique stable pattern throughout the adult life of an individual.

These unique characteristics make iris recognition a powerful biometric method for the purpose of identification and authentication. We can extract the unique pattern of the iris using methods for image processing and then store it in the database by encoding it as a template. When identification of a person needs to be done, a photographic image of their eye is first taken and creation of template is done. Comparison of the template is then done with other stored templates. When the template is found to be matched with one of the templates stored in the database, the person is said to be identified, or else the person remains unidentified.

Iris recognition system includes two modes of operation:
1. Enrollment Mode
2. Identification Mode

The Enrollment mode functions to add templates to the database. When a person first uses a biometric system it is termed as enrollment. Storing of biometric information from an individual takes place during enrollment.

The Identification mode functions as the identifying step for an individual. Here, a template is created for an input image and matching is done with the stored templates in the database.

2. METHODOLOGY

Biometrics systems are famous because of their potential for application to identify and verify individuals for controlling access to secured areas [1]. Iris recognition has emerged as one of the most promising technologies to provide reliable human identification [4]. The properties of iris which makes it useful and better is that it is clearly visible yet for a clearer and perfect view there is some dilation solution required. Properties like uniqueness, stable and nonintrusive nature makes iris recognition one of the most reliable method with higher recognition rate and lower equal error rate [2]. An iris consists of many irregular small blocks, like stripes, freckles, coronas, furrows, and various others which are responsible for making the distribution of these textures in the iris random [5]. These are the merits and the demerits which are to be observed and dealt with while understanding an Iris Recognition System

Iris recognition system may be classified into two different modes first mode is enrolling mode, the second mode is verifying and identifying mode. Enrolment mode may be defined as the step which involves adding iris pattern into identification database. Verifying and identifying mode is required to develop an iris pattern and then to search for the

matched pattern in stored database by comparison mode [1]. Various important contributions have been made in the area of iris recognition by Daugman [1] and Wildes [2]. Daughman's technique is basically a circular edge detector which searches for the maximum of the contour integral derivative in the blurred image. On the other hand, Wildes' technique is responsible for searching an ellipse in the edge image using Hough transform to segment the iris [4]

There are three basic steps that are responsible for recognising an iris by the system:

1. Segmentation– This process uses Daugman's integro-differential operator is used for locating the circular iris and pupil regions, and also the arcs of the upper and lower eyelids.

2. Normalization- The homogenous rubber sheet model devised by Daugman is used to remap each point within the iris region to a pair of polar coordinates (r, θ) where r is on the interval [0,1] and θ is angle [0,2π],

3. Feature Encoding- Wavelets can be used to decompose the data in the iris region into components that appear at different resolutions. Wavelets have the advantage over traditional Fourier transform in that the frequency data is localised, allowing features which occur at the same position and resolution to be matched up.

3. IMPLEMENTATION

A. Image Acquisition

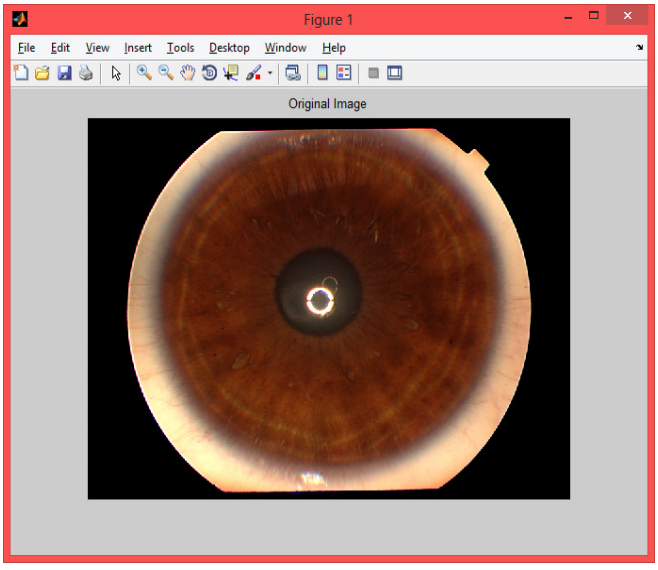

Fig. 3.1 Input Image of Eye

It is the first step, it is a critical task in different areas, as it deals with the accepting the data from a outsource for further processing. Image reproduction i.e. collecting an image and performing various function on them is an important factor is this process [3]. To perform this phase a traditionally image acquisition system should be deployed with distinctive image toolbox as a source of system input as well as results, this phase is responsible for effecting the results [4]. Image Acquisition toolbox is a great help in acquiring images and working on them. The input image is taken from an iris scan model 2100 iris scanner. The format of the image is in "png" with memory size is about 444 KB (455,621 bytes), which is a normally like other images. The advantage of using this scanner is that it focuses on the iris.

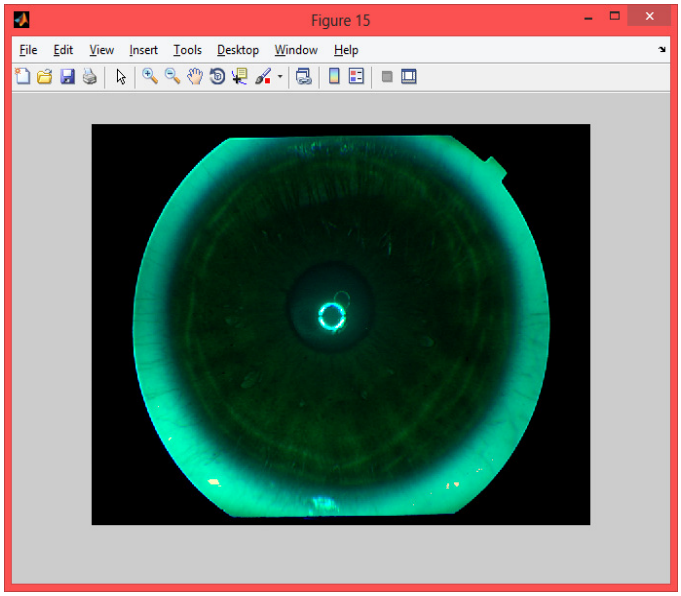

Fig. 3.2 Segmentation of input image

B.Segmentation

In this process iris and pupil are separated out so that the important part which is required for the processing is collected. Even the edges and boundaries of eye are also considered so as to get maximum features regarding its pattern. For this Daugman's Integro-diffrential Operator is used.

To perform Segmentation 5 steps are needed:

1. Differentiating different circles in an eye.

2. Function to detect the pupil boundary and distinguish it.

3. Finding the centre co-ordinates of the pupil.

4. Finding the partial derivative.

5. Calculate the normalized line integral.

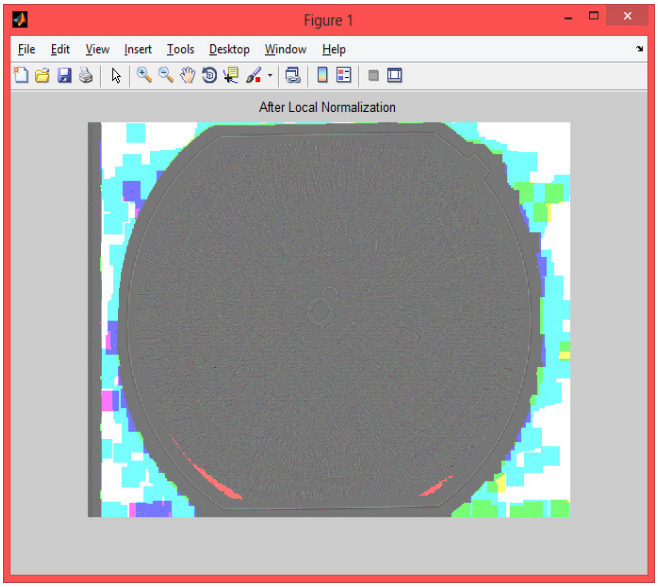

Fig. 3.3 Local Normalization of input image

C.a. Local Normalization

The homogenous rubber sheet model devised by Daugman [7] changes few points of iris region into even fractions with polar coordinates on the interval [0,1] and θ is angle [0,2π].

The iris region image, (x, y) are the original Cartesian coordinates are the corresponding normalized polar coordinates, and xp,yp and xl,yl are the coordinates of the pupil and iris boundaries along the θ direction. This model explains the inconsistence produced on size by pupil dilation, so that normalized representations with constraints can be produced. By this expiation iris region is defined in this model where considering pupil center as the reference point for the findings.

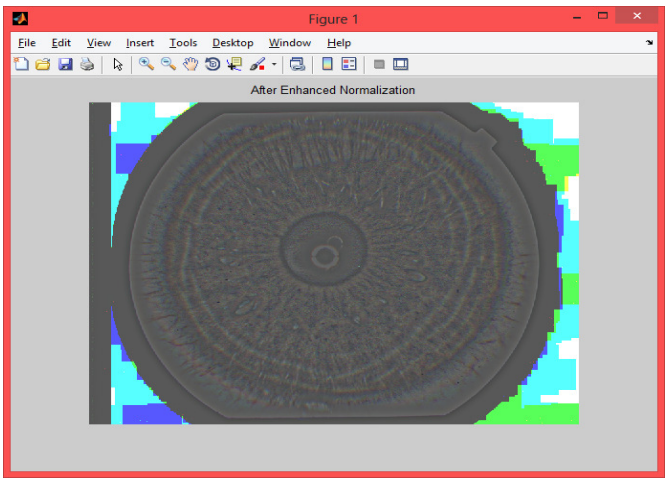

Fig. 3.4 Normalization Enhancement of input image

C.b. Normalization Image enhancement

It is the increment of the digital image which is being processed. This step is normally done to increase the quality of the image. This is done according to the image analyst; analyst may be system or a human being.

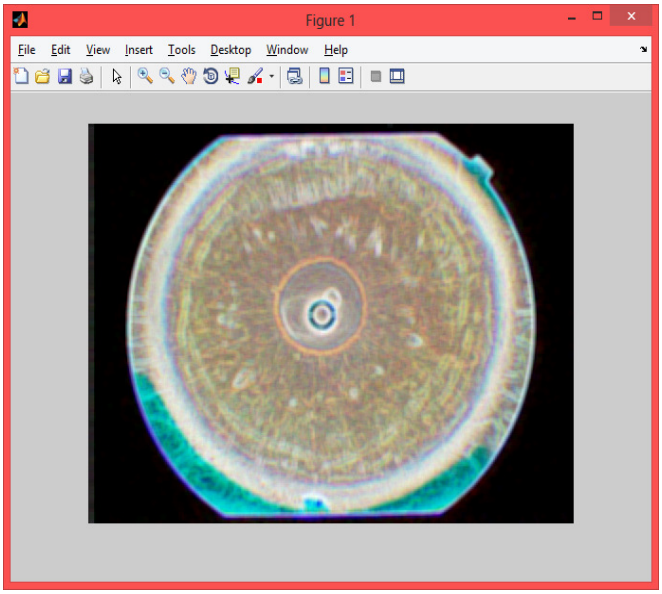

Fig. 3.5 Generating Pixels Around the boundary.

D. Iris Localization

Iris localization is done by differentiating the iris and pupil by performing the first step of Daugman's Integro-differential operator.

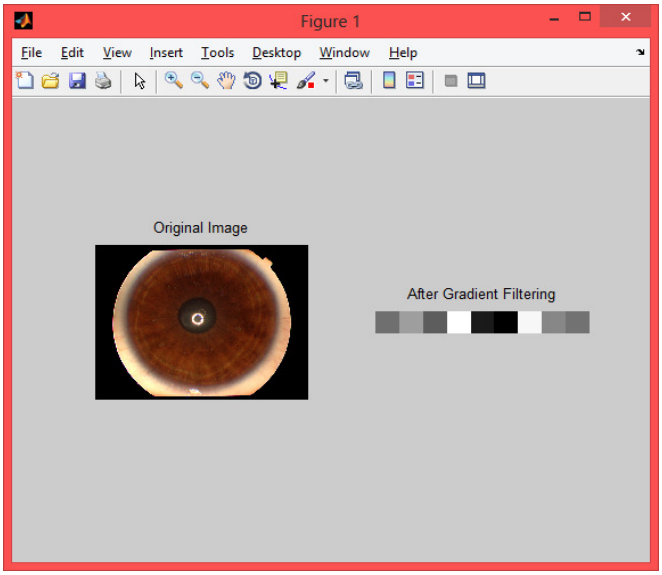

Fig. 3.6 Gradient Filtering

Wavelets can decompose the data in the iris region into components that appear at variable resolutions. They have the advantage over traditional Fourier transform method, in that the frequency data is localized and also allow features which occur at the same position and resolution to be matched. Wavelets as filter act on iris region as a scaled version of some basis function. The output is applied to encode in order to get a compact and differentiating representation of iris pattern.

4. CONCLUSION & FUTURE WORK

The methodology proposes using the MATLAB toolbox, which being a user friendly environment, allows easy image acquisition and processing. As steps toward Iris recognition—Segmentation, Normalization & Localization of the input image has been done, using the MATLAB scripter. These processes lead towards the end step of template creation and matching, which would have to be implemented on hardware and the matching process to be carried on the hardware itself. Another work could be adding different layers to the security by introducing more biometrics at a time.

The uses of Iris as a biometric have been widely accepted for identification & authentication applications despite the challenges involved. The need is to identify and overcome these challenges, so that the technology can be properly leveraged and more algorithms and systems devised in this regard.

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