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A Survey on IRIS Recognition System: Comparative Study

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Abstract— Because of an increasing emphasis on security, Iris recognition has gained a great attention in both research and practical applications over the past decade. The demand for iris recognition in the various fields of access control reducing fraudulent transactions in electronic commences, security at border areas etc is increasing day by day due to its high accuracy, reliability and uniqueness. A review of various segmentation approaches used in iris recognition is done in this paper. The performance of the iris recognition systems depends heavily on segmentation and normalization techniques.

Keywords- *Biometric; Iris recognition; Segmentation*

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I. INTRODUCTION

An extensive variety of systems require dependable individual recognition schemes to either confirm or decide the identity of an entity requesting their services [1]. The reason of such schemes is to make sure that the render services are access only by a rightful user, and not by anyone else. Example of such applications includes secure access to buildings, computer systems, laptops, cellular phones and ATMs. In the nonexistence of strong personal recognition schemes, these systems are susceptible to the tricks of the frauds. Biometric recognition, or just biometrics, refers to the mechanical recognition of persons based on their physiological and behavioral individuality. By using biometrics, it is probable to confirm or establish an individual's identity based on "who she is", rather than by "what she possesses" (e.g., an Identity Card) or "what she remembers" (e.g., a password) [2]. In this document, we give a concise impression of the field of biometrics and summarize some of its compensation, disadvantage, strengths, limitations, and linked isolation concerns. Computer science describes biometrics as automatic recognition of individuals through their unique attributes i.e. Physiological (fingerprint, face, iris etc.) or Behavioral (voice, signature etc.). Besides, biometric attributes cannot be lost, transferred or stolen, and ensures better security because they are very difficult to forge. Moreover, they require the presence of the genuine user while granting access to the particular resources.

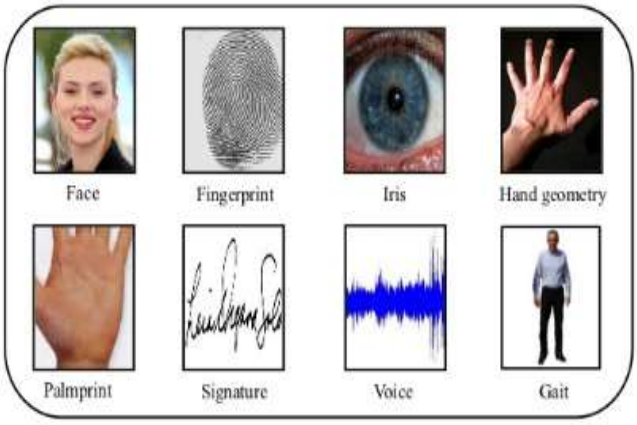

Figure 1. Biometric Traits

In this paper, study of iris in biometric recognition is taken place. Various methods used for the recognition of iris with the system are described following the work done by number of authors in the form of comparative analysis

II. IRIS RECOGNITION

Iris recognition is known as an automated method for identification of biometric for using the flowery patterns of the human iris for the identification and verification of human being [2]. Iris recognition demand is increasing regularly in different fields for access control and security at border areas etc. because to the unique features like rings, ridges, a furrow, complex patterns, freckles. So, it poses an immense degree of randomness [3].

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The key advantage of iris recognition, in addition its speed for matching and its extreme resistance to false matches is the constancy of the iris as, protected, an internal but externally visible eye organ.

Figure 1 describes the block diagram for a biometric system for recognition of iris in unconstrained environments in which every block's function is being briefly given:

- Image acquisition: This stage takes a photo from iris.
- Pre-processing: This stage basically consists of contrast adjustment, edge detection with a multiplier.
- Segmentation: It consists of localization of boundary among iris and eyelids and localization of iris inner and outer boundaries.
- Normalization: This level includes polar transformation to Cartesian coordinates with the normalization of iris image.
- Feature extraction: Removal of noise from iris image with the generation of iris code is included in this stage.
- Classification and matching: This level involves the comparison with the matching of iris code being saved in database.

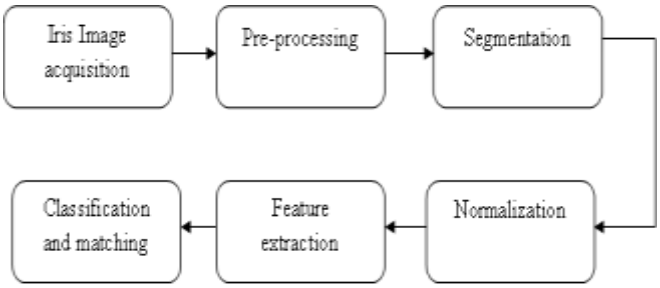

Figure 2. Stages of Iris Recognition System

A. Iris Segmentation

In this process, the color images are transformed into gray shade means the brightness/luminance for the color image can be converted into gray shade by using the formula defined below [11].

Y=0.3RED+0.59GREEN+0.11BLUE

The primary stage of iris recognition is the conversion of the actual iris region into a digital eye image. The iris region, as depicted in Figure 2, could be approximated by basically two circles, one is used for the sclera/ iris boundary and other, that is interior to the first, intended for the pupil/ iris boundary.

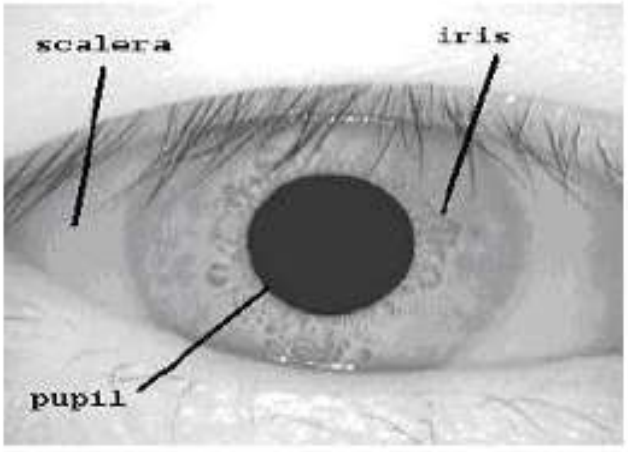

Figure 3. Human Iris front View

The eyelashes and the eyelids normally have the lower and upper parts of the iris region. The specular reflections could happen in the iris region that corrupts the iris pattern.Figure3 depicts the technique and designs for isolating and excluding the artefacts with the addition of localizing the circular iris region.

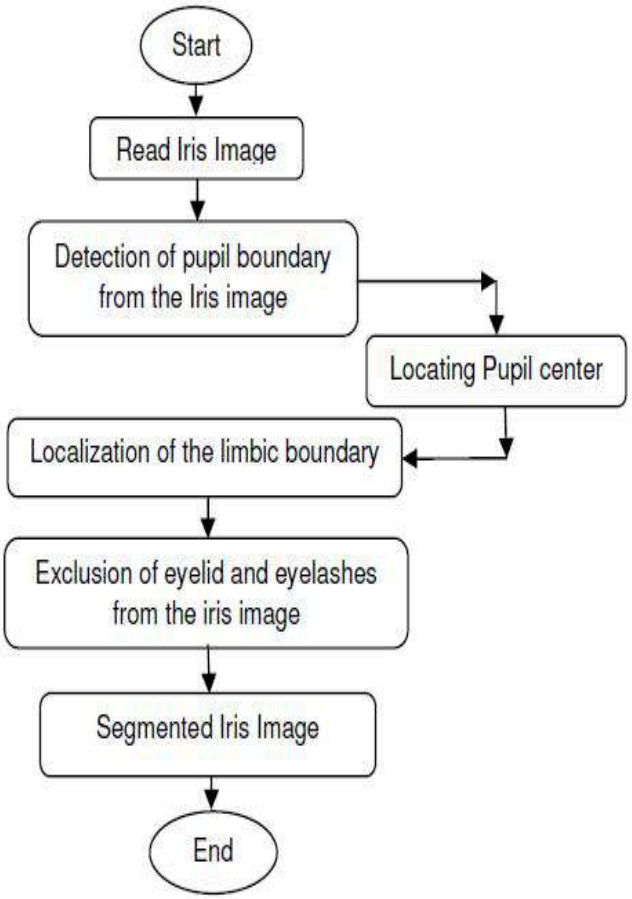

Figure 4. Image Segmentation design

III. FUSION IN BIOMETRICS

As the feature set holds extended knowledge regarding the input biometric data than the matching score or the output decision of a matcher, therefore, fusion at the feature level is supposed to provide sufficient recognition results [9]. However, fusion at this level is complex to achieve in practice because the feature sets of the several modalities may not be suitable, and most of the popular biometric systems do not grant access to the feature sets which they employ. There are three possible levels of fusion that are briefly described below [10]:

A. Fusion at the feature extraction level

In feature extraction level of fusion, the signals are initially processed and feature vectors are extracted individually from the each biometric attribute. Subsequently, these feature vectors are merged to create a composite feature vector which is further utilized for classification. Since features bear abundant information of biometric attribute than matching score or decision of matcher, therefore the fusion at the feature level is presumed to give excellent results for recognition [11].

B. Fusion at the matching score level

Match score-level fusion is also called confidence-level fusion. In matching score level, the feature vectors are processed exclusively and the individual matching score is determined and ultimately these matching scores are fused to create classification. Several statistical learning techniques may be employed to merge match scores [12].

C. Fusion at the decision level

In decision level fusion, each modality is initially pre-classified individually i.e. each biometric attribute is apprehended, and later the features are extracted from that particular attribute. The final classification is based upon the fusion of the outputs of different modalities. This is the highest level of fusion with respect to human interface. In other words, the decision from each biometric system is gathered to deliver the final decision.

IV. IRIS RECOGNITION METHODS

This section includes the number of methods used for the recognition of iris and are defined below:

TABLE I. IRIS RECOGNITION METHODS

Phase Base Method	The phase based method recognize iris patterns based on phase information. Phase information is independent of imaging contrast and illumination. Eye images with resolution of 80-130 pixels iris radius were captured with image focus assessment performed in real time. The results of the iris search greatly constrain the pupil search, concentricity of these boundaries cannot be assumed. Very often the pupil center is nasal, and inferior, to the iris center. Its radius can range from 0.1 to 0.8 of the iris radius. Thus, all three parameters defining the pupillary circle must be estimated separately from those of the iris. The pupil and iris boundary was found using integro differential operator.
Texture-Analysis Based Method	High quality iris images was captured using silicon intensified target camera coupled with a standard frame grabber and resolution of 512x480 pixels. The limbus and pupil are modeled with circular contours which are extended to upper and lower eyelids with parabolic arcs. The particular contour parameter values x, y and radius r are obtained by the voting of the edge points using Hough transformation. The largest number of edge points represents the contour of the iris. The Laplacian of Gaussian (LoG) is applied to the image at multiple scales and Laplacian pyramid is constructed.

Zero Crossing Representation Method	It represents features of the iris at different resolution levels based on the wavelet transform zero-crossing. The algorithm is translation, rotation and scale invariant. The input images are processed to obtain a set of 1D signals and its zero crossing representation based on its dyadic wavelet transform. The virtual circles are constructed from the center and stored as circular buffers. The information extracted from any of the virtual circles is normalized to have same number of data points and a zero crossing representation is generated. The advantage of this function is that the amount of computation is reduced since the amount of zero crossings is less than the number of data points.
Approach Using Independent Component Analysis	This method adopts Independent Component Analysis (ICA) to extract iris texture features. The iris localization is performed using integro-differential operator and parabolic curve fitting from the inner to outer boundary of iris, fixed number of concentric circles n with m samples on each circle is obtained. The basis function used is kurtosis. The independent components are estimated and encoded.
Iris Authentication based On Continuous Dynamic Programming	It authenticates iris based on kinematic characteristics, acceleration. Pupil extraction begins by identifying the highest peak from the histogram which provides the threshold for lower intensity values of the eye image. All the connected components in sample eye image less than threshold intensity value are labeled. Continuous dynamic programming is used with the concept of comparing shape characteristics part wise.
Approach Based On Intensity Variations	The sharp variation points of iris patterns are recorded as features. In the iris localization phase, the centre coordinates of the pupil are estimated by image projections in horizontal and vertical directions. The exact parameters of the pupil and iris circles are calculated using canny edge detection operator and Hough transform. Gabor filters are constructed to acquire frequency band in the spatial domain. Gabor functions are Gaussians modulated by circularly symmetric sinusoidal functions.

V. RELATED WORK

This section describes the comparison of the existing work by number of author in the respective field. The comparison is being made on the basis of methods, performance with the disadvantages:

TABLE 2: A GLANCE OF EXISTING TECHNIQUES

Name	Method	Performance	Disadvantages
High confidence visual recognition of persons by a test of statistical independence	Integrodifferential operator	High performance in iris recognition	Computational time is very high

Recognition of Human Iris Patterns for Biometric Identification	Liber Masek's encoding algorithm	Localization of circular iris region as well as eyelids, eyelashes and also the reflections occurs	Speed of the system is low
Iris Recognition: An emerging biometric technology	Hough transform	Segmentation accuracy achieved up to an extent	Does not provide attention to EL as well as reflections etc
Toward Accurate and Fast Iris Segmentation for Iris Biometrics	Pushing and pulling (PP) method	Possess accuracy and speed	Occurrence of segmentation error
Iris segmentation methodology for non cooperative recognition	Fuzzy clustering algorithm	Better segmentation for non co-operative iris recognition	Thorough search is needed to recognize the circle parameters of both pupil and iris boundaries
Efficient segmentation technique for noisy frontal view iris images using Fourier spectral density	Segmentation approach based on Fourier spectral density	Computational complexity is low	Limbic boundary detection should be improved
Iris Segmentation in Visible Wavelength Environment	Circular Gabor Filter	segmentation accuracy for both the pupil as well as the iris boundaries has been achieved	Over all segmentation accuracy is less than that of the unified framework approach

VI. CONCLUSION

This paper enlightens the various existing techniques of iris segmentation proposed by various different researchers from time to time. This paper also presents a literature survey on the various segmentation techniques involved in iris recognition. There are various techniques that can be used for this purpose. Overall segmentation accuracy of all these techniques has been analyzed. The applications of the iris recognition system are innumerable and have already been deployed at a large number of places that require security or access control.

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