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Proposed Iris Recognition Algorithm through Image Acquisition technique

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Abstract. This paper addresses the new idea in iris recognition process which is helpful to recognize an individual through his iris in different conditions such as indoor and outdoor. Iris recognition is the method of biometric which is more stable and secure as compared to the other biometric traits such as fingerprints, hand geometry, face recognition, gait pattern, speech recognition etc. because the characteristic of iris doesn't change in individual's lifetime. The iris recognition process just takes 1 to 2 seconds to verify the individuals. The challenge response test in iris recognition provides the technique to check the eye uniqueness and put the data in iris database. This method takes less time as compared to the existing methods and keeps away from duplicity because iris image captured in different real time conditions. This method easily used in elections, bank transactions and various security purposes.

Keyword: Biometric Recognition; challenge-response test; iris image acquisition; normalization feature extraction.

1. INTRODUCTION

Image acquisition is the initial step of iris recognition process. This method is based on the user's liveness characteristics which shows that user is present in actual or not. Biometric is the science which provides the methods to identify a user based on physical characteristics and behavioral characteristics. Physical such as fingerprints, hand geometry, iris, and retina, face etc. and behavioral such as user signature, gait pattern, voice patterns etc. The iris recognition is one of the safest and highly accurate technique. There are so many reasons behind it such as user-friendly, reliable for person, uniqueness, accuracy, secure, safe etc. In reality, no two irises in the world are the same. Even a user's left and right eyes have completely dissimilar iris patterns. Iris is made before the birth and does not change during the lifetime. If we compare iris with other biometric traits, then we found the false acceptance rate of iris recognition system is 1 in 1.2 millions and the false rejection rate is about 0 percent which is much far better than the fingerprints recognition. The process of iris recognition starts with a photograph. With the help of camera, an infrared imager locates the position of eye and captures a high resolution photograph and the whole process takes only one to two seconds. This is the first step of iris recognition process and in this paper we are going to discuss the basic algorithm which will work on the first step of iris recognition. Iris itself is used as a kind of living password. The algorithm in this paper describes that how a biometric system identify that the person is present in actual or not. This algorithm has a number of steps and used by the iris recognition process to determine that the person is identified positively. If the first step found incorrect then there is no need to go to the other steps because of the inner edge and the outer edge of the iris is located same in the different environment or conditions.

2. RELATED WORK

Iris recognition process divided into two basic parts: verification and identification. The captured image converted first into its encoding feature because of iris verification and manipulation process manipulated easily. The process of iris recognition consists of five steps: image acquisition, localization, normalization, feature extraction and matching. In accordance with iris acquisition, the iris recognition algorithm can be described in challenge response algorithm which we will discuss in next section. This algorithm improves the image error and liveness detection and removes the fake artifacts. On the other hand, near the beginning the research was inoperative by the lack of iris image. But now there are so many databases are available on the internet for testing usage. A well recognized database is CASIA IRIS IMAGE DATABASE (version 1.0) [1] granted by the Chinese Academy of Science. It consists of 756 iris images from 108 eyes composed over two sessions. All the images captured is nearly faultless and free from noise and rough image conditions. Other practical image conditions were captured into concern in the UBIRIS DATABASE [2]. UBIRIS DATABASE contains 1877 images from 241 persons composed over in two sessions. The image captured in the first session was noise free or low-noise image. In contrast, image captured in second session were captured in different conditions such as: under natural light, reflections, different contrast levels etc. Such type of images capable to provide the realistic situations and environment with nominal relationship from the subjects. Other databases also exist such as LEI [3] and the UPOL [4]. LEI Database includes images with some noise and it is very small database which works only for 120 grayscale

images. UPOL Database includes images from internal parts of the eye which focus on the localization part of iris. In the next section, we will discuss a new approach for the iris recognition system which includes eye liveness checking to avoid fake sources entering from the database. This algorithm provides the real time security applications.

3. CHALLENGE RESPONSE TEST

Challenge response method requires user support. In the case of iris recognition process the system is recognize that the iris is original or other artificial sources. Challenge response test could be performed where the user could be randomly find out to blink or to look in different directions such as look left and right or look up and down. In case of iris acquisition at the time to get pictures of iris an automatic reflex of the body can be generate by changing lighting level because the internal part of iris i.e. pupil changes its size according to light conditions. It may be driven larger or small. The response time of a system is about 250 ms for constriction and 400 ms for dilation [5].

4. IMAGE ACQUISITION ERRORS

Apart from the accuracy and stability of the iris recognition matching process the performance of a biometric system does matter if a user enroll their data accurately for the later attempt. If a user doesn't present the accurate data then there may be chance of error. In the acquisition process, the errors are failure to enroll and failure to acquire.

Failure to enroll rate: This type of error is occur when the estimated amount of the population for whom the system is not capable to generate repeatable pattern. The 'failure to enroll' rate doesn't generate the image of supportable quality at the time of enrollment and doesn't confirm that the user is matched correctly or not. All the process of enrollment depends on the enrollment strategy.

Failure to acquire rate: This type of error is occur when the estimated amount of transaction for which the system is not able to capture or locate an image of supportable quality. The 'failure to acquire' rate depends on the changeable threshold for an image.

5. PROPOSED IRIS RECOGNITION ALGORITHM

A proposed iris recognition system is shown in the figure 1. In this proposed work the system is divided into seven steps: Iris image acquisition, challenge response test, iris segmentation, iris normalization, iris enhancement, iris feature encoding and iris matching.

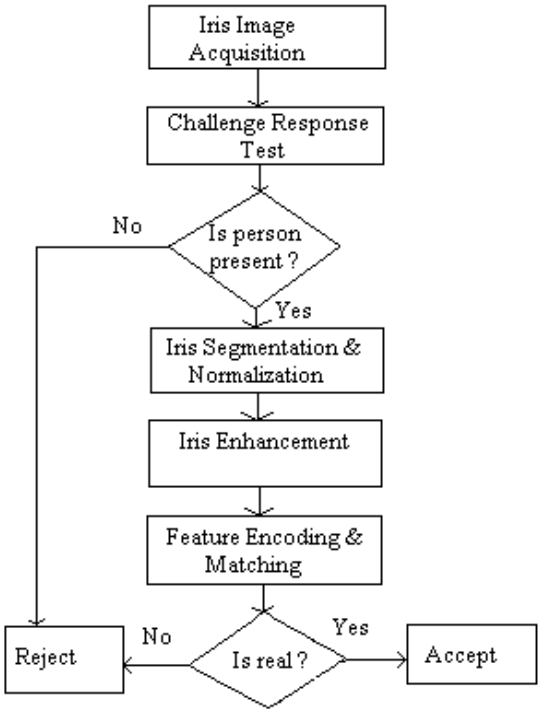

Figure 1: Block diagram of proposed work

Algorithm:

The proposed work of iris recognition step is described as following steps:

Step-1 Image Acquisition: The first step of the iris recognition system is image acquisition. This step is very complicated because the size and color of iris of every person is different. It is very difficult to capture clear images using the standard CCD camera in different environmental conditions. Usually, the acquisition distance for average capturing is 2 to 3 feet and the average time is 1 to 2 seconds. Sometimes the acquisition process produces different results for the same person due to the different lighting effect, positioning and different separation of distance.

Step-2 Challenge Response Test: This step is the main concept of the proposed work. The aim of the challenge response test is distinguish in between the real and artificial biometric traits. It makes sure that the captured image derived from an original source or other artificial source. The iris changes its size according to the lighting effect and controlled by the two muscles i.e. dilator and sphincter. The sphincter muscles control the iris and less light allowed arriving at the retina when the amount of light is bright or more intense because the sphincter muscle pull towards the centre of iris. On the other hand, the dilator control the iris and more light allowed arriving at the retina when the amount of light is dark or less intense because the dilator muscle pull away from the center of iris. The following footstep is described as follows:

(i) Take at least three eye images of the same person in different lighting effect.

(ii) Then calculate the diameter of all eye images. If all the diameters are different because of lighting effect, then it will make sure that the images captured from the original source and if all the diameter size are same in different lighting effect then it will sure that the images captured from the fake source.
The diameter of the pupil is calculated by the following formula [6]:

$$(x - x_1)(x - x_2) + (y - y_1)(y - y_2) = 0 \quad (1)$$

$$T_d \begin{matrix} \theta_i - \theta_{i+1} \vee \\ \sum_{i=0}^{n-1} \end{matrix} \quad (2)$$

$$\text{CRT} = \int_{FALSE, otherwise}^{TRUE, If T_d \neq 0} \quad (3)$$

where n is the number of eye images, CRT is the challenge response test module, T_d is a total diameter of pupil, $\theta_i \wedge \theta_{i+1}$ are the pupil's diameter under different lighting. This step makes sure that the captured input images are original. This method is used to prevent from artificial sources. The measurement of diameter of pupil is shown in figure 2.

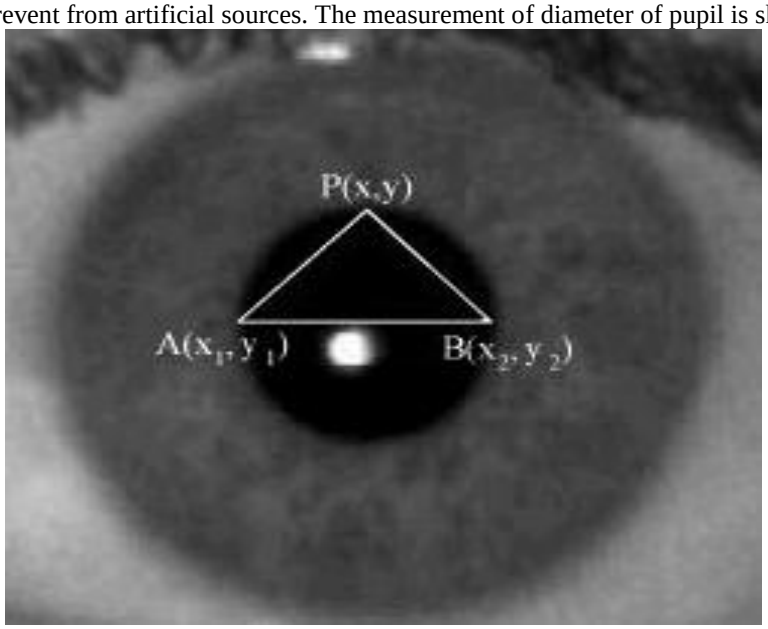

Figure 2: Pupil boundary diameter.

Step-3 Iris segmentation: It is the process to eradicate all the different parts of eye such as pupil diameter, eyelashes, eyelid, sclera part of eye, inner and outer part of the eye and other irrelevant details of iris image which is not useful for the next steps such as feature extraction and matching process. To remove all irrelevant details increase the efficiency and save time of the recognition process.

Step-4 Iris Normalization: It is the process which changes iris image to the standard rectangular strips using the radial scan method. In this method all the pixels collected from the iris image portion and converted into the rectangular form. There are many other methods used in the normalization such as Daugman's model [7].In this model the process will produce the iris regions, which has the same dimensionality of the two same captured image of iris under the different lighting effect.

Step-5 Iris Enhancement: This process enhances the iris image so that the poor image quality can be accepted by next step of iris recognition system. The iris feature extracted by circular symmetric filter method [8] as shown in figure3. This method describes the relationship between low frequency information and high frequency information. This method improves the efficiency and correctness of the iris recognition system with the help of image preprocessing and feature representation. The inner and outer boundaries of an iris is localized by filtering, edge detection and Hough transform.

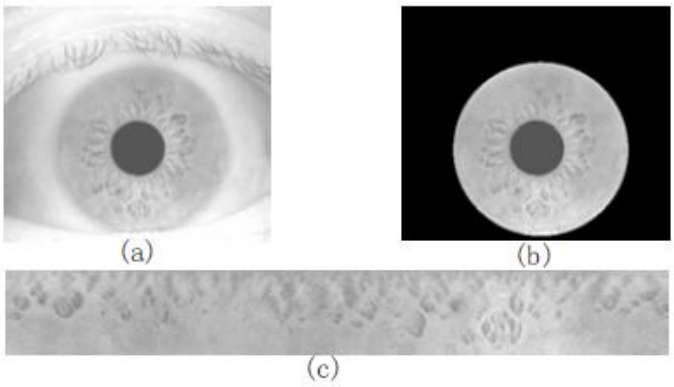

Figure 3: Image preprocessing (a) Original image (b) Location of iris (c) Normalized

Step-6 Iris Feature encoding and Iris Matching: This is the last step of iris recognition process. In this step the encoding process extract the feature from iris image and used for the matching process. Iris code is developed by the different methods such as 2-D Gabor filter and Haar- Wavelets. The encoding process encodes the pattern of iris into 3002 bit iris code because the binary code is much easier to decode as compare to the decimal codes. After the encoding process the Hamming distance method [9] is used to matching process. Hamming distance method gives a measure in two bit patterns that how many bits are same. On the basis of bit patterns, it makes sure that the two bit patterns are generated from the same irises or different one. This method is developed by Daugman and the hamming distance calculation is calculated by the actual iris region. The purpose of hamming distance reduce the errors motive by false accept and false reject rate.

6. CONCLUSION

This paper present a new algorithm used to identify a user based on its iris pattern. This algorithm works in both environments such as indoor and outdoor conditions. The challenge response test is the main focus of this algorithm. It ensures that the captured image of iris is taken from the original source or artificial source. This algorithm is much more efficient and accurate as compared to the existing approaches and finds the location of iris in efficient manner. The space complexity of this method is also reduced as compared to the existing approaches. This method is also appropriate for the real time applications like attendance management system, person identification in airports and borders, e-voting, terrorist identification etc.

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