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New methods of verification and identification using iris patterns

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Abstract: To detect and track eye images, distinctive features of user eye are used. Generally, an eye-tracking and detection system can be divided into four steps: Face detection, eye region detection, pupil detection and eye tracking. To find the position of pupil, first, face region must be separated from the rest of the image using mixture of Gaussian, this will cause the images background to be non-effective in our next steps. This will result in decreasing the computational complexity and ignoring some factors such as bread. Color entropy in the eye region is used to detect pupil. In the next step, we perform eye tracking. We proposed algorithm for the eye tracking by combining the pupil based Kalman filter with the mean shift algorithm. That use modal recognition technique and is based on pictures whit high equality of eye iris .Iris modals in comparison whit other properties in biometrics system are more resistance and credit .In this paper we use from fractals technique for iris recognition. Fractals are important in these aspects that can express complicated pictures with applying several simple codes. Until, That cause to iris tissue change from depart coordination to polar coordination and adjust for light rates. While performing other pre-process, fault rates will be less than EER, and lead to decreasing recognition time, account table cost and grouping precise improvement.

Key words: Biometrics; Eye tracking; Identity verification; Eye detection

1. Introduction

Automatic tracking of eyes and gaze direction is an interesting topic in computer vision with its application in biometric, security, intelligent human-computer interfaces, and driver's drowsiness detection system. Localization and extraction of eyes are operations requisite for solving problem. In (Jain et al., 1991) eye localization methods have been classified into five main categories:

(1) Shape-based Approaches which described by its shape, which includes the iris and pupil contours and the exterior shape of the eye (eyelids).

(2) Feature-Based Shape Methods which explore the characteristics of the human eye to identify a set of distinctive features around the eyes. The limbus, pupil (dark/bright pupil images) and cornea reflections are common features used for eye localization.

(3) Appearance-Based Methods which detect and track eyes directly, based on the photometric appearance as characterized by the color distribution or filter responses of the eye and its surroundings. These methods are independent of the actual object of interest and are in principle capable of modeling other objects besides eyes.

(4) Hybrid Models which aim at combining the advantages of different eye-models within a single system to overcome their respective shortcomings.

(5) Other Methods which employing temporal information and active light. In (Jain et al., 2006), skin-color filter is used to extract face. The eye position is gained by gradient characteristic projection and corresponding conditions setting. In (International Biometric Group (2005)) use the Haar-like features to detect the eye. This method trains classifiers with a few thousands of sample view images of object and construct a cascade of classifiers to detect eye rapidly. Biometric use for identity distinction of input sample compare to one modal and in some case use for recognition special people by determined properties .Using password or identity card. Can create some problems like losing forgetting thief. So using from biometric property for reason of special property will be effective. Physiologic: this parameter is related to fig.1 of body human. Behavioral: this parameter is related to behavior of one person.

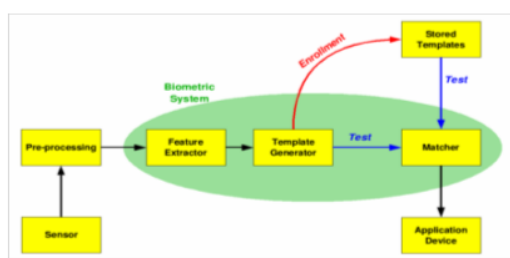

Fig. 1: lock diagram of a biometric system

2. Available iris recognition system

Daugman technique (International Biometric Group, 2005; Daugman, 2007) is one of oldest iris

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recognition system. These systems include all of iris recognition process: Taking picture, assembling, coding tissue and adaption.

2.1. Daugman techniques

Daugman algorithm is the famous iris algorithm. In this algorithm, iris medaling by two circles than aren't necessary certified. every circle defined whit there parameters (xo , y o , r) that (x o , y o) are center of circle with r radios . Use - a differential – integral performer for estimating 3 parameter in every circle bound. All pictures search rather to increasing r radius to maximize following Equation (1):

$$\left| G(r) * \frac{\partial}{\partial r} \oint_{x_0, y_0, r} \frac{I(x,y)}{2\pi r} ds \right| \quad (1)$$

In this formulate (x , y) is picture light intensify , ds is curve circle , 2πr use for normalization in tetras G(r) is Gus filter as used for flotation , and * is convolution performed (agent).

2.2. Local Intensity comparison

This method determines that a pixel is a possible corner if it has either, N contiguous valid bright surrounding pixels, or N contiguous dark surrounding pixels. Specifying the value of N is discussed later in this section. The next section explains how these surrounding pixels are found. We suppose that p is the pixel under consideration and j is one of the pixels surrounding p. The locations of the other surrounding pixels are denoted by the shaded areas in fig 2.

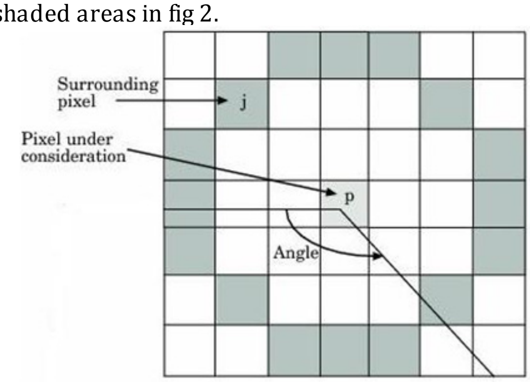

Fig. 2: locations of the other surrounding pixels are denoted by the shaded areas

I_p and I_j are the intensities of pixels p and j, respectively. Pixel j is a valid bright surrounding pixel if $I_j - I_p \geq T$. Similarly, pixel j is a valid dark surrounding pixel if $I_p - I_j \geq T$. In these equations, T is the value you specified for the Intensity comparison threshold parameter. This process repeats to determine whether it has N contiguous valid surrounding pixels. The value of N is related to the value you specify for the Maximum angle to be considered a corner (in degrees)

3. Suggestive algorithm

In this algorithm, we use from new method for identity distinction base on fractal techniques, specially used fractal codes as coding iris tissue modal. For testing suggestive method, we used from available pictures in picture base of bath university. General steps of iris distinction would be as follow. Clearly indicate advantages, limitations and possible applications.

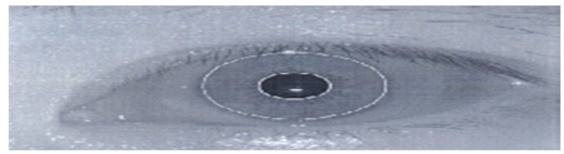

Fig. 3: Sample of available pictures in iris database of Bath University

3.1. Iris assembling

The main goal of this part is recognition of iris area in eye pictures. For this reason, we should recognize internal and external bound in iris by two circles. One method for assembling is using from fractal dimension. For accounting of fractal diminution, the picture dived to Blocks with 40 pixel width. As showed in picture, pupil and eye- lid areas recognized very good.

3.2. Iris normalization

In this step, should decant coordination change to polar coordination. For this reason, 128 perfect circle next to pupil center and with starting from pupil radius toward out, separate from iris, pour pixels on these circles in one rectangle, in this way iris that was the form of circle trope, change to rectangle, it means iris from Decoct coordination change to polar coordination. In fig.3 you can watch iris polar coordination. Since changing in light level, pupil environment of iris changed. We should control input light. However, it may person interval different from camera, but size of iris doesn't same in different pictures. So with choosing this 128 prefect circles iris normalization done in respect to size.

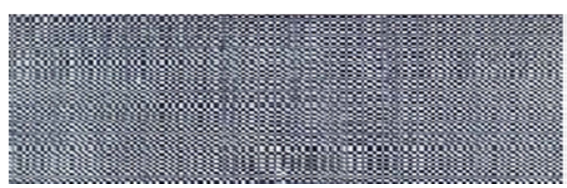

Fig. 4: Diagram of polar coordination of iris tissue

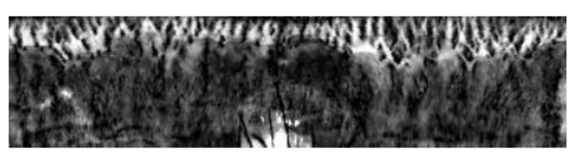

Fig. 5: Diagram of normal iris picture

Then separated iris tissue control for light intensifies. Means picture contrast increased to iris tissue recognize very good. In Fig.6 you can see sample of norm led iris tissue.

3.3. Iris tissue coding

In this step, we should coding iris tissue pixels set, and use it for comparing between 2 iris pictures. In suggestive methods. We use from fractal code. So fractal code of normal iris account. And this code as one modal saves in data base. To used for recognition and comparing iris pictures. In next step, we should encoding input picture with this fractal codes. So I need to change all pictures to standard size. For accounting fractal code first normal iris picture change to one rectangle 64*180 pixels. So fractal codes for different iris have same length (Fig. 7).

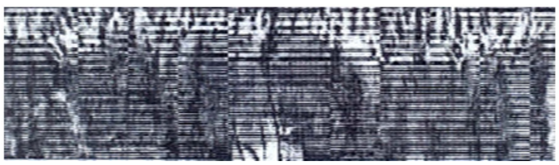

Fig. 6: Normal iris picture in diminution 64*180 pixels

3.4. Change range to wide blocks

Main step in accounting fractal picture coding is changing range to wide blocks. For every wide block copy of range block compare to that block. W changing is combination of geometrics and light changing. In case of I grey picture, if z express pixel light intensify in (x, y), we can show w as matrix as follow:

$$W\left(\begin{bmatrix} x \\ y \\ z \end{bmatrix}\right) = \begin{bmatrix} a & b & 0 \\ c & d & 0 \\ 0 & 0 & s \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} + \begin{bmatrix} e \\ f \\ o \end{bmatrix} \quad (2)$$

f, a, b, c, d, e coefficient, control main aspect of changing geometrical. While s, o recognized contrast and both of them recognize light parameters. Changing geometrics parameters limit to hardness adaption. (Ebrahimpour-Komleh et al., 2004). Comparing range wide in a 3 steps process. One of base eight directions applied on selected range block. Then, oriented range block, become minimum till be equal to wide block Rk. If we want general changed be contradictor, wide should be range block. However, present ting picture as set of changed blocks, don't present precise copy, but it's good approximate. Minimizing fault between Rk and w (Dj) can minimize fault between estimated and main picture. If ri and d and I=1,…,n be pixel amounts relate to blocks having same size Rk and shrink , fault and ERR is as following:

$$Err = \sum_{i=1}^{n} (s.d_i + o - r_i)^2 \quad (3)$$

$$Err = n.o^2 + \sum_{i=1}^{n} (s^2.d_i^2 + 2.s.d_i.o - 2.s.d_i.r_i - 2.o.r_i + r_i^2) \quad (4)$$

$$\begin{cases} \dfrac{\partial err}{\partial s} = \sum_{i=1}^{n} (2.s.d_i^2 + 2.d_{i.}o - 2.d_i.r_i) = 0 \\ \partial Err = 2.n.o + \sum_{i=1}^{n} (2.n.o + \sum_{i=1}^{n} (2.s.d_i - 2.r_i) = 0 \end{cases} \quad (5)$$

It happens when [10]:

$$\begin{cases} s = \dfrac{\lfloor n\sum_{i=1}^{n} d_i.r_i - \sum_{i=1}^{n} d_i \sum_{i=1}^{n} r_i \rfloor}{\lfloor n\sum_{i=1}^{n} d_i^2 - (\sum_{i=1}^{n} d_i)^2 \rceil} \\ o = \dfrac{1}{n}\left[\sum_{i=}^{n} r_i - s\sum_{i=1}^{n} d_i\right] \end{cases} \quad (6)$$

One of advantage of suggestive method for iris recognition is that when registering person, we save input fractal code of person iris picture as modal in data base, and so with regard to compressing property of fractal codes, we have less weight data base.

3.5. Grouping and adapting

In this respect we should compare input picture with available modals in data base system, and achieve similarity between them. For this reason, iris norm led picture encoding with available fractal codes in data base. For recognition similarity between input and encoding picture, used form interval between them. Nominal similarity size is 0 and 1. (Ebrahimpour-Komle, 2004) Interval form mincosci defined base on soft LP:

$$d_p(x,y) = \sqrt[p]{\sum_{i=0}^{N-1} (x_i - y_i)^p} \quad (7)$$

When $p \to \infty$, achieved L_∞:

$$D(x,y) = \max_{0 \le i < N} \{|x_i - y_i|\} \quad (8)$$

3.6. Suggestive method simulation

Suggestive method for identity recognition performed on subset iris picture data base in Bath University. Available subset include 1000 picture from 25 different persons. 20 pictures from left eye and 20 picture form right eye were showed. Since iris left and right eye is different in every person. Among every 50 eyes, from 20 pictures, 6 pictures are considered for teaching and testing (Fig. 7,8 and 9).

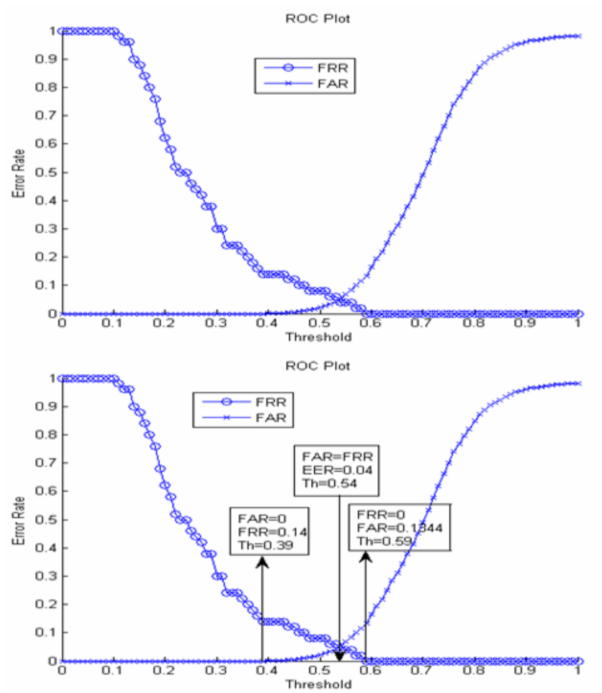

Fig. 7: curve ROC relate to suggestive identity verification system

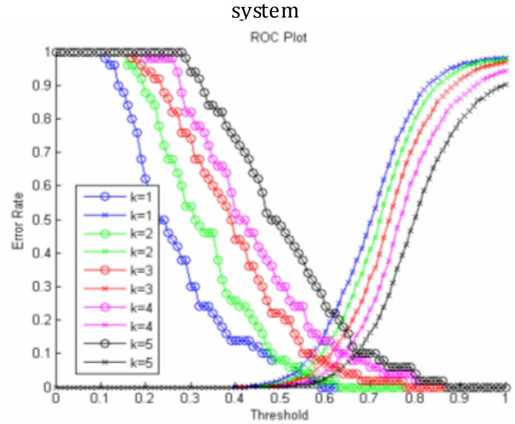

Fig. 8: curve ROC RELATES to suggestive identity verification system with regard to adoptions numbers. (n= 1, 2, 3, 4, 5)

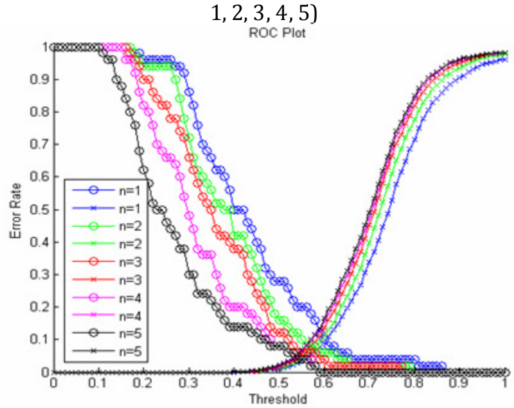

Fig. 9: curve ROC relate to suggestive identity verification system with regard to adoptions numbers

4. Conclusion

In this paper, we have proposed a new method for identity verification and recognition with help of eye iris modals. For a lot of reasons that iris modals have ran the than other biometrics properties it's more fantastic. In assembling part. It says that with using of light in tensely process techniques and modeling performance and Anny margin or can recognize iris internal bound. In normalization part centrifuged rules toward pupil center and starting radius toward out, can determine noise originate from eye-lash and eye-lid.

Table 1: comparing identity distinction precise of suggestive system with Daugman method base on register teaching picture number. (n=1, 2, 3, 4, 5, 6)

Identity Daugman method	Identity suggestive method	Picture number(n)
%96	%88	**1 picture**
%96	%86	**2 picture**
%96	%94	**3 picture**
%96	%94	**4 picture**
%96	%96	**5 picture**
%96	**%96.13**	**6 picture**

Since in coding and encoding iris picture and we use fractal codes iris fractal codes save as modals in data base. This method has same advantages like less weight of database .more security and relative good precise. when entering one person, iris picture encoding on fractal codes for one step, to Euclid interval and interval minimum e method can use .In suggestive system normalization part, iris tissue change form depart coordination to polar coordination and adjust light in tensely, while performing other preprocess, fault rate ERR will be less than this amount .If used data base in iris distinction system be big, search time will be a lot. So, in grouping and adapting iris modals for reason of decreasing distinction time, decreasing accounting cost and improving grouping precise, can use form diminution fractal.

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