Iris Recognition Process

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--ABSTRACT--

Biometric based identification of people is getting more and more importance in the increasing network society. Various types of biometrics include face, finger, iris, retina, hand geometry, palm print, ear, voice etc. In all of these characteristics, iris recognition is gaining more attention because iris of every person is unique and it never changes during a person's lifetime. Iris is an internal organ that is well protected against damage and wear by a highly protected against damage and wear by a highly transparent and sensitive membrane. This unique feature shows that iris can be good security measure. This iris is recognized by four steps called Acquisition, Localization, Segmentation and Normalization. In this paper I propose iris recognition process, importance of binary conversion and how inner and outer areas of iris are removed.

Key words: Iris Acquisition, Binary Conversion, Sclera, Pupil, Normalization, Localization, Segmentation
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INRODUCTION

Biometric based identification of people is getting more and more importance in the increasing network society. Various types of biometrics include face, finger, iris, retina, hand geometry, palm print, ear, voice etc. In all of these characteristics, iris recognition is gaining more attention because iris of every person is unique and it never changes during a person's lifetime. Its complex pattern contains many distinctive features such as arching ligaments, furrows, ridges, crypts, rings, corona, freckles and zigzag collarette. The acquired image of eye contains iris along with pupil and data derived from the surrounding eye region like sclera, eyelid and eyelashes. The acquired eye image has to be segmented to detect the iris, which is an annular portion between the pupil (inner boundary) and the sclera(outer boundary). The important steps involved are outer boundary (sclera along with eyelashes and eyelids)detection and inner boundary (pupil) detection. Therefore, prior to calculating the features of iris and iris matching, it is very important to accurately segment and localize the iris from acquired eye image because the overall performance of iris recognition system is decided firstly by the fact that how accurate iris is segmented and localized from an eye image and secondly by the resolution of an image.

1.IRIS ACQUISITION

Image acquisition is the action of retrieving an image from source, usually a hardware based source, which can be used whatever processes need to occur afterward. In short, it is nothing but to capture the image by using hardware. In iris recognition process the first step is image acquisition. This step is very complicated because the size and color of iris of every person is different. 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. A high quality image with sufficient resolution and sharpness can be achieved only in the distance upto 3 meter which shown in Figure-1

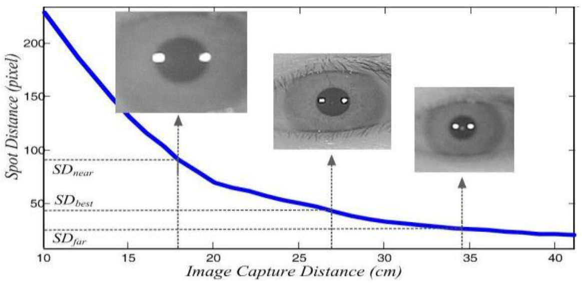


Figure 1: Proper Capture of Image

2. IRIS LOCALIZATION &SEGMENTATION

During acquisition image of eye does not contain only on iris but it also contains pupil and data derived from the surrounding eye region like sclera, eyelid and eyelashes as shown in Figure 2. Therefore, it is extremely important to segment and localize the iris from the acquired eye image, prior to feature extraction. Iris localization is a process to isolate the iris region from the rest of the acquired image. Iris can be approximated by two circles, one for iris/sclera boundary and another for iris/pupil boundary.Localization& Segmentationinvolves three process such as 1) Pre processing 2) Inner Boundary Detection (iris-pupil) 3) Outer Boundary Detection (sclera-iris)

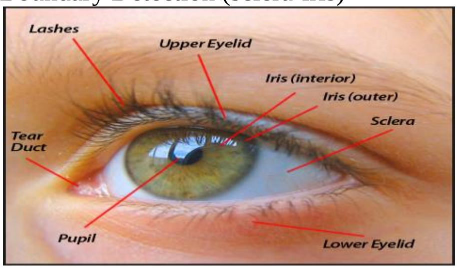


Figure 2: Parts of the Eye

2.1 PREPROCESSIONG

Color image of eye is to be converted into grayscale image. The grayscale is a range of monochromatic shades from black to white. Therefore, a grayscale image contains only shades and no color.**Grayscale** is a range of shades of gray without apparent color. The darkest possible shade is black, which is the total absence of transmitted or reflected light. The lightest possible shade is white, the total transmission or reflection of light at all visible wavelength s. Many image editing programs allow you to convert a color image to black and white, or grayscale. This process removes all color information, leaving only the luminance of each pixel. Since digital images are displayed using a combination of red, green, and blue (RGB) colors, each pixel has three separate luminance values. Therefore, these three values must be combined into a single value when removing color from an image. Edge detection, pixel accuracy, intensity calculations are more accurate than color image. Because of these reasons images are converted into grayscale.Figure 3 shows how the colored iris is converted into grayscale iris.

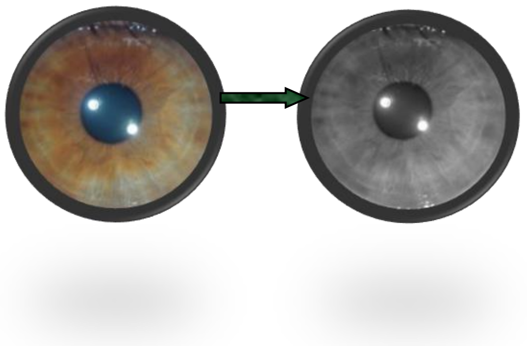


Figure 4: Colored iris into grayscale iris.

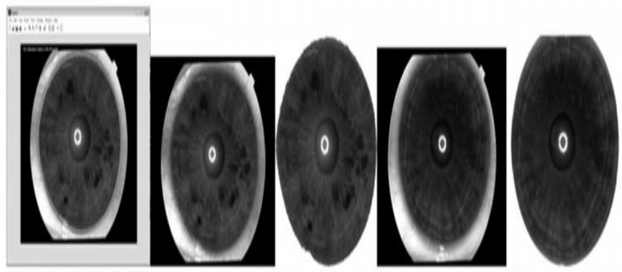
2.2 OUTER BOUNDARY DETECTION(SCLERA-IRIS)

Various types of algorithms are available which proves that the iris is circular in nature, which is seldom true but such assumption results into failure. Intensity gradients across sclera-iris, iris-pupil is also low. So this low level intensity gradient must be converted into binary images. In this algorithm, binary image is traced and pixels are classified based upon values of their intensities i.e one group with intensity values of 255(White, Level 1) and the other with intensity of 0(Black, Level 0). The binary image is shown in figure 5(a) and the inverted is shown in 5(b).

a) b)

Figure 5a: Binary Image 5b: Inverted Image

Boundary is traced for all points with binary value as 1 in all direction starting from selected point that is the first point that has value as 0 coming from top to bottom in any one quarter of image. Thus, complete boundary is traced for a complete iris without any intersection. For images with intersection with upper or lower eyelids as shown in figure 6b. may not result into a complete one object (closed circular path), for such cases, point of intersection is calculated and all points above point of intersection in case of intersection with upper eyelid and points below in case of intersection with lower eyelids are removed. The traced boundary of iris is shown with green colour and a virtual circle is drawn using all these traced points with blue colour as shown in figure 6. In case of complete iris, area under the traced circle (green colour) boundary is selected and in case of intersection, area within virtual circle (blue colour) boundary is selected. This selected area is cropped from rest of the image and copied to new image which is used for pupil detection stage.

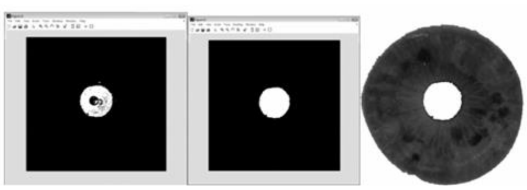


a) b)

Figure 6: Tracing of Outer Iris Boundary and Cropping of Iris for (a) Complete Circle and (b) Incomplete Circle

2.3 INNER BOUNDARY DETECTION (PUPIL-IRIS)

Once the iris has been separated from the rest of the eye, next step is to remove the pupil. Pupil is the darkest portion near the center of the eye. So the middle portion of the eye within the limits defined is scanned for pixels with intensity less than 60. This particular threshold is an approximation based on the analysis of the iris database and its variation may give different and incorrect results. Therefore, to avoid such variation, two image reference method is used. In this method, it is assumed that, two images of same subject are acquired in a small interval of time (one after another) under different light intensities. These images are first converted to binary images then binary images are compared / subtracted to detect the variation in size of pupil. As iris part of two images is same, result of subtraction will give 0 value and only place where non zero values are obtained is the region of pupil due to variation in size of pupil. The nature of pupil within iris is very complex, and due to flash lights and other room lights it produces lots of variation in intensities of iris and bright light spots in pupil as shown in Fig. 7.Therefore, above test may result into number of small parts (regions) of pupils as noise or unwanted information instead of one complete pupil as shown in Fig. 7(a). These small parts (regions) of pupil need to be removed. This is achieved by tracing an image for any region of less than 30 pixels. If such region is detected then this is removed considering the fact that size of pupil is certainly much larger than 30 pixels. This results into removal of extra unwanted information and detection of complete pupil from iris as shown in Fig 7(b). Tracing this inner boundary and selecting region outside inner boundary and below outer boundary will give exact iris with minimum losses as shown in Fig 7(c). For detection of dynamics in pupil, variation in size of pupils of two images of same subject is detected. If variation is in the range of 5 to 15%, then it may be considered as real eye, else fake eye.



a) b) c)

Figure 7: Pupil Detection

3. NORMALIZATION

Once the iris region is successfully segmented from an eye image, the next stage is to transform the iris region so that it has fixed dimensions in order to allow comparisons. The dimensional inconsistencies between eye images are mainly due to the stretching of the iris caused by pupil dilation from varying levels of illumination. Other sources of inconsistency include, varying imaging distance, rotation of the camera, head tilt, and rotation of the eye within the eye socket. The normalisation process will produce iris regions, which have the same constant dimensions, so that two photographs of the same iris under different conditions will have characteristic features at the same spatial location. Another point of note is that the pupil region is not always concentric within the iris region, and is usually slightly nasal. So iris region must be normalized with the help of the following equation. Now in this process, completely detected iris is converted to rectangular image using normalization Equation (1) and (2) as shown in Fig 8b.

$x1 = x + r * \cos(F)$ (1)

$y1 = y + r * \sin(F)$ (2)

where, (x, y) are the coordinates of center of the ring, $(x1, y1)$ are the coordinates of pixel of rectangular image, r is a radius of iris ring that varies from inner to outer boundary of iris image and F is an angle of that varies from 0 to 360 degree.

Figure 8: (a) Segmented iris (b) Normalized rectangular iris

CONCLUSION

The strength of this binary method is that it does not based on the above stated assumptions which seldom true but it uses a very practical approach which is based on the comparison of two iris images at different light intensities to detect the change in the size of pupil. Iris recognition is considered to be the most reliable and accurate biometric identification system available. Iris recognition system captures an image of an individual's eye, the iris in the image is then meant for the further segmentation and normalization for extracting its feature. The performance of iris recognition systems depends on the process of segmentation. Segmentation is used for the localization of the correct iris region in the particular portion of an eye and it should be done accurately and correctly to remove the eyelids, eyelashes, reflection and pupil noises present in iris region.

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