TO STUDY IRIS RECOGNITION SYSTEMS, DATABASES, COMPLEX PATTERNS AND SEGMENTATION TECHNIQUES

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Abstract—

Biometric authentication has been receiving extensive attention over the past decade with increasing demands in automated personal identification. Among many biometrics techniques, iris recognition is one of the most promising approaches due to its high reliability for personal identification. This paper presents the literature survey of Iris Recognition Systems, different types of databases and complex patterns of the iris texture. Conventional Iris Recognition System follows six steps, Image Acquisition, Preprocessing, Feature Extraction, Iris Coding, Matching and Result Generation. Matching will be done by using various databases like UBIRIS, CASIA , MMU2 etc. Also this paper will mention some methods of Iris Recognition.

Keywords – iris recognition,texture, complex patterns

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1. INTRODUCTION

For increasing threat to the security systems biometric has been using widely for many applications. Biometric recognition is the recognition of individuals based in their physiological or behavioral characteristics. Examples of biometrics are face, iris, fingerprints, voice, palms, hand geometry, retina, handwriting, gait etc. The various application using biometrics are passports, driving licenses,

banking, refraining imposters from hacking into networks, stealing mails etc.

As in all pattern recognition problems, the key issue is the relation between interclass and intra-class variability: objects can be reliably classier only if the variability among different instances of a given class is less than the variability between different classes. Against this intra-class (same face) variability, inter-class variability is limited because different faces possess the same basic set of features, in the same canonical geometry. For all of these reasons, iris patterns become interesting as an alternative approach to reliable visual recognition of persons when imaging can be done at distances of less than a meter, and especially when there is a need to search very large databases without incurring any false matches despite a huge number of possibilities.

The iris textural pattern has been used as a biometric cue for the purpose of human recognition. Most iris recognition systems exploit the global and local texture information of the iris in order to characterize its pattern. They do not consider specific anatomical features present on the surface of the iris.

In the year 1885, a French ophthalmologist, Alphonse Bertillon first proposed iris pattern as a basis for personal identification. In 1987, Flom and Safir obtained an unimplemented concept of automated iris biometrics system. Iris based security systems capture iris patterns of individuals and match these patterns against the record in available databases. Even though significant progress has been made in iris recognition, handling noisy and degraded iris images require further investigation. The iris recognition algorithms need to be developed and tested in diverse environment and configurations. Research issues are based on iris localization, nonlinear normalization, occlusion, segmentation, liveness detection and large scale identification. It is required to achieve lowest false rejection rate and fastest composite time for template creation and matching.

A conventional iris recognition system[2][5] involves four main modules.

- The first module, image acquisition deals with capturing sequence of iris images from the subject using cameras and sensors. An image acquisition consists of illumination, position and physical capture system. The occlusion, lighting, number of pixels on the iris are factors that affect the image quality. The good and clear image reduces the process of noise removal and also helps in avoiding error calculations. The infrared light can be used to illuminating the eye to avoid any specular reflections.

- The second module, preprocessing involves various steps such as iris likeness detection, pupil and iris boundary detection, eyelid detection and removal and normalization. Iris liveners detection differentiates live subject from a photograph, a video playback, a glass eye or other artifacts. It is possible that biometric features are forged and illegally used. Several methods like Hough transformation, integro differential operator, gradient based edge detection are used to localize the portions of iris and the pupil from the eye image. The contours of upper and lower eyelids are fit using the parabolic arcs resulting the eyelid detection and removal. It is essential to map the extracted iris region to a normalized form. For storing images there are many databases. Experiments are done on some databases like UBIRIS[12], CASIA[7][8] experiments were conducted on UBIRIS database with accuracy of 98.02% and 97.88% for images captured in session 1 and session 2, respectively. The segmentation performance for 1214 good quality images and 663 noisy images was 98.02% and 97.88%, respectively.

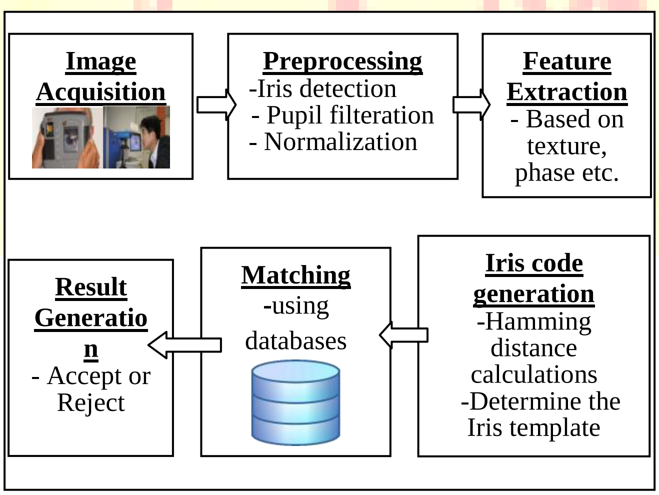

Figure 1.Iris Recognition System

- The third module, feature extraction identifies the most prominent features for classification. Some of the features are x-y coordinates, radius, shape and size of the pupil, intensity values, orientation of the pupil ellipse and ratio between average intensity of two pupils. The features are encoded to a format suitable for recognition. The macro-features are usually yellow, tan, and brown in color. Latanoprost treatment may cause changes in iris color but typically does not cause changes in nevi or freckles with respect to their shape, color and texture. The observation that these features may not be present in every iris makes them useful for iris image retrieval from a large database. These features are prominently observed in blue and light-colored irises and are less prominent or rare in dark-colored iris. They can be viewed as a soft biometric trait. Recent works in face recognition have investigated the use of moles [6], scars and freckles for the purpose of image recognition and retrieval.

- The fourth module, Iris code generation [2]. For this most discriminating feature in the Iris Pattern is extracted. The phase information in the pattern is only used because the phase angles are assigned regardless of the image contrast. The Iris code generation carried out on the texture processed image for better performance.

- The fifth module, matching achieves result by comparison of features with stored patterns. The interclass and intra-class variability are used as metrics for pattern classification problems.

Table 1: Database specifications

Database	Version	Camera used	No.of Images	Format	Resolution
UBIRIS	V1	Nikon E5700	1877	jpeg	400x300
	V2	Canon EOS 5D	11,102	jpeg	800x600
	V1	Self-developed	756	bmp	320x280
	V2	Self-developed	1200	bmp	640x480

CASIA	V3-Interval	Self-developed	2655	jpeg	320x280
	V3-Lamp	OKI	16213	jpeg	640x480
	V3-Twins	OKI	3183	jpeg	640x480
MMU	MMU1	LG IrisAccess 2200	450	bmp	320 x 280
	MMU2	Panasonic BMET100US Authenticam	995	bmp	320 x 280

Matching is the process of comparing the key points of the input macro-feature against the set of key points extracted from a gallery iris image. The output of the matching algorithm is the number of key point correspondences obtained between the query macro-feature and the iris image in the database. Each query key point is matched with all the key points of the gallery iris image and a correspondence is obtained by comparing the top two closest matches for the query key point. The cosine similarity measure, θ, is used to estimate the similarity between two 128-dimensional key point descriptors des1 and des2. The angle, θ, is defined as,

$$\theta = \cos^{-1}\left(\frac{desT1des2)}{(\|des1\|\ \|des2\|)}\right)$$

2. *IRIS IMAGE DATABASES*

The accuracy of the iris recognition system depends on the image quality of the iris images. Noisy and low quality images degrade the performance of the system. UBIRIS database is the publicly available database. It consists of images with noise, with and without cooperation from subjects. The UBIRIS database has two versions with images collected in two distinct sessions corresponding to enrolment and recognition stages. The second version images were captured with more realistic noise factors on non-constrained conditions such as at-a-distance, on-the-move and visible wavelength. CASIA iris image database images are captured in two sessions. CASIA-IrisV3[7][8] contains a total of 22,051 iris images from more than 700 subjects. It also consists of twins' iris image dataset.

3. *Macro-feature characterization*

Since macro-features [4] can take on arbitrary shapes, it is difficult to characterize them using parametric models.

Furthermore, depending upon the pigmentation of the iris, the structure of these macro-features may not be pronounced. Thus, in this work we employ the Scale Invariant Feature Transform (SIFT) to characterize the

Macro-features and use the ensuing template to retrieve

Pertinent irises from a database. The SIFT technique associates key points with an image.

Key points correspond to local features in the image representing color or intensity discontinuities. Interest point detectors may be used to identify key points for the purpose of object recognition, image retrieval, tracking and other image matching tasks. The scale Invariant Feature Transform (SIFT) [5] based on DoG detector can be used to detect key points that are invariant to changes in scale and orientation. These points are stable at multiple scales and are not affected by the change in view angle The scale space image, L(x, y, σ) is constructed from difference of images . where, σ defines the scale and I(x, y) is the input image. The difference of Gaussians between two scales which are separated by a multiplicative factor k is defined as,

$$DoG = (G(x, y, k\sigma) - G(x, y, \sigma)) * I(x, y).$$

Figure 2 shows examples of some of the macro features used in the experiment for image retrieval and the SIFT key points detected on a few macro-features. Note that multiple key points can be computed for a single macro-feature. Figure 3 shows the SIFT key points detected on two iris image; here, the direction of the arrow is the orientation assigned to the key point detected.

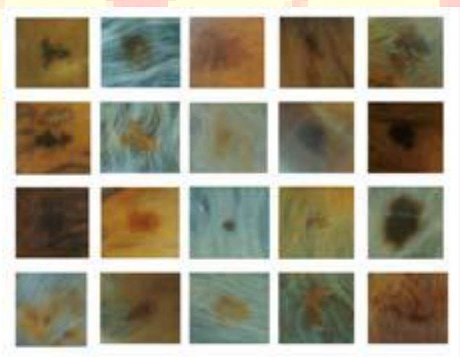

Figure 2. Examples of Macro-features

4. Types of iris Textures

4.1 Stream Iris

It contains a uniform fiber structure with subtle variations or streaks of color as shown in figure 3. The structure of the iris is determined by the arrangement of the white fibers radiating from the center of the iris

4.2 Jewel Iris

It contains dot-like pigments in the iris. The jewel iris can be recognized by the presence of pigmentation or colored dots on top of the fibers as shown in figure The dots (or jewels) can vary in color from light orange through black.

4.3 Shaker iris

It contains dot-like pigments and rounded openings. The shaker iris is identified by the presence of both flowers like petals in the fiber arrangement and pigment. dots or jewels is shown in figure 3.

4.4 Flower iris

It contains distinctly curved or rounded openings in the iris. In a flower iris the fibers radiating from the center are distorted (in one or more places) to produce the effect of petals (hence the name flower) In this image one can notice that they are neither regular nor uniform.

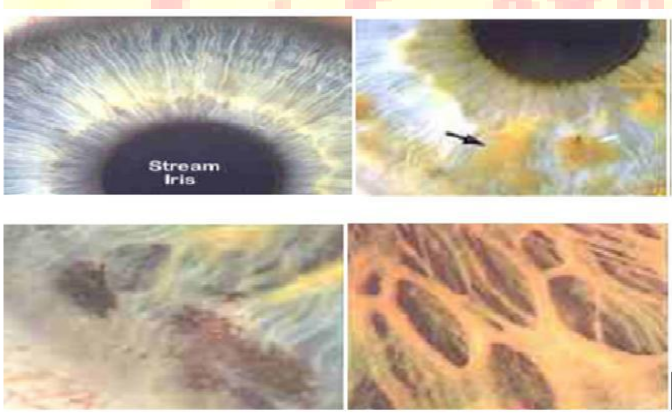

Figure 3. a)Stream Iris, b)Jewel Iris c)Shaker Iris d) Flower Iris.

5. CONCLUSION

The physiological characteristics are relatively unique to an

Individual. An approach to reliable visual recognition of persons is achieved by iris patterns. The other approaches are based on discrete cosine transforms, corner detection and parametric template methods. The future work in real applications utilization to support generation of compact iris codes for mobile phones and PDAs. In this paper, an attempt has been made to present an insight of different iris recognition methods. The survey of the techniques provides a platform for the development of the novel techniques in this area as future work.

Iris features may also be used for point-to-point matching of iris images. The use of the SIFT method is also advantageous as it replaces the actual iris image in the database with the key points detected on it. The inability of the proposed approach to retrieve the correct iris images in some instances provides an opportunity for further improvement. The use of advanced matching techniques based on texture, color and location of macro-features is being currently studied.

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